About the University

New Jersey Institute of Technology
NJIT's history spans the Industrial Revolution to the Information Age. Newark was a factory town when the tuition-free evening school was founded in 1881 to support local industries. The first 90 students - including machinists, draftsmen, carpenters, printers, electricians and clerks - studied algebra, geometry, trigonometry, chemistry, physics and drawing. The range of courses offered is testimony to the fact that, from the beginning, NJIT's programs have provided a broad-based foundation to prepare students for success in the workplace. From those early days, science and technology have been the engines fueling the university's development.

Over time, the university both anticipated and responded to change by expanding its curriculum and mission. Most notably, in 1919 the university established baccalaureate programs in three engineering fields. By 1975, NJIT offered a broad range of undergraduate and graduate degrees including architecture, engineering, computer science, management and other science-oriented programs. All of these programs included significant research and public service components with the goal of providing an academic environment that fostered intellectual depth and breadth, as well as social responsibility.

Today, continuing a fourfold mission of instruction, research, economic development and public service, NJIT is among the leading comprehensive technological universities in the nation. With well over 8,000 students, NJIT is the largest technological university in the New York metropolitan region. The university has state-of-the-art facilities with more than 2 million square feet located on a 45-acre campus in Newark, and a solar observatory in Big Bear, California. With robust extension and distance education programs, NJIT's degree and non-degree programs are available throughout the state and world.

NJIT Mission Statement

NJIT is a **public, urban, research university** committed to the **pursuit of excellence** in:

- Undergraduate, graduate and continuing professional **education**, preparing students for productive careers and amplifying their potential for lifelong personal and professional growth.
- The conduct of **research** in such multidisciplinary areas as environmental engineering, materials science, manufacturing, productivity enhancement, infrastructure systems, communications technologies, and an array of biorelated sciences and technologies.
- Service to both local communities and the broader society of the state and nation by conducting public policy studies, making educational opportunities widely available and initiating community-building projects.
- Contributing to the state's **economic development** through partnerships and joint ventures with the business community and through the development of intellectual property.

NJIT **prepares its graduates** for positions of leadership as professionals and as citizens; **provides educational opportunities** for a broadly diverse student body; responds to needs of large and small businesses, state and local governmental agencies and civic organizations; and **advances the uses of technology** as a means of improving the quality of life.

NJIT offers a **comprehensive array of programs** in engineering and engineering technology, computer science, architecture, applied sciences, mathematics, management, policy studies, and related disciplines throughout New Jersey and the nation.

NJIT's Six Colleges
NJIT's roots are in engineering education. For more than eight decades, **Newark College of Engineering (NCE)** has been preparing engineering students to use science, mathematics, technology and problem-solving skills to design, construct, test and maintain products, services and information systems. NCE alumni lead major corporations, hold senior public positions, own their own businesses and teach at universities.

NJIT’s **New Jersey School of Architecture**, established in 1974, is one of the largest architecture schools in the nation -- nationally recognized for integrating computer technology into its design curriculum. The college’s design curriculum was so successful that in 2008 it changed its name to the **College of Architecture and Design**, now comprised of the **NJ School of Architecture** and the

School of Art and Design.

The **College of Science and Liberal Arts (CSLA)**, established in 1982, is moving into the forefront of many national research activities from solar astronomy to mathematical modeling. CSLA provides students with the skill sets for the professional marketplace, including literacy in the mathematical, physical and biological sciences, as well as traditional liberal arts disciplines.

The **School of Management**, established in 1988, combines the best of traditional business disciplines (e.g., finance, marketing, accounting, e-commerce) with the power of information and technology management to develop professionals who can manage and communicate effectively.

The **Albert Dorman Honors College**, established in 1993, offers one of the nation's leading technologically oriented honors programs for students who are prepared to undertake a rigorous and individualized course of study.

The **College of Computing Sciences**, established in 2001, has one of the largest educational programs in the nation, with approximately 2,000 students in 13 degree programs.

A Public Research University

NJIT is designated as a "Research Intensive" University by the Carnegie Foundation and ranks among the "best national universities" by *US News and World Report*. The university expends more than $75 million in a panoply of research and development partnerships with industry, government and other universities. NJIT researchers are making important advances in a wide range of areas, including the biosciences, manufacturing, microelectronics, multimedia, transportation, computer science, solar astrophysics, environmental engineering and science, and architecture and building science.

As a public research university, NJIT is educating leaders for a technology-driven economy. The university is constantly updating educational programs to emphasize marketplace skills, and redesigning its methods of delivering education. Indeed, computing and information technology underpin every facet of the NJIT mission.

Computing-Intensive Campus

As one of America's most computing-intensive universities, NJIT is nationally recognized as a pioneer in the use of information technologies from developing complex algorithms to reducing simulation times on large-scale parallel computers, to advancing the frontiers of visualization technology in computer-aided design, to patenting optics-based sensors, to developing computer-based infrastructure management systems, to developing advanced computer-mediated communications systems.

NJIT's Information Services and Technology (IST) division provides members of the university community with universal access to a wealth of resources and services available over the NJIT network and the advantages of a highly computing-intensive environment.. EDUCAUSE recently recognized the university for streamlining student processes "with creativity, efficiency, and effectiveness worthy of emulation."

At NJIT, the latest advances in telecommunications and multimedia technologies are used to enhance the delivery of courses and the overall educational experience, allowing students to experience many aspects of a "virtual university" in a traditional campus setting. Computers and information technology play an important role in virtually every task performed on campus, from cutting-edge research to applying for on-campus student employment. Computers assist in teaching and independent study, campus communication, library research, engineering and architectural designs. Students register for classes, check the status of financial aid, run degree audits, ask questions of academic advisors, and pay their bill – all online. Students can access the tools they need to design new buildings, develop complex solutions to engineering problems or compile detailed management analyses – all by logging on to the NJIT network. With connectivity to Internet2, students have the opportunity to work closely with faculty and researchers as new families of advanced applications are developed for an increasingly networked and information-based society.

NJIT's multi-gigabit network connects more than 6,500 nodes in classrooms, laboratories, residence halls, faculty and staff offices, the library, student organization offices and others. The campus wireless network blankets the university's public, classroom and outdoor areas. Both networks provide access to a wealth of shared information services. Included among these are high-performance, multi-processor servers used for simulation and computational research; disk arrays for storage of large data sets; communication servers for computer conferencing and e-learning, and a digital library with access to over 19,000 online journals. A virtual private network combined with Internet access extends access to network services to faculty, staff and students at home, work, any of the university's extension sites or throughout the world.

Students, faculty, staff, and alumni receive a single university computing ID (UCID) that authenticates them as members of the NJIT community and authorizes them to role-based campus services. Highlander Pipeline, the NJIT portal, is the starting point for most online services. Students have access to hundreds of computer workstations in public-access computer labs across the campus, supplemented by special-purpose departmental facilities. A healthy mix of Windows, Mac, Linux, and other Unix operating environments support the diverse needs of a technological research university. Campus-wide software licenses provide NJIT faculty and students with the latest versions of the most popular Microsoft products, as well as software tools for virus-protection, statistical analysis, mathematical programming, computer-aided design and visualization, and much more. Advanced software libraries support the computational research needs of faculty and students in mathematics, engineering, and the sciences.

The Office of Instructional Technology and Media services provides several facilities used for live and recorded broadcast of e-courses as well as satellite downlinks for a wide variety of video conferences and other educational and public service satellite broadcasts. Several interactive television studio classrooms provide distance learning facilities. Multi-media capability is now being deployed to all areas on campus via network based video technologies.

In addition to these extensive resources, several departments have special facilities for the support of individual academic programs, including the New Jersey School of Architecture's award winning Imaging Laboratory that provides students an opportunity to explore new media and images that alter the way buildings are visualized, interpreted and created.

NJIT is one of the founding members and administrative home to NJEDge.Net, New Jersey's higher education network. NJEDge.Net provides collaborative resources and networked information services to its members and affiliates in support of education; research and development; outreach and public service; as well as economic development throughout the state of New Jersey. With 53 connected institutions including all of New Jersey's research universities, NJEDge.Net leverages economies of scale and supports new and emerging technology-enabled forms of inter-institutional collaboration among members and affiliates.

Library Services

The University Library is composed of two modern library facilities in Newark and extensive online resources which may be accessed on campus or remotely at www.library.njit.edu. The main library, the Van Houten Library, is located in the Central Avenue Building. Erected in 1992, it provides a modern facility for individual and group study, research and browsing. The Barbara and Leonard Littman Architecture Library, redesigned and relocated in 1998, is found on the fourth floor of Weston Hall, part of the Architecture and Building Sciences Complex.

The collections include more than 150,000 volumes of print and electronic books plus maps, slides, models, images, theses and dissertations, product catalogs, CDs, DVDs and an historical archive. The Libraries have over 19,000 subscriptions to journals, databases, and other serials, almost all available online remotely. These focus on NJIT's curriculum and research areas of architecture, engineering science, computer science and technology, management, and liberal arts.

Library staff acquire and organize books and other materials in print and electronic format and make them accessible to the NJIT community. Though the library and online collections form the backbone of research support at the university, NJIT librarians consider the world their resource and help faculty and students obtain materials from other libraries or online sources whenever necessary through the Library's Inter-Library Loan and Document Delivery services.

Through collaborative agreements, NJIT students and faculty have access and borrowing privileges, with some limitations, at several other nearby academic libraries. These include Rutgers-Newark's Dana Library, UMDNJ's Smith Library, and Newark Public Library. Students may also borrow from the libraries of Jersey City University, Kean University, Ramapo College, Rowan University, Stockton State College, William Paterson University, College of New Jersey, and Montclair State University. Arrangements can be made for special privileges at other institutions in the New York area, when appropriate, through an NJIT Reference Librarian.

The libraries are truly academic centers. They are popular places to study, with comfortable chairs, tables, study carrels, rooms for group study, quiet work areas, and a computer lab called the Information Commons.

The Information Commons at the Van Houten Library consists of 120 computer workstations designed to satisfy student computing and online research needs. Both libraries are wireless to facilitate the collaboration so characteristic of the NJIT community. The Van Houten Library's Information Commons provides a convenient and relaxed atmosphere to check e-mail, search the Web, view digital archives of lectures, or retrieve scholarly publications from the university's digital library collections. Reference librarians are available on-line and in-person to help students and researchers sort through the vast amounts of information resources available and access what they need.

A team of highly trained information and research assistants, reference and instructional librarians bridge the gaps between research resources and users. They provide ad hoc assistance in person via the Research Helpdesk at the Van Houten Library and the service desk at the Littman Architecture Library, or by phone (973-596-3210 for Van Houten and 973-596-3083 for Littman), email, and instant messaging. The online library is available 24/7 as is the chat help line at www.QandANJ.org, a New Jersey librarians' collaborative providing research assistance round the clock.

Reference Librarians are subject specialists and work closely with departmental faculty in all of NJIT's curriculum and research areas to ensure that the right information resources are accessible to the right people at the right time. They teach research techniques and resources in the classroom in conjunction with course content and in small groups. They are also available for individual in-depth consultation sessions. Contact information for departmental liaisons can be found on the library website.

More information about the library can be found at www.library.njit.edu or by calling (973) 596-3210.

Consortium with Rutgers-Newark and UMDNJ

NJIT, Rutgers-Newark and UMDNJ, New Jersey's university of the health sciences, offer 10 joint master's or doctoral degree programs, placing them as leaders in development of programs to prepare individuals for a world increasingly multidisciplinary and technological in nature.

The three institutions are partners in University Heights Science Park, designed as a mixed-use, multi-sponsor science and technology park. University Heights Science Park is a partnership among academia, the community, private industry, and local, state and federal governments, which provide opportunities to transfer university-based research and technology to public uses. The 50-acre University Heights Science Park is adjacent to the NJIT campus. Each year, thousands of students from NJIT, Rutgers-Newark and UMDNJ take courses at the institutions. NJIT and Rutgers-Newark cosponsor common seasons of theatrical productions, as well as "World Week," and a variety of other cultural and social activities.

NJIT Campus

Located in the University Heights section of Newark, NJIT's 45-acre campus is adjacent to the campuses of Rutgers-Newark and Essex County College and a short distance from UMDNJ. The campus is reached easily via interstate highways and public transportation. New Jersey Transit's City Subway stops on campus, the Pennsylvania Railroad Station is 5 minutes from campus and Newark International Airport is within 5 miles of NJIT.

The expansion and improvement of NJIT's campus facilities have been vigorous, proceeding pursuant to a carefully drawn long-range plan, providing an environment conducive to accomplishment of the university's mission. A new student center is under construction.

NJIT's campus is home to some 20 R&D centers supported with industry, state, federal, foundation and university funding. NJIT's three-story Otto H. York Center for Environmental Engineering and Science houses a number of state and federally funded research centers.

The 187,000-square-foot William S. Guttenberg Information Technologies Center houses the Center for Manufacturing Systems and the Multi-lifecycle Engineering Research Center. The building is the site of the College of Computing Sciences and industrial and manufacturing engineering instruction and research facilities.

The Campus Center houses the food court, dining room and a more informal eating facility, The Highlander Cafe. In addition, there is a campus theater in which student productions are staged, an athletic field, tennis courts, and indoor recreational facilities, including a swimming pool, racquetball courts, weight rooms, track, aerobics room and more. The residence halls provide dormitory and apartment-style coed living accommodations for more than 1,400 students.

Academic Policy and Procedures

The academic calendar lists the dates classes begin and end, dates on which the university is closed for holidays, deadline dates for registration and withdrawal and other dates of interest to the academic community. It may also be accessed at http://www.njit.edu/Calendar/Academic.html.

Registration for Courses at NJIT

Registration is required each semester. The Registrar's office is located in the Student Mall, on the ground floor of the parking deck. The office is open when classes are in session, Monday through Thursday, from 8:30 a.m. to 6 p.m., and Friday 8:30 a.m. to 4:30 p.m. Registration procedures for each category of student are listed below.

NJIT has an advance self-registration system that obligates all students currently enrolled in graduate degree programs to register in advance for their courses. An approved registration guarantees class seats until the first class meeting. Students who do not attend the first class meeting may lose their place in class.

All admitted students register online via the registrar's Web site at www.njit.edu/Registrar.

Currently Enrolled Students Currently enrolled students are informed of registration procedures for the fall and spring semesters by the Office of the Registrar during April and October respectively, and must then register during the advance registration period. Students who fail to comply with these instructions are charged a late fee. Instructions for the summer session are provided separately and mailed to students. Currently enrolled extension and distance-learning students are informed of registration procedures for fall, spring and summer semesters by the Division of Continuing Professional Education.

New and Readmitted Students The Office of University Admissions informs prospective and readmitted students of registration procedures.

International Students

New international students are only permitted to register after attending the required international student orientation program and must register in person. International students who register appropriately for full-time study will be reported in the Student and Exchange Visitor Information System (SEVIS) administered by the U.S. Immigration and Customs Enforcement Agency.

Non-Matriculated Students Non-matriculated students should contact the Office of University Admissions for details of admission and registration procedures at least one month before the date of intended enrollment. Extension and distance-learning students should contact the Division of Continuing and Professional Education.

Approval of Initial Registration

NJIT degree programs are purposely flexible to meet a variety of career and personal objectives within minimum requirements. Students are required to arrange a conference with their graduate advisor as soon as possible after notification of admission to formulate a course of study that meets the requirements of the particular degree program and reflects the interests and aspirations of the individual student. New students are required to obtain advisor approval for initial course registration. Advisors are available for international students during the international student orientation program.

Auditing a Course

Students who wish to audit a course must state their intention to do so at the time of registration. Change in auditing status is not permitted once a semester has begun. Students who audit are required to pay full tuition and fees for the course. Financial awards are not applicable to audited courses. Audited courses are not counted in determining full-time status. Students on probation are not permitted to audit. Students who wish to attend a course must have an authorized reason for attendance and a registration in that course (regular or audit) and cannot merely "sit in" at their own discretion.

Undergraduate Registration in Graduate Courses

Undergraduate students who wish to take 500- or 600-level courses must obtain the written approval of the graduate advisor for the program that offers the course, their undergraduate advisor and submit an "Approval for Undergraduates Taking Graduate Courses" form. If undergraduates wish to take 600-level courses, they must also obtain written approval from the chairperson of the department offering the course. Undergraduates are not permitted to take 700-level courses.

Undergraduate students who enroll in graduate courses for undergraduate credit pay tuition at the undergraduate rate. Grades will follow the graduate grading system.

The undergraduate and academic advisor will review the student's academic record prior to approval. Approval can be granted only to students who have completed the appropriate prerequisites for the course and are in satisfactory academic standing. The approval will be noted on an "Approval for Undergraduates Taking Graduate Courses" form that requires appropriate signatures and reports the student's cumulative undergraduate GPA. Students shall have a cumulative undergraduate GPA of 2.5 to be approved for registration in 500-level courses (500G for Architecture) and 2.8 for registration in 600-level courses.

Students whose undergraduate GPA is below the 2.5 or 2.8 minima, are considering courses out of the student's current major, are lacking appropriate prerequisites, have completed any prior graduate courses with a grade below a B, or have already completed 9 or more credits at the 500 level and above (15 credits for those in the B.S./M.S. program), or have an excessive number of credits for the undergraduate degree will also require review by the dean of graduate studies and the program advisors.

Undergraduate students should be aware that need-based financial aid may not be sustainable for registration in graduate courses.

Graduate Registration in Undergraduate Courses

Graduate students may be asked to register in undergraduate courses as conditions of admission, as bridge courses or by direction of the graduate advisor for their current program. Enrollment in other undergraduate courses requires the approval of the dean of graduate studies or the graduate advisor, and the undergraduate department offering the course. Tuition for these courses is assessed at the graduate rate. Grades will follow the undergraduate grading system.

Multiple Registration

A student generally cannot be matriculated in more than one graduate degree program at a time. Special circumstances may require the approval of the dean of graduate studies and the director of graduate admissions. This also applies to programs run cooperatively with Rutgers-Newark and UMDNJ. Currently enrolled graduate students who wish to enroll in a subsequent graduate degree program should NOT file an application for admission to the new program until they are in the final semester of their initial program. In addition, students may not be enrolled in both a degree and a non-degree graduate program or as an undergraduate and graduate student simultaneously.

Students should consult the Office of University Admissions when contemplating a change in program enrollment. Students should refer to "Change of Major" under Admissions in this catalog.

Course Additions and Schedule Changes

Students who add a course to their program will be charged the full tuition and fee for the course added; however, the flat rate (12--19 credits) may still apply. Students who add a course to their program will be charged the full tuition and fee for the course added. All schedule changes are completed via ***Highlander Pipeline*** and a schedule change fee will be assessed during late registration as determined by the Registrar.

Courses cannot be added after the fifth day of the semester. Students cannot receive credit for courses if they are not registered. Attendance in a class without proper registration for that class is not permitted.

Withdrawal from Course(s)

Students who wish to withdraw from one or more courses should first determine if the withdrawal would have an impact on full-time status, financial support, or academic standing and progress. They should consult their advisor or the Office of Graduate Studies in advance. International students must consult with the Office of International Students and Faculty because of the possible impact of federal reporting of status in SEVIS. Withdrawals are done by completing and submitting a Schedule Change Form to the Registrar's Office by the end of the ninth week of the semester. This form requires the signature of the instructor(s). It is available from the Registrar's Office. Failure to submit this form to the registrar by the deadline will result in a final grade other than W.

Discontinued attendance or verbal approval alone to withdraw will not result in a W and most likely will instead result in an undesirable final grade, generally an F or U.

Project, Thesis and Dissertation

Students may not register for project, thesis or dissertation credits until they arrange for a department- or program-approved faculty advisor to supervise the work. Continued registration for additional thesis, project or dissertation credits within the overall time limits for completion will be allowed as long as the advisor grades the work to show that there is satisfactory progress. Credits for which a U (unsatisfactory) grade is given are not counted as degree credits toward completion of the thesis, project or dissertation.

Master's project, master's thesis, or doctoral dissertation registration must be at least 3 credits during a semester. Summer session registration, if needed to allow completion for the August 31st degree date, must be at least 3 credits.

All students must have the program advisor's approval and appropriate section identification each time they register for project, thesis, dissertation, pre-doctoral research, co-op, or independent study. Students must register within the deadlines established by the registrar.

Maximum credit registration each semester is 12 credits for the doctoral dissertation, 6 credits for the master's thesis and 3 credits for the master's project. Additional credit registrations, beyond 12, for doctoral dissertations, will require approval of the dean of graduate studies. It is highly recommended that the masters thesis registration be only 3 credits in a semester unless a single semester completion is anticipated.

Once a student has begun a master's project, master's thesis or doctoral dissertation, the student must register for these courses each semester until the project, thesis or dissertation is completed. Unapproved interruptions in project, thesis or dissertation may be subject to billing for omitted credits.

Students must be registered in project, thesis or dissertation in any semester or summer session in which completion is expected. The advisor for thesis or dissertation assigns the final grade of P when the Office of Graduate Studies confirms it has received all documents in final and approved form and all related bills have been paid.

Approval by the graduate program advisor and the Office of Graduate Studies must be obtained if the student wishes to interrupt the thesis, project or dissertation for a semester or more. Students may neither maintain registration, nor fail to register without notifying and getting approval from the graduate program advisor and the Office of Graduate Studies. If a master's project is not completed after two semesters' registration, a final grade of F is given. Failure to complete a master's project by students who received financial support to do the project may result in dismissal. The university complies with all state and federal laws related to military service.

No more than four semesters and two summers of registration for a master's thesis are permitted. Failure to complete a master's thesis within this period will result in a final grade of U, and may result in dismissal.

No more than six years of registration for doctoral dissertation is permitted. Failure to complete a doctoral dissertation in this period will result in a final grade of U, and dismissal from the program.

Students who require additional time to complete a project, thesis or dissertation should appeal for an extension, in writing, to the graduate program advisor, the academic department, and the Office of Graduate Studies.

Continuous Registration Requirement, Programs

Once admitted to a degree program, students must be continuously registered for credit each semester until they complete degree requirements, unless they have been approved for a leave of absence by the Office of Graduate Studies.

Continuous Registration Requirement, Project/Thesis/Dissertation

Once a project, thesis, or dissertation has begun, students must register in these each semester until completion. MR (maintaining registration) is not permitted in place of a credit registration for project, thesis, or dissertation. The grade of I is not permitted for project, thesis, or dissertation.

Students who complete work for projects, theses or dissertations over several semesters receive a grade in the semester in which the work is completed and the final document is approved and received in proper format.

Discontinuance

Domestic students enrolled in graduate programs who find it necessary to temporarily discontinue their studies may either maintain registration, request a leave of absence, or voluntarily discontinue. A discontinuance form must be filed with the Office of Graduate Studies. International students may not discontinue studies without approval, but should seek approval for a leave of absence at which time maintaining registration may be authorized. Students who have discontinued must follow procedures defined by the offices of University Admissions and Graduate Studies to resume their studies.

Leave of Absence

Students who anticipate a protracted absence from the university may request a leave of absence from the Office of Graduate Studies. Students requesting a leave of absence for medical reasons will be required to consult with the Office of Health Services first. Leaves are granted for up to one year and may be extended for a second year. Leaves of absence are not counted toward the seven-year period in which the degree must be completed, but rules regarding expiration of credit do apply for course work, projects, thesis and dissertation research. Students returning, on-time, from an approved leave of absence are generally not required to apply for readmission but are required to inform the Office of Graduate Studies and the Office of University Admissions on their return. International students may be required to apply for readmission and file new financial documents. They also are required to consult with their graduate advisor. The university complies with all state and federal laws related to military service.

Readmission After Voluntary Discontinuance

Students who have voluntarily discontinued their studies without receiving a leave of absence, and who have not been dismissed from the NJIT graduate program must apply for readmission to the Office of University Admissions by the application deadline. A non-refundable application fee of $60 must accompany applications. Applicants are subject to all probationary and unmet conditions in force at the time they discontinued their studies. Program requirements at the time of readmission will apply in addition to satisfaction of any prior unmet conditions. Application deadlines are:

For the Fall semester June 5
For the Spring semester October 15

Maintenance of Registration

Students enrolled in a degree program who find it necessary to temporarily discontinue their studies are permitted to maintain registration with approvals as note above, for a fee of $60 for each semester they do not register and for a maximum of two consecutive semesters. Students working on project, thesis or dissertation are generally not permitted to register for maintaining registration. International students on F-1 and J-1 visa status may not maintain registration unless they have obtained prior written permission from the Office of International Students and Faculty.

Students who maintain registration are mailed registration notices for the following semester and are not required to reapply for admission. To maintain registration, students must register for "Maintaining Registration" on the registration Web site.

Each semester in which registration is maintained is counted in the total time period allotted to complete degree requirements except for students with an approved leave of absence. The Graduate Studies Office and the academic department will generally place registration holds on students who maintain registration for two semesters or more.

Responsibility for Registration

NJIT emails notices in advance, but cannot guarantee delivery. Regardless, students are expected to obtain all necessary information and comply with all registration procedures on time. Students who receive financial support must be in attendance at NJIT and will not be permitted to have other persons register for them.

Scheduling of Classes

Graduate courses at NJIT and at Extension Sites are, in general, scheduled for late afternoon and evening hours and Saturdays for the convenience of those employed full-time. Evening courses normally begin at 6 p.m. and end at 9 p.m. Some laboratory sessions begin at 6 p.m. and end at 9:50 p.m.

Courses in heavy demand may be scheduled for additional sections if adequate enrollment can be assured. Day and evening classes during the summer months are possible under the same conditions. Special programs such as the Executive Management program and those offered by Distance Learning have their own schedules.

Course Cancellations

The university does not guarantee offering all or any of the courses listed in this catalog. When there is inadequate registration, a course may be cancelled without notice. The registrar will attempt to notify all students of course cancellations before the first meeting of the semester.

Room Changes

Room and laboratory changes are in the online schedule maintained by the Registrar via ***Highlander Pipeline***.

Courses Taken at Other Colleges

Cross-Registration Procedures

Students may take courses at UMDNJ and Rutgers-Newark College of Arts and Sciences provided that the:

- Course is used toward a degree.
- Course is not offered at NJIT, or, because of a conflict in schedule, cannot be taken at NJIT.
- Approval is obtained, in advance, from the student's advisor.
- Approved cross-registration form is submitted by the student to the host school. The course must also be included on the NJIT registration form.

Students in joint programs should register at the school that admitted them to their current degree program. Students from Rutgers-Newark and UMDNJ must be matriculated in graduate programs at their home institution to cross-register for NJIT courses. Students from Rutgers-Newark and UMDNJ who cross-register into NJIT are considered NJIT non-matriculated students and are therefore limited to 9 credits maximum. In order to take more than 9 credits, these students would have to apply and be admitted as matriculated students for an NJIT graduate degree program.

Summer course registration procedures, and inclusion of courses on NJIT transcripts for students wishing to take courses at Rutgers-Newark and UMDNJ, are determined by the registrar. In general, cross-registration cannot occur for summer sessions.

Registration at Another College

To take graduate courses at colleges other than those in the cross-registration program, students must obtain prior approval from their advisor and the dean of graduate studies. Students should review the section on "Transfer of Credit" if they wish to transfer these courses to an NJIT program.

Tuition remission from NJIT is not available for courses taken at educational institutions not participating in NJIT's cross-registration program.

Transfer Credits

Transfer credits are calculated by NJIT according to the total number of instructional minutes earned at the other institution. The equivalent instructional minutes of a maximum of 9 credits of graduate work, taken within seven years, from accredited US educational institutions may be transferred and applied to degree requirements at NJIT. Credits from educational institutions outside the United States (except Canada) cannot be transferred as individual courses. On a case by case basis, up to 9 transfer credits may be considered for non-collegiate-based instruction after evaluation by the dean of graduate studies. The university does not grant transfer credit for work experience or other non-instructional activities.

Groups of courses may sometimes be accepted as a block of credits toward some types of programs. An appropriate prior Master's degree is often accepted as a block equivalent to 30 credits toward a PhD program at NJIT. Subject to specific MBA program conditions, an equivalent block of 12 credits can be accepted from a graduate degree previously awarded by a US AACSB accredited management program or internationally from a program accredited by AACSB or an AACSB-affiliated accrediting agency. For the MBA program, the proposed block must be based on courses with grades of B or better and on courses with equivalent credit values of 3 or more credits

Credits are transferred only if the courses were taken for full academic credit, were never applied to any other degree, and a final grade of at least B (3.0 GPA equivalent) was attained. In addition, the student's graduate advisor and the Office of Graduate Studies must agree that such courses directly relate to the student's program of study before they can be transferred.

Requests for transfer credit must be submitted on a form available from the Office of Graduate Studies, accompanied by course descriptions from the other educational institution. Students must also arrange for the other institution to send an official transcript to the Office of Graduate Studies at NJIT. Requests may be submitted and approved at any time but are not added to a student's record until matriculation is granted and one semester completed. Grades that are transferred will not be calculated in cumulative GPAs.

Transfer of Credits Within NJIT

A student may transfer credits from one program to another program within NJIT under certain circumstances. This type of transfer requires consultation with The Office of Graduate Studies but does not require completion of a transfer credit form or submittal of NJIT transcripts. All graduate credits taken at NJIT, regardless of the major, appear on a general transcript.

Academic Standing

Enrollment Status

Students registered for 9 credits or more throughout an entire semester are considered full-time. International students must be in full-time status every semester. The Office of International Students and Faculty will report, in SEVIS, international students who meet the full-time definition under F-1 regulation 8CFR 214(f)(6). Any international students unsure of their status should contact the office at 973-596-2451 or e-mail to international.students@njit.edu Students who are not registered for 9 credits and do not meet the conditions for full-time certification are considered part-time.

Full-time Certification

The Office of Graduate Studies may certify students as full-time even if they are not registered for 9 credits, under any of the following circumstances:

- If a master's thesis registration is included in a prior semester, an additional semester for a maximum of two with only a master's thesis registration is acceptable
- Students have fewer than 9 credits remaining for completion of all degree requirements and are registered for all credits needed to complete the degree. This certification can only be given for one semester.
- Doctoral candidates who completed all required course work, and accumulated the required dissertation credits but have yet to complete the dissertation and defense, are registered in Dissertation Research (and seminar if required) for at least 3 credits each semester.
- Students originally registered for 9 credits but have substantial extenuating circumstances that require a reduction in course load. Normally this certification applies only in cases of medical or similar emergencies that incapacitate a student for a significant part of a semester. Improper course registration, failure to seek proper advisement, inadequate academic progress, or risk of earning a weak or failing grade are not extenuating circumstances. Inability of an international student who had earlier filed a financial attestation to pay tuition and fees, is also not an extenuating circumstance.
- Students on a full-time cooperative education assignment are registered in a graduate co-op work experience or equivalent course. The Office of Graduate Studies should be consulted for limits on cooperative education because cooperative education has an influence on full-time certification and allowable time to complete the degree.
- Audited courses and withdrawn courses do not count toward full-time status; ESL (English as a Second Language) courses do count as one course each.

Half-time Students

For federal, financial aid, and other reporting purposes, half-time graduate student status may be defined for students registered for 6 credits or fewer during a semester. Contact the Office of Graduate Studies for more information.

Grades

The following grades are used for graduate courses:

GRADE	GPA	SIGNIFICANCE
A	4.0	Excellent
B+	3.5	Good
B	3.0	Acceptable
C+	2.5	Marginal Performance
C	2.0	Minimum Performance
F	0.0	Failure
I		Incomplete
W		Approved Withdrawal
AUD		Audited (no academic credit)
S or U		Satisfactory or Unsatisfactory
P		Passing for Master's Thesis or Doctoral Dissertation

(Unlike undergraduate courses, there is no D grade for graduate courses. Assigned grades must be consistent with the level of the course and not the matriculation level of the student in the course. Grades used in GPA calculations (A, B+, B, C+, C, and F) are not to be used as grades for dissertation research (790), pre-doctoral research (792), master's thesis, 0, 1/2, and 1 credit seminars, co-op, teaching methods, and ESL courses. Incompletes are not assignable for these courses with the exception of co-op as described later.)

Project, Thesis and Dissertation Grades

Grades for these are S or U until completion. Students who do not complete a thesis, project or dissertation in a semester, regardless of accumulated credits, must register again for at least 3 credits of thesis, project or dissertation in the following semester. Grades of S or U cannot be changed after a semester is over to show retroactive completion and to avoid additional registrations that are required.

Final Grades in Project, Thesis and Dissertation

Letter grades bearing on the GPA are given for satisfactory completion of a project. The final grade for a completed and approved thesis or dissertation is P. Theses and dissertations require a successful defense before the thesis or dissertation committee after which the P is assigned. Theses and dissertations are submitted to the Office of Graduate Studies. Projects are submitted to the project graduate advisor.

Semester and cumulative GPA calculations by the registrar only include courses for which a letter grade is given. For the purpose of the GPA, the registrar only calculates the grades for credits earned in the semester in which the project, thesis or dissertation is completed. Letter grades cannot be given for an unfinished project or thesis, nor for work not submitted. Receipt of two U grades for project, thesis, dissertation, or pre-doctoral research can result in dismissal from the program.

Special Topics

Regular letter grades are assigned for special topics courses.

Independent Study

Regular letter grades are assigned for independent study courses.

Incomplete

A grade of I (Incomplete) is given when courses cannot be completed because of special circumstances. Students on academic probation are not permitted a grade of incomplete without permission from the Office of Graduate Studies. Required course work may be finished at the discretion of the instructor, no later than the end of the subsequent semester. Receipt of an I does not require or suggest attendance in the courses in a following semester. A letter grade must be assigned by then or a grade of F will be automatically assigned. Students nominated for financial awards must have I grades resolved by the fourth week of the subsequent semester to allow a determination of their eligibility for the award. The new grade cannot be changed.

A grade of I cannot be given for thesis, project, dissertation, seminar, pre-doctoral research, or English as a Second Language (ESL) courses. Students in joint programs or cross-registered from or with Rutgers-Newark should note that NJIT has a different and much earlier deadline for resolution of I's before they automatically become F's. Some departments may assign an initial I for co-op courses, which may be changed to an S or U based on submittal of a report by the student to the co-op advisor. Students continuing for a second consecutive registration period in co-op with the same employer will have an I assigned as a grade for the first registration. This will be changed to S or U, based on co-op performance and evaluation by the co-advisor at the end of the second registration period.

Satisfactory and Unsatisfactory

The grades S or U report progress in project, thesis, dissertation, and pre-doctoral research courses. These also can be final grades in seminar, co-op, teaching methods and ESL courses. The grade of S is given for satisfactory progress and U is given for unsatisfactory progress. Students who fail to meet with their advisors or do not satisfy relevant attendance requirements will receive a U grade. Credits for courses in which U is received cannot count toward a degree.

Grade Reports

The registrar no longer issues grade reports. Grades may be viewed using a confidential password and identification number at http://www.njit.edu/Registrar, the registrar's home page.

Grade Changes

Grade change requests will not be accepted after the end of the subsequent semester. Students should carefully monitor their records and contact the Registrar or the Office of Graduate Studies about any missing or incorrect grades no later than the end of the following semester.

Grade Disputes

Students are expected to resolve disputes about grades with their instructors. If they cannot reach a satisfactory settlement with their instructor, students are permitted to request the intervention of the chairperson of the department and the dean of the school or college. Most schools and colleges have defined procedures for grade disputes coordinated by the dean of the school or college. The dean of graduate studies may be consulted.

In all cases, final authority to award grades rests with the instructor.

Special Circumstances

Students should bring to the attention of the dean of graduate studies any special circumstances that may adversely affect academic standing. This action must be taken as soon as such circumstances develop.

Course Repetition

Graduate students may request approval to repeat a course using a form available from the Office of Graduate Studies. The grade received in a repeated course is calculated in the cumulative GPA, but the first grade still appears on the transcript. A maximum of two courses may be repeated in matriculated graduate study. Students may not repeat a course without prior approval from the department and the Office of Graduate Studies. Non-matriculated students, including certificate students, may repeat a maximum of one course. Students who receive an F in a course will be required to repeat that course. The dean of graduate studies should be consulted if the course is no longer offered or not applicable to the student's current program or other extenuating circumstances are believed to exist.

Transcript of Grades

Students who wish to obtain a transcript issued on their behalf must submit a request in writing to the registrar. A fee for each copy must accompany written transcript requests. Allow 10 days to process the request. Transcripts will not be issued to or on behalf of a student with outstanding financial obligations to the university. Official transcripts bearing the university's raised seal will be issued only to other educational institutions, government agencies, or employers. Under no circumstances will official transcripts be issued to students.

Progress Toward Degree

Academic Performance and Satisfactory Progress Policy

New Jersey Institute of Technology requires that students maintain satisfactory progress in working toward a degree. Federal and state regulations governing financial aid and awards require that students receiving aid from government agencies must meet academic performance and progress requirements defined by the university and approved by the appropriate government agencies. Students are responsible for checking regularly with the office of the department of major study or the Office of Graduate Studies to determine if they are fulfilling degree requirements.

The Office of Graduate Studies, along with academic departments, reviews academic standing of all graduate students at the end of each semester. To have satisfactory academic standing, students must have a cumulative GPA of 3.0 or above, meet all university requirements and be making satisfactory progress toward a degree. Students who do not have satisfactory academic standing are subject to academic warning, academic probation or academic dismissal.

Academic Warning

Students who have completed at least one full-time semester (or its equivalent of 9 credits) and do not have satisfactory academic standing may be asked by the Office of Graduate Studies to visit in-person to review their academic record and also to meet with their graduate advisor. This is not noted on the permanent academic record.

Academic Probation

Students who have completed two or more semesters, or more than 9 credits, and do not achieve satisfactory academic standing may be placed on academic probation or be subject to dismissal. Conditions for continuing graduate study at NJIT are sent, in writing, to students on academic probation. The Office of Graduate Studies will work with students to determine approaches toward successful program completion. Course repetition or the taking of up to 6 additional credits are typical recommendations for students whose GPA is below 3.0 and have the ability to raise the GPA to 3.0 with appropriate grades.

Students on academic probation may not maintain registration without the approval of the Office of Graduate Studies. Academic probation may be noted on the permanent academic record.

Dismissal

Students may be dismissed from Graduate Studies for cause at any time. Cause shall include, but is not limited to:

- Failing to meet the conditions of admission.
- Failing to maintain a cumulative GPA of at least 3.0 after completing one semester or attempting at least 9 credits.
- Failing to make satisfactory progress toward a degree.
- Failing to meet the requirements for graduation.
- Failing a required or repeated course more than once.
- Failing to satisfy requirements for project, thesis, or dissertation within the required time limits.
- Failing doctoral qualifying and similar examinations required for continuing studies in the program, or failing to take examinations within prescribed time limits.
- Professional conduct offenses as defined in the NJIT Code of Professional Conduct.
- Making a false representation relating to admission, registration, or the awarding of financial support.
- Failure to pay all tuition, fees and other charges within the required time limits.

Dismissal is noted on the permanent academic record.

Appeals

Decisions relating to a graduate student's academic status are made in accordance with regulations approved by the faculty and its standing committees. Committees include, but are not limited to, the Graduate Council and the Committee on Academic Affairs.

Students who disagree with a decision should attempt to resolve the matter with those immediately responsible. When a matter cannot be resolved at this level, students should appeal to the chairperson of the department and then to the dean of the school or college. At any time, the student may request that the dean of graduate studies be consulted.

A graduate student who remains dissatisfied may appeal the decision to the Committee on Graduate Appeals through the Office of Graduate Studies. The Committee on Graduate Appeals is chaired by the Provost. The committee's decision, made in writing, is final. Student requests for review or appeal must be in writing and state accurately and completely the decision being appealed, when it was made, by whom, and the reason for the request. Requests should be sent to the dean of graduate studies. A copy of the request together with information that defines the student's record are distributed to the committee members for their consideration.

Readmission if Dismissed

Students dismissed from NJIT for academic reasons may apply for readmission to another degree program after at least one calendar year.

Dismissed students who seek readmission should apply to the Office of University Admissions at least two months before the date of intended readmission. These students must complete, in full, the application for admission and provide all requested documentation, regardless of previous applications. Readmission is treated as a new application. Readmits compete against all other applicants for admission that semester. The circumstances and conditions of the dismissal will be considered in the readmission process.

Students dismissed for professional conduct offenses or for making false representation will not be readmitted to NJIT.

Students who reapply should also include supportive material to justify readmission. Such material may include, but not be limited to, scores obtained in the GRE or GMAT, grades obtained in graduate level work at other institutions, letters of recommendation, and a statement by the applicant. A non-refundable fee of $60 must accompany applications.

General Graduate Degree Requirements

Graduate degree candidates must achieve a cumulative GPA of at least 3.0 in all graduate-level courses (500 level and above) and satisfy other academic and non-academic requirements. These include financial obligations to the university. Until the Office of Graduate Studies verifies that all tuition bills and fees have been paid, and that any required master's thesis or doctoral dissertation has been completed in the appropriate format, degrees will not be certified. Students whose programs require a thesis or dissertation must complete these within time limits, format, and policy prescribed by the Office of Graduate Studies. Master's theses and doctoral dissertations must be submitted for final approval to the Office of Graduate Studies. Master's projects need to be submitted only to the advisor or program office. At least three program approval signatures are required for master's theses; at least five are required for doctoral dissertations. Fees that must be paid include, but are not limited to, the binding fee, publishing fee, copyright fee, and graduation fee.

Grade Point Average Calculation

GPAs are calculated for each semester and cumulatively for the entire graduate record. In order to obtain a graduate degree, candidates must have a cumulative GPA of at least 3.0 in all graduate-level courses, exclusive of grades in master's project, master's thesis or doctoral dissertation. All 500 level (500G for Architecture) or higher graduate courses are included in the cumulative graduate GPA. Only the initial grades for graduate courses that have been repeated (with a maximum of two allowed) are excluded from GPA calculations. Undergraduate credits taken by graduate students are not counted. Some programs also may require a 3.0 GPA in designated core course requirements.

In addition, the cumulative GPA for all courses counted for the degree, exclusive of master's project, master's thesis or doctoral dissertation, must be 3.0 or better. Grades for master's project must be a B or better. Successful completion of the master's thesis and the defense or the doctoral dissertation and the defense will be assigned a grade of P for passing. The P grade is for the thesis or dissertation credits taken in the student's final semester.

Theses and Dissertations

Theses and dissertations submitted for graduate degrees must follow a prescribed university format. The approved format is based on the Estrin/Roche manual: Guidelines for Scientific and Professional Theses. The Office of Graduate Studies provides seminars, guidance documents and continuing assistance for students. The office or its web site should be consulted for more information.

Degrees cannot be certified until the Graduate Studies Office receives and approves the final thesis or dissertation documents with all related requirements completed. The Graduate Studies Office will notify the advisor and the registrar that these documents have been approved before a final grade of P can be assigned. The NJIT Library handles the scanning of completed theses and dissertations into the NJIT website and works with the external bindery. Students are notified by the Library about availability of completed and bound theses and dissertations, typically several months after degree completion. The Graduate Studies Office can make arrangements, for a specified period, for sequestering a completed thesis or dissertation for proprietary or patent reasons, if requested by the student or the advisor.

Special Topics

Special Topics courses are occasionally offered by departments to present new areas of study or of high demand where rapid developments in the field have not allowed time for formal approval of specifically named courses in advance of the offering. These are announced by the departments in time for registration and are typically well-enrolled. They may be at the master's or doctoral level. There is no university limitation on the number of special topics courses that may be taken.

Independent Study

Some programs permit up to three independent study courses (a total of 9 credits) to be taken by graduate students. Independent study is for students who want highly specialized study with a specific faculty member in areas in which specifically titled courses are not normally available. Most departments offer independent study at both the master's and doctoral level. Students should see their advisors regarding independent study options. For students in doctoral programs, a maximum of two independent study courses may be used to partially satisfy the 700-level course requirements. Enrollment in independent study may be as low as one student under a faculty section number.

Expiration of Credit

For all degrees, credits expire seven years after completion of the semester in which they are earned. Expired courses cannot be used to fulfill degree requirements and must be replaced by current credits.

Degree requirements must be completed within seven consecutive years of original admission. Approved leaves of absence do not count against the seven-year limit for completion of the degree although the validity of individual courses may still expire during this time. Requests for waivers of the seven-year limit for extenuating circumstances, other than mere failure to register, are made to the dean of graduate studies. The technical content and remaining currency of courses is considered in evaluating these requests. The majority of courses in rapidly changing fields (such as computer science) are not likely to be accepted after seven years.

Awarding of Degrees

Degrees are awarded three times each academic year: August, January and May. The unversity conducts its commencement ceremony once per year, normally in May. Candidates for graduation must file an Application for Candidacy with the registrar. The application must be consistent with the student's program of admission and current record. Forms are available at www.njit.edu/Registrar. Applications received after the specified deadline are accepted for the requested degree date at the discretion of the registrar and are subject to a late fee. Unsuccessful applications will be automatically added to the next commencement list and students will be billed for the appropriate fees. This will be done a maximum of three times.

Deadline Waiver

Applicants for the August, January or May degree dates whose master's thesis or doctoral dissertation is substantially complete, but who are unable to submit it in final form by the specified date, may request a deadline waiver from the Office of Graduate Studies before it is due. Students granted a waiver may be permitted until a date specified by the Office of Graduate Studies to submit the final copy of the work to the office. Such students may then apply for the next scheduled graduation without having to pay for additional thesis or doctoral dissertation credits. Contact the Office of Graduate Studies for further information.

Students who do not meet the deadline waiver will be required to register for master's thesis or doctoral dissertation in the subsequent enrollment period to allow formal completion.

Master's Degree Requirements

NJIT offers Master's degrees in a variety of disciplines through the five degree granting colleges and schools: Newark College of Engineering, College of Science and Liberal Arts, College of Computing Sciences, School of Management, and New Jersey School of Architecture. NJIT also offers master's degrees in interdisciplinary areas that may include coursework from a number of colleges or schools. The programs are flexibly arranged to allow new specializations and to allow new programs to be developed in response to changing needs. All current programs are listed in another section of the catalog. Students seeking more than one Master's degree should consult the Office of Graduate Admission and the Office of Graduate Studies. There are options available that can reduce the time and number of credits for completion of the second degree.

Most Master's degrees require a minimum of 30 credits to complete. Some master's degree programs, particularly those in professional areas require additional credits beyond 30 credits. Specific program sections of the catalog describe these requirements. The university requirements within the 30 credit minimum are 18 credits minimum in a specialization; the other 12 credits may be elective or include other required courses as determined by the program. In general, courses for Master's programs must be numbered at the 600 level or above; some programs will allow up to two courses numbered 500-599. Some programs may also require a Master's Thesis or a Project.

Up to 9 credits from outside NJIT, subject to approval by the advisor and the Graduate Studies Office and based on NJIT transfer credit policies described elsewhere, may be applied to Master's degrees. Generally, NJIT does not allow transfer of credits already used as part of the credit requirements for a prior degree outside of NJIT. However, students who have completed a Master's degree elsewhere that includes much more than the typical 30 credits for a master's degree and are considering an NJIT Master's degree that also includes much more than the typical 30 credits such as an MBA or an MArch degree, will be considered for a block transfer of up to 12 credits from the prior degree toward the NJIT degree. These types of transfer will require approval of the advisor and the dean of graduate studies.

Bridge Program

Students who seek a master's degree in an academic discipline different from that of the bachelor's degree may be admitted to a master's degree program but may be required to complete appropriate undergraduate and/or graduate prerequisites in addition to the normal graduate degree requirements of the program. The program of courses will be individually designed in consultation with their graduate advisor. Bridge courses must be completed before 9 credits of graduate degree courses are earned. Bridge courses are not counted as degree credits but do count in graduate GPA calculations if the course is numbered 500 (500G for Architecture) or higher.

Master's Thesis Advisor, Committee, and Defense

A master's thesis committee should be formed at the start of the second semester of thesis registration (or at the start of the first semester if a single semester completion seems certain). The committee must have at least three members. All members of the committee must hold faculty rank.

The chair of the committee must be a tenured or tenure track faculty member in the department or program offering the degree. At least one other member of the committee must be a tenure or tenure track faculty member or a research professor in the department or program offering the degree. Approval of the committee is made by the program director and reported to the Graduate Studies Office on a standardized thesis committee appointment form.

The thesis must be defended in a publicly announced oral defense. Each program has its own policies on scheduling and submitting thesis drafts to members of the committee. Students are responsible for following their program's policies. Successful defense of the thesis is determined by vote of the thesis committee. The chair of the thesis committee, one other person who is a tenured or tenure-track faculty or a research professor, and third member of the committee must be present to hear the defense. Every member of the thesis committee must sign and date the approval page of the final thesis document. A report on passage, conditional passage, or failure of the defense is completed by the thesis committee chair, signed by the thesis committee members, and sent to the Graduate Studies Office on a standardized form.

Specific Requirements

Detailed descriptions of the degree requirements for specific degrees or degree/discipline combinations may be found in the Degree Programs section of this catalog.

Doctor of Philosophy Degree Requirements

The number of credits required for completion of doctor of philosophy degrees varies with the program and the level of entry into the program. Students holding a prior master's degree generally require a minimum of 60 graduate credits beyond the master's degree (which is assumed to have included at least 30 graduate credits beyond the bachelor's degree). Students entering the doctoral program with a bachelor's degree and who do not wish to complete a master's degree while pursuing the doctoral degree will be required to complete a minimum of 84 graduate credits beyond the bachelor's degree for programs offered by the Newark College of Engineering and 78 graduate credits beyond the bachelor's degree for programs offered by the College of Science and Liberal Arts.

Students who enter an NJIT doctoral program with two or more master's degrees already completed or a large number of appropriate prior graduate credits may be considered for a reduction in the credits required at NJIT. The evaluation of the requirements will be made by the program advisor in consultation with the Dean of Graduate Studies. The minimum credit requirement at NJIT for the doctoral degree at NJIT is 36 dissertation research credits, regardless of any other requirement waiver.

Doctoral program credit requirements for joint programs for which the names of multiple universities appear on the diploma, are to follow the requirements of the program as approved by the universities, generally a minimum of 72 credits beyond the bachelor's degree.

In addition to overall credit requirements, each program includes the following minimal requirements:

- For those entering the program with master's degrees, 24 credits of course work beyond the master's degree of which at least 12 credits must be at the 700 level and none at the 500 level or lower.
- For both entry levels; baccalaureate or master's start-point, at least 12 credits of course work at the 700 level; no more than two independent study courses may be used to satisfy this requirement. Master's project or thesis cannot be used to satisfy this requirement.
- 36 credits minimum of doctoral dissertation research for programs offered offered jointly with other universities.
- 30 credits minimum of doctoral dissertation research for the programs offered by the College of Computing Sciences.

- Dissertation research credits in accordance with the program approval documents for programs offered jointly with other universities
- Seminar attendance each semester or as required by the program. Nominal credit values, if any, for registration in seminar do not count toward fulfillment of overall credit requirements.

Students who wish to complete a master's degree while pursuing a doctorate in the same field must be approved for this by the doctoral department, the Dean of graduate studies, and the director of graduate admissions, and satisfy all requirements for the master's degree, including any thesis or project requirement. In general, such permission is given only after passage of the research proposal exam or if the student is near completion of the doctorate. Students in doctoral programs initially, who terminate their studies at the master's level, will lose further eligibility for support.

Qualifying Examination

Students must pass a qualifying examination within two years of being admitted into doctoral programs. Exceptional students, only having bachelor's degrees, who are admitted into doctoral programs must take the qualifying examination within one and one-half years of admission and must pass it within two years. Students are only permitted to take the examination twice. The passage of qualifying examinations is reported to the Office of Graduate Studies. Each department determines its own policies with regard to format, confidentiality, grading, and review of examinations by faculty and students. Students are, at their request, permitted to view their examination papers in the presence of a designated faculty member and to see correct examination answers.

Dissertation and Pre-Doctoral Research Credits

Students may register for doctoral dissertation credits (course number 790) only after passage of the qualifying examination. They may register for a maximum of 6 credits of pre-doctoral research (course number 792) prior to passage of the qualifying exam. These credits may count toward the required number of dissertation credits for the degree. Dissertation and pre-doctoral dissertation credits are graded as S or U except that P is assigned to the last registration for doctoral dissertation upon completion of the degree.

Dissertation Advisor, Dissertation Committee and Research Proposal

Doctoral students are required to have a dissertation advisor selected, a dissertation committee formed, and research proposal approved within one year of passage of the qualifying examination.

Department chairpersons or doctoral program directors are responsible for approving formation of dissertation committees. The committee consists of a minimum of five members, one of whom is external to the program or to NJIT. The majority of the committee members are tenured or tenure-track faculty from the student's program or department having research experience or developing research interests related to the dissertation research. The dissertation committee chairperson typically is the doctoral candidate's dissertation advisor, but other faculty may be selected, provided they are from the student's program or department. The dissertation committee chair must be a tenured or tenure-track faculty member in the program. Two committee members, including an external member, may serve as co-advisors. The advisor or at least one of the co-advisors must be a tenured or tenure-track faculty member from the program.

The other members of the dissertation committee, except for an external member from outside the university, must have faculty rank at the level of Assistant Professor, Associate Professor, Professor, Distinguished Professor, or Research Professor. Former students of any committee member, who are less than four years beyond doctoral completion, are specifically excluded from membership. Post-doctoral Associates, Instructors, Special Lecturers, Research and Teaching Assistants, or any other student category, are specifically excluded from membership. The external members should either have appropriate faculty rank elsewhere or have sufficient research expertise to warrant inclusion on the dissertation committee.

Part-time doctoral students pursuing the doctorate with industry collaboration should have at least one dissertation committee member from the participating industrial partner whose research credentials would otherwise be appropriate for a member of the university faculty. Committees for joint doctoral programs with other universities shall either follow these policies or the specific policies for the joint program consistent with the program approval and related documents.

Each doctoral program has specific requirements for preparing, presenting and accepting proposals. Research is expected to investigate or develop a unique contribution to science and technology. Research may be experimental, analytical, applied, or theoretical, provided it satisfies this criteria and is approved by the dissertation committee. It should be of a quality to warrant scholarly presentation or paper submission to reputable journals in accordance with program practice.

Residency

Doctoral candidates must spend at least one academic year in full-time residence. This requirement is sometimes waived with the approval of the dissertation committee and the Dean of graduate studies. Such waivers are granted when a candidate's dissertation research requires use of research facilities at an approved off-campus site. A typical example for residency requirement waiver would apply in the case of students in the collaborative doctorate option.

Doctoral Candidacy

Doctoral candidates are doctoral students who have completed all other requirements for the degree except for completion of the dissertation and the defense. This includes, as a minimum, passage of the doctoral qualifying examination, approval of the research proposal and completion of all course work. Status as a doctoral candidate does not imply candidacy for the degree. A degree candidate will be both near degree completion and have made a formal degree application for a particular graduation date.

Dissertation and Defense

The dissertation should be a scholarly publication of the quality to warrant conference presentation or paper submission to reputable journals. The dissertation must be defended in a publicly announced oral defense. Successful defense of the dissertation is determined by vote of the dissertation committee. All members of the committee must be present to hear the defense.

Each program has its own policies on scheduling and submitting dissertation drafts to members of the dissertation committee. Students are responsible for following their program's dissertation policies. In regard to format, the standard reference is the latest edition of the Estrin/Roche manual: Guidelines for Scientific and Professional Theses. Office of Graduate Studies policies on number of copies, deadlines, fee payments, information documents, and grade submission for acceptance of the final dissertation and for doctoral degree certification are to be followed. The Office of Graduate Studies provides guidance and assistance to students working on the final details of the dissertation. Students should contact the office for appointments early in the final semester. The review of format should proceed well in advance of final document approval and dissertation defense.

Every member of the dissertation committee must sign and date the approval page of the final dissertation document.

Graduate Certificate Requirements

Certificates require completion of 12 specified credits with a GPA of 3.0 or better. Only one course repetition is permitted for certificate students to improve the GPA. The cumulative GPA of the entire graduate record at NJIT also must be 3.0. Graduate certificate credits may be applied to a following master's degree. Dual use of credits from a completed first master's degree to a second and following certificate is not permitted.

Students in certificates programs are usually considered to be non-matriculated students for the duration of the certificate program. Graduate certificate programs are generally completed before students are admitted to a following matriculated graduate program. Students who did not apply for admission to a certificate program initially and instead complete the certificate requirements as part of a completed graduate degree program may be permitted to receive a certificate also with approval of the graduate program director.

Rights and Responsibilities

Code of Professional Conduct

New Jersey Institute of Technology requires students to conduct themselves with decorum and to adhere to standards of ethical and professional behavior. NJIT has adopted, and requires all students to comply with, a Code of Professional Conduct. The policies and procedures governing this code are contained in a separate publication, the Student Handbook, and are deemed incorporated into this catalog. The student handbook, maintained by the Dean of Students Office, is available online at: www.njit.edu/handbook/

Identification Card

All students must carry an NJIT identification card while on campus. An ID card must be presented at the request of a university administrator, faculty member or public safety officer. Facilities, parking, building access, and services of the university require presentation of a valid university ID.

Students should obtain an ID card as soon as possible after registration is completed. Photographs for ID cards are taken throughout the semester in the Department of Public Safety, located in the parking facility. Dates and times to obtain an ID are posted at the Campus Center Information Desk. Proof of registration in the form of a tuition receipt or registrar's receipt is required to obtain an ID card. These receipts also will be accepted as NJIT identification until the ID card is issued. ID validation stickers are issued each semester and are available at the Department of Public Safety or the Campus Center Information Desk.

Lost or stolen IDs should be reported as soon as possible to the Department of Public Safety. A replacement for a lost card is obtained by paying a $25 charge at the Bursar's Office cashier's window in the Student Services Mall and presenting the receipt at the Department of Public Safety where the card will be re-issued.

NJIT cards are not transferable. Cards are not to be loaned to anyone for any reason. ID cards are the property of NJIT and must be returned upon request.

Family Educational Rights and Privacy Act

The Federal Family Educational Rights and Privacy Act of 1974 gives students the right to inspect any educational records about them maintained by NJIT. Students have the right to a hearing to challenge the contents of these records, and also have the right to add to their records an explanation of information they challenge. Unless specifically exempted by the public law, NJIT is mandated to keep student records strictly confidential.

The university registrar is responsible for student records. Educational records are defined as transcripts, admission files and registration forms. To review their files, students must contact the registrar, in writing, to specify the items they want to see. Student health records are maintained by the Director of Health Services and may only be examined by a health professional chosen by the student.

Educational records defined by the public law must be made available within 45 days after a student requests to see them. A catalog of educational records kept by NJIT is available from the registrar. Exceptions to the right of inspection include financial aid records and records of institutional, supervisory, and administrative personnel, and ancillary educational personnel.

For a nominal service fee, copies of these records may be made for students.

Only those at NJIT acting in the student's interest are allowed access to student files, including personnel in the registrar's, admissions, student services, and finance offices; and academic personnel within the limitations of their need to know.

With the exceptions stated in the law, no one outside NJIT shall have access to a particular student's educational record without the written consent of the student, except in extraordinary circumstances such as emergencies. Accrediting agencies carrying out their accrediting function and certain state and federal officials are permitted access. A record of, and reasons for, granting access will be kept by the university and will be available to the student.

The university, at its discretion, may provide directory information, in accordance with the provisions of the law including a student's name, address, telephone listing, date and place of birth, major field of study, participation in officially recognized activities and sports, weight and height of members of athletic teams, dates of attendance, degrees and awards received, and the most recent previous educational agency or institution attended by the student. Students who desire directory information to be withheld should notify the registrar in writing within the first two weeks of initial registration.

Request for non-disclosure will be honored by the university for ONLY ONE ACADEMIC YEAR AT A TIME. Authorization to withhold directory information must be filed annually in the Office of the Registrar.

Students who disagree with an entry may challenge its accuracy with the Office of the Registrar. If this remedy fails, either NJIT or the student may request a formal appeal hearing. The law mandates that such hearings be held within 30 days of requests, and be conducted by a university official or other person with no direct interest in the outcome. Students will be given a full and fair opportunity to present relevant evidence and be represented by their own counsel.

Students may include a written statement in their file explaining a disputed entry following an unfavorable determination of an appeal. A written decision will be rendered within 15 working days after the hearing of an appeal.

Students who believe that they are treated unfairly or improperly and contrary to the provisions of the law may request, in writing, assistance from the provost of the university or the provost's designee. Students who believe that their rights have been abridged may file complaints with the appropriate federal agency.

Anti-Discrimination Policy

New Jersey Institute of Technology reaffirms its commitment to a policy of non-discrimination on the basis of race, sex, sexual orientation, age, religion, ethnic origin, handicap or veterans' status in its employment policies, educational programs and activities under university control.

Assuring a climate of equal opportunity is the direct responsibility of all levels of management. Administrative and supervisory personnel are required to comply with applicable government regulations and the affirmative action goals of the university. Among these are Executive Orders 11246 and 11375 (Affirmative action); the Civil Rights Act of 1964, as amended; Title IX of the Education Amendments of 1972 (Sex Discrimination); Section 504 of the Rehabilitation Act of 1973; Americans with Disabilities Act (Non-discrimination on the Basis of Handicap); The New Jersey Law Against Discrimination, Title 10, Chapter 5, 10:5-1 to 10:5-28, NJ Revised Statutes, as amended; and the New Jersey Governor's Code of Fair Practices, Executive Order No. 21 (1965), as amended and Executive Order No. 39 (1991), "Prohibition in State Government of Discrimination Based on Sexual Orientation."

Any reported act of discriminatory behavior will be investigated through the Office of the Dean of Student Services, the Office of Compliance and Training, or the Office of General Counsel and Employment Policy Relations.

Sexual Harassment Policy

It is the continuing objective of the university to offer a work and study environment to its employees and students that rewards career and educational goals based upon relevant factors such as ability and work performance. Sexual harassment of employees and students is unacceptable. It is a barrier to educational and professional development and contrary to law and university policy.

In accordance with the NJIT Sexual Harassment Policy and Procedures, persons found to have violated university policy will face investigation, managerial review and possible disciplinary action up to and including employment termination and or dismissal from the university (for students). For a full copy of the university's policy prohibiting sexual harassment, please contact the Office of General Counsel and/or the Office of Compliance and Training.

Copyright Ownership

NJIT believes its role as an educational institution is best served by disclosing to the public all academic research, projects, theses and dissertations developed by students during the course of their studies or employment at the university.

Projects, theses and dissertations created by students shall be governed by the following provisions as outlined in NJIT's copyright policy under "Ownership and Disposition of Copyrightable Materials":

A. Copyright ownership of projects, theses and dissertations generated by research that is performed in whole or in part by the student with financial support in the form of wages, salaries, stipend, or grant from funds administered by the University shall be determined in accordance with the terms of the support agreement, or in the absence of such terms, shall become the property of the University.

B. Copyright ownership of projects, theses and dissertations generated by research performed in whole or in part utilizing equipment or facilities provided to the University under conditions that impose copyright restriction shall be determined in accordance with such restrictions.

C. Copyright in projects, theses and dissertations not within the provisions of Categories A and B of this policy shall be the property of the author. However, the student must, as a condition of a degree award, grant royalty-free permission to the University to reproduce and publicly distribute copies of the project, thesis or dissertation.

Requests for permission to publish Category A and B should be addressed to the Office of Intellectual Property.

For further information, call the Office of Intellectual Property, (973) 596-5825.

Ownership of Intellectual Property

In accordance with university policy, NJIT retains all right, title and interest to any and all intellectual property (i.e., inventions, discoveries, creative works, trade secrets and know-how) developed by NJIT students during the course of their studies or employment at the university or while using university facilities.

To protect against premature disclosure of an invention and/or publication of anything that may be of a proprietary nature, students must immediately report their intent to do so to the Office of Technology Development. Students must neither publish nor discuss proprietary information with anyone other than the Office of Technology Development or members of the University's Intellectual Property Committee. When a project, thesis or dissertation covers material that is potentially proprietary, both the student and the advisor must report the existence of such material to the Office of Graduate Studies and the Office of Technology Development; so that the University may expedite its review of such material and determine whether or not it is proprietary and should be protected under the University's guidelines for protecting its Intellectual Property. If necessary, the Office of Graduate Studies and the Office of Technology Development will take steps to sequester patentable material in archival documents such as theses and dissertations. If the University applies for a patent, the student will sign an appropriate assignment agreement. All income derived from such intellectual property will be shared between NJIT and the student in accordance with the University's published policy (see http://www.njit.edu/research/officetech/inventors/inventors.php).

For further information, call the Office of Intellectual Property, (973) 596-5825.

Property Loss and Damage

NJIT is not responsible for loss of property by fire or theft in its buildings or grounds. NJIT is not responsible for property damaged as the result of vandalism in its buildings or grounds.

Drug Abuse Prevention Program

New Jersey Institute of Technology prohibits the use of illegal drugs on its premises. University policy concerning possession and consumption of alcoholic beverages on campus subscribes to strict enforcement of the laws of the State of New Jersey, the County of Essex and the City of Newark. In addition, the policy stipulates that any consumption must occur within a responsible social framework wherein beverages are not the focus of the event.

Students with drug and alcohol abuse problems should be aware that they can receive information, counseling and referral assistance from the Office of the Dean of Student Services, the Counseling Center, the Health Services Office, or the Stop-In Center. The professional staff of the Counseling Center can provide substance abuse counseling and assessment in some situations and will refer more serious problems to off-campus facilities and services.

In addition, the university, through the Division of Student Services, offers a series of educational programs focused on the areas of drug and alcohol information and substance abuse prevention.

Drug-Free Workplace Policy

Student employees are subject to university policies regarding employment. New Jersey Institute of Technology is committed to maintaining a drug-free workplace in compliance with applicable laws. The university is further committed both to rigorous enforcement of applicable laws and policies and to support for those trying to cope with drug-related problems. The unlawful possession, use, distribution, dispensation, sale, or manufacture of controlled substances is prohibited on university premises. Any NJIT employee determined to have violated this policy or engaged in drug-related problems that have an impact upon the workplace may be subject to disciplinary action up to and including termination. At the discretion of the university, any employee convicted of a drug offense involving the workplace shall be subject to employee discipline (up to and including termination) and/or required to satisfactorily complete a drug rehabilitation program as a condition of continued employment.

The illegal use of controlled substances can seriously injure the health of employees, adversely affect the performance of their responsibilities, and endanger the safety and well-being of fellow employees, students, and members of the general public. Therefore, the university urges employees engaged in the illegal use of controlled substances to seek professional advice and treatment. Anyone who is employed at NJIT who has a drug problem is encouraged to contact the Director of the Employee Assistance Program (EAP), who will assist in obtaining available treatment. Employees engaged in contracts with the U.S. Department of Defense are additionally subject to Department of Defense requirements and may be required to submit to tests for the illegal use of controlled substances.

As a condition of employment, an employee of NJIT will notify his/her supervisor if he or she is convicted of a criminal drug offense involving the workplace within five days of the conviction. In the event any such conviction involves an employee working on a federal contract or grant, the university will notify the granting or contracting federal agency within 10 days of receiving notice of a conviction. A copy of this statement shall be given to all employees.

This statement and its requirements are promulgated in accordance with the requirements of the Drug-Free Workplace Act of 1988 enacted by the United States Congress. The university will continue its efforts to maintain a drug-free environment by adhering to the above policy and by providing through the EAP and the offices of Human Resources, and Compliance and Training, ongoing drug awareness programs.

Accreditation

NJIT is accredited by the Middle States Association of Colleges and Schools (MSACS) Commission on Higher Education.

Most of NJIT's eligible professional programs, both graduate and undergraduate, are accredited by the respective accrediting agency for their field. Addresses and telephone numbers for all of these accrediting agencies are listed below.

Details about the accreditation of specific programs are included in the descriptions of those degrees.

ABET
(CAC of ABET) Computing Accreditation Commission of ABET
(EAC of ABET) Engineering Accreditation Commission of ABET
(TAC of ABET) Technology Accreditation Commission of ABET

111 Market Place, Suite 1050
Baltimore, MD 21202
Tel. (410) 347-7700

AACSB International
777 South Harbour Island Boulevard
Suite 750
Tampa, FL 33602-5730
Tel. (813) 769-6500

Middle States Association of Colleges and Schools
3624 Market Street
Philadelphia, PA 19104
Tel. (215) 662-5606

National Architectural Accrediting Board, Inc. (NAAB)
1735 New York Avenue, NW
Washington, DC 20006
Tel. (202) 783-2007

Admissions

Every application for admission is processed through the Office of University Admissions and is reviewed by the Graduate Admissions Committee. Candidates are notified of their admission status by mail. Admission decisions cannot be communicated by telephone, e-mail, fax, in-person, or to third parties. For admissions information contact:

Office of University Admissions
New Jersey Institute of Technology
University Heights
Newark, NJ 07102-1982
(973) 596-3300, fax (973) 596-3461, e-mail: admissions@njit.edu

For an online application for admission go to www.njit.edu/admissions/apply-online.php

Test Requirements

Graduate Record Examinations (GRE) The GRE (general test) is required of all applicants to doctoral programs, all applicants seeking financial support, and all applicants whose most recent degree was awarded from an institution outside of the United States.

Specific master's programs: applied physics, architecture, biology, infrastructure planning, and materials science require all applicants to submit official GRE scores.

The GRE can be used to fulfill test requirements for the master's programs in information systems and in public health. The GRE is highly recommended for all other programs.

For further information about taking the GRE, contact: Educational Testing Service, P.O. Box 6000, Princeton, NJ, 08541; phone (609) 771-7670, 8 a.m. to 8:45 p.m.; www.gre.org

Graduate Management Admission Test (GMAT) The GMAT is required for all applicants for the MBA in Management of Technology and the MS in Management programs. Students with significant business experience who are seeking admission into the MS in Management program may apply for a GMAT waiver. For additional information, contact the graduate admissions office at (973) 596-6378. The GMAT also can be used to fulfill test requirements for the master's programs in information systems and in public health.

For further information about taking the GMAT, contact: Educational Testing Service, P.O. Box 592, Princeton, NJ, 08541; phone (609) 771-7330, 8 a.m. to 8:45 p.m.; or www.gmat.org

Law School Admission Test (LSAT) The LSAT can be used to fulfill test requirements for the master's program in public health.

For further information about taking the LSAT, contact: Law School Admission Council, (215) 968-1001 or www.lsac.org

Medical College Admission Test (MCAT) The MCAT can be used to fulfill test requirements for the master's programs in information systems and in public health.

For further information about taking the MCAT, contact: Association of American Medical Colleges, (202) 828-0600 or www.aamc.org/stuapps/admiss/mcat/start.htm. For registration materials, contact: MCAT Program Office, P.O. Box 4056, Iowa City, Iowa, 52243; or phone (319) 337-1357.

Test of English as a Foreign Language (TOEFL) All international applicants must show a TOEFL score of at least 550 (paper-based); 213 (computer-based); 79 (internet-based).

For further information about taking the TOEFL, contact: TOEFL/TSE Services, P.O. Box 6151, Princeton, NJ 08541; phone (609) 771-7100 Monday--Friday, between 8 a.m. and 9:45 p.m. and Saturday, between 9 a.m. and 4:45 p.m. New York time, for recorded information or personal assistance; or see www.toefl.org.

International English Language System (IELTS)

International applicants may submit results from the IELTS exam in lieu of the TOEFL. The minimum score id 6.0 with no sub-score lower than 6.0.

For further information about taking the IELTS, contact IELTS; www.ielts.org.

Master's Degree Programs

Master's degree programs provide advanced education needed by professionals in an era of rapidly expanding technology and normally require more specialization in the academic discipline of the student's bachelor's degree.

Applicants for admission to graduate study must have completed an undergraduate program accredited in the United States or its equivalent and demonstrate superior academic achievement in an appropriate discipline. Students are expected to have placed in the top half of their graduating class and program and to have achieved a cumulative GPA no lower than 2.8 on a 4.0 scale. Individual departments may impose requirements that are more stringent. Applicants with undergraduate degrees in engineering technology must have ranked in the top quarter of their class and have a cumulative GPA of at least 3.0.

All applicants should submit supplementary evidence of their potential for successful graduate work. Letters of recommendation, GRE or GMAT scores, a publications record, prior research experience, a record of exceptional career development, a statement of the applicant's objectives, interests and professional experience are examples of appropriate supplementary evidence.

Bridge Program

Students who seek a master's degree in an academic discipline different from that of the bachelor's degree may be admitted to a master's degree program but may be required to complete appropriate undergraduate and/or graduate prerequisites in addition to the normal graduate degree requirements of the program. The program of courses will be individually designed in consultation with their graduate advisor. Bridge courses must be completed before 9 credits of graduate degree courses are earned. Bridge courses are not counted as degree credits but do count in graduate GPA calculations if the course is numbered 500 (500G for Architecture) or higher.

Admissions Procedures for Master's Study

An Application for Admission to Graduate Study form may be obtained from the Office of University Admissions or submitted via online at www.njit.edu/admissions/apply-online.php. A non-refundable fee of $60 must accompany the application. Applications may be deferred for one semester for a delay in admission without incurring another $60 fee. Official transcripts from all colleges and universities previously attended are required. To be accepted as official, transcripts must be sent directly to the Office of University Admissions by the institutions concerned. Applications for fall (September) admission must be received by June 1; for spring (January) admission by November 1. Applications for financial support for fall (September) must be received by January 15. Applications for financial support for spring (January) must be received by October 15. Supporting documents must also reach the Office of University Admissions by the above dates. Incomplete applications or applications received after these dates will normally be processed for the following semester.

Program Transfers

Students who wish to transfer from one master's degree program at NJIT to another at NJIT must complete an application for admission to the new program and provide appropriate supporting materials. Courses taken in one program are not necessarily transferable to another, nor may credits be applied to more than one degree, except as provided by the M.S./M.S. program. Students admitted to one degree program are normally required to be in the original program for one full year before admission and enrollment in another degree program.

Joint Master's Degrees with Other Universities

The university cooperates with Rutgers-Newark and with UMDNJ in unique offerings of joint master's programs. Specific information about application and admission requirements for each is provided in the degree program descriptions located in the Degree Program section of this catalog. Programs that lead to joint master's degrees are applied physics, biology, computational biology, environmental science, and history with Rutgers-Newark and public health with Rutgers-Newark and UMDNJ.There is also a dual degree program in which a student may simultaneously earn a masters degree in Infrastructure Planning from NJIT and in City and Regional Planning from Rutgers-New Brunswick.

Doctoral Programs

New Jersey Institute of Technology offers doctoral programs to fill society's need for creative research scientists and engineers.

Admissions Requirements for Doctoral Study

Applicants are required to have an appropriate academic background as described by the individual degree programs, which are located in the Degree Programs section of this catalog, and a GPA of at least 3.5 on a 4.0 scale in prior study. GRE scores are required for admission to all doctoral programs. Individual programs may establish additional or more stringent requirements.

An applicant who wishes to pursue a doctoral degree in a field different from that of previous study, and who is otherwise qualified, may establish eligibility by satisfactorily completing a program of study recommended by the department in which they seek admission.

Applicants who wish to complete a master's degree while pursuing a doctorate must apply for admission to the master's program. This requires the approval of the doctoral program and dean of graduate studies, and where permitted, generally occurs only at or near the completion of the doctoral program.

Mid-career scientists and engineers interested in part-time study may wish to consider the collaborative doctorate option described in the Graduate Studies section of this catalog.

Admissions Procedures for Doctoral Study

Admissions procedures are the same as for a master's degree. In addition, three letters of recommendation are required from individuals who can best judge the applicant's ability to pursue independent research and complete a doctoral program.

Joint Doctoral Degrees with Other Universities

NJIT cooperates with other universities in Newark in operating and developing doctoral programs of mutual interest.

The university participates in unique offerings of joint doctoral programs with Rutgers-Newark and UMDNJ. Students may apply and be admitted through either university. Programs that lead to joint degrees are applied physics, biology, environmental science and mathematical sciences with Rutgers-Newark, biomedical engineering with UMDNJ and urban systems with both Rutgers-Newark and UMDNJ.

NJIT faculty participate in the doctoral program in management offered by Rutgers-Newark. NJIT faculty supervise Rutgers doctoral students in this program. Admissions to the doctoral program in management is handled by Rutgers-Newark.

Admission Classifications

DEGREE (MATRICULATED STUDENTS)

Regular Admission

Applicants who meet NJIT standards and have an appropriate undergraduate academic background for the degree program to which they are seeking admission will be offered regular admission as degree-seeking (matriculated) students.

Conditional Admission

NJIT expects applicants to have a superior academic record, but recognizes that interest, creativity, maturity, and motivation are also important. Conditional admission to the university may be granted to applicants who do not have the appropriate academic background required for a particular degree program, but who have an academic record that meets NJIT's scholastic standards.

Once granted conditional admission, students must complete conditional or bridge courses specified by the university within their first two semesters. Such courses may be at either the undergraduate or graduate level and are NOT counted as degree credits although all courses numbered 500 (500G for Architecture) or higher are calculated in the cumulative GPA. Students must attain grades specified by the university and are not permitted to take more than 9 credits that count as graduate degree credits at NJIT before meeting the terms of conditional admission. Failure to meet these conditions may result in dismissal from the university.

Contingent Admission

Students who apply for admission to graduate programs before completing their bachelor's degree, and whose records demonstrate superior academic achievement, may be offered admission to NJIT contingent on their showing proof of receiving a bachelor's degree appropriate for the degree program for which they are seeking admission. Such students must show proof of graduation before being permitted to enroll in a graduate program.

Change of Program

Students are admitted to one graduate degree program and not to the university as a whole. Students who wish to change major on arrival at NJIT must file an application for the new program and must generally remain in the original program for one full year before the application is approved. There is no guarantee or requirement that the new application will be successful. Those on support are liable to loss of support from the original department and cancellation of a current award.

Change of Level

Students who wish to change current degree level must file an application for admission to the new degree level. There is no requirement or guarantee that the application will be successful. Students who wish to drop down to a master's program from a doctoral program should be aware of the impact of this action on current and future financial support. Students who wish to raise their level from a master's to a doctoral program should be aware of any impact on incomplete master's theses or projects.

NON-DEGREE (NON-MATRICULATED) STUDENTS

Students who wish to take graduate courses without seeking a degree (non-matriculated status) should contact the Office of University Admissions for a Non-Degree Application Form.

Non-matriculated students may be permitted to take a maximum of 9 graduate-level credits accumulated over three registration periods, except students seeking a graduate certificate. These students may take a maximum of 12 graduate-level credits accumulated over four registration periods. Students wishing to take credits beyond these limits must apply and be accepted to a degree program as a matriculated student.

Academically qualified students who do not desire to enter degree programs may enroll in certain individual graduate courses. Such students must present transcripts of previous academic work or other appropriate evidence at each registration in order to indicate adequate preparation for the course work involved. If approved by the Office of University Admissions, registration will be permitted if space is available. Permission to enroll as a non-matriculated student does not imply eventual admission to a degree program.

Graduate Certificate Programs

NJIT offers designated courses in concentrated areas for students wishing to obtain a graduate certificate in specific areas. These require completion of 12 NJIT credits at the graduate level. Students in these programs are generally non-matriculated students for the duration of the certificate program. Graduate certificate programs may also be completed during a matriculated graduate program by making use of degree credits. Students in a matriculated degree program are not permitted to receive a certificate until completion of the degree program. Only one certificate can be earned within the credits applied toward a master's degree.

Students Matriculated at Other Universities

Graduate degree students at other colleges or universities may take courses for credit at NJIT for transfer back to their home institution. In addition to satisfying the course prerequisites, students must furnish a letter of approval from an appropriate administrative officer of their home institution.

NJIT Undergraduates

NJIT undergraduates may register for graduate courses, 500- or 600-level, with written approval from both their undergraduate advisor and from the graduate advisor in the department in which the course is taught. NJIT students in the BS/MS program are required to take 6 graduate-level credits while undergraduates to satisfy BS/MS program requirements.

Rejected Applicants

Students whose application for admission to a degree program is unsuccessful are not permitted to register as non-matriculated students.

International Students

International students on F-1 and J-1 visas are not permitted to register as non-matriculated students. Students on other visas should consult the Office of University Admissions regarding non-matriculated status.

Auditors

Students who wish to attend courses for which they are qualified, but who do not wish to be graded in the course, may be permitted to enroll as auditors. Registration will be approved only after a review of credentials by the Office of University Admissions and only if space is available. A notation signifying that the course was audited will be made on the student's record, but no credit will be granted for the course. Students who wish to audit a course must state their intention at the time of registration. A change to, or from, auditor status is not permitted once a semester has begun. Students who audit a course are required to pay full tuition and fees. There is no tuition remission allowable for audited courses. Audited courses cannot be counted in determining full-time status.

TRANSFER STUDENTS

Students enrolled in graduate programs at other institutions may apply for transfer to NJIT by completing the normal admission procedure.

Transfer students may apply for credit for courses taken at other U.S. educational institutions by following procedures outlined in "Transfer of Credits from Outside NJIT" in the Academic Policies and Procedures section of this catalog. In addition, international students wishing to transfer from other educational institutions in the United States must:

- Demonstrate a cumulative GPA of at least 3.0 in graduate courses taken at other U.S. educational institutions;
- Complete the required immigration procedures for transfer; and
- Be eligible for admission to the NJIT program of their choice.

To transfer to NJIT from an other institution in the U.S., international students must already have been placed into SEVIS, The Student and Exchange Visitor Information System. NJIT will ask the "leaving institution" to verify the student's current standing in F-1 or J-1 status under immigration regulations. All financial and academic requirements must be completed before admission will be granted and the I-20 or DS-2019 issued.

INTERNATIONAL STUDENTS AND TOEFL

New Jersey Institute of Technology welcomes applications from international students with records of superior academic achievement. In addition to the procedures stated below, international students are required to provide evidence of English language proficiency by submitting either the Test of English as a Foreign Language (TOEFL) or the International English Language System (IELTS) scores

For further information about taking the TOEFL, contact: TOEFL/TSE Services, P.O. Box 6151, Princeton, NJ 08541; (609) 771-7100 Monday-Friday, between 8 a.m. and 8:00 p.m. New York time, for recorded information or personal assistance; or see www.toefl.org.

For further information about taking the IELTS, contact IELTS; www.ielts.org.

Students with TOEFL scores of 550 (Paper-based); 213 (Computer-based); 79 (Internet-based); 6.5 (IELTS) or better are not required to take an ESL course but are encouraged to improve their English-language skills by doing so voluntarily.

All ESL courses are graded on an S/U (Satisfactory/Unsatisfactory) basis. The course credits count towards the 9 credits required for full-time status; however, the credits do not count toward degree credits.

International Students Who Seek Financial Support

Those seeking financial support from NJIT at the time of admission will be required to achieve a TOEFL score of at least 550 (Paper-based); 213 (Computer-based); 79 (Internet-based). Students who may be offered Teaching Assistant or similar positions are required to be tested for spoken English proficiency in advance of classroom or laboratory placement. The test is offered at NJIT after admission. New international students offered TA or similar awards must also participate in the teaching assistant training program offered by ESL staff in advance of the first semester (usually in August.) All new TAs must register for ENG 599 in their first TA assigned semester.

INTERNATIONAL STUDENT FINANCIAL STATEMENT

In accordance with Department of Homeland Security, Bureau of Citizenship and Immigration Services requirements, international students must also submit to the Office of University Admissions an International Student Financial Statement to demonstrate financial resources sufficient to meet the academic and living costs of their anticipated stay at the university. International students should note that they will be required to pay non-resident tuition rates. Immigration papers (e.g., I-20, DS-2019) will NOT be issued until the International Student Financial Statement is on file with the Office of University Admissions.

Academic Credential Equivalents for International Students

Undergraduate degrees must be equivalent to the typical four-year program in the United States. NJIT is working with a number of countries and universities to provide a transition from two- and three-year degree programs to baccalaureate and later graduate study. To be eligible for admission to graduate study at NJIT, international students must have the following minimum academic qualifications.

Argentina	Licenciatura
Bahamas	Honors bachelor's degree
Barbados	Honors bachelor's degree
Bolivia	Licenciatura
Brazil	Bacharel or Licenciado
Canada	Honors bachelor's degree or equivalent
Chile	Bachillarato, Licenciatura? or Titulo of at least four-year duration
People's Republic of China	Bachelor's degree

Colombia	Licenciatura or Titulo
Dominican Republic	Licenciatura of at least four-year duration
Ecuador	Licenciatura or Titulo
Egypt	Bachelor's degree
El Salvador	Licenciatura
France	Maitrise or equivalent
Germany	Ptychion
Guatemala	Licenciatura
Haiti	Diplome d''EtudesSuperieures or Licence of at least four-year duration
Honduras	Licenciatura of at least four-year duration
Hong Kong	Honors bachelor's degree
India	Bachelor's degree(first class) in Engineering or Architecture, master's degree in other?
Indonesia	Sarjana or Insinyur
Iraq	Bachelor's degree
Isreal	Bachelor's degree
Italy	Laurea
Jamaica	Honors bachelor's degree
Japan	Bachelor's degree
Jordan	Bachelor's degree
Korea	Bachelor's degree (Taehak Taehakkyo)
Kuwait	Bachelor's degree
Lebanon	Bachelor's degree, Licence of at least four-year duration, or Maitrise
Libya	Bachelor's degree
Malaysia	Bachelor's degree
Mexico	Licenciatura of at least four-year duration
Morocco	Licence or Ingenieur d'Etat
Netherlands	Doctorandus, Ingenieur or Meester
Nicaragua	Licenciatura
Nigeria	Honors bachelor's degree
Norway	Cand. Mag
Pakisthan	Bachelor's degree in engineering or other four-year bachelor's degree or master's degree
Panama	Licenciatura
Paraguay	Licenciatura? of at least four-year duration
Peru	Bachillerato, Licenciatura or Professor from four-year university program
Philippines	Bachelor's degree
Saudi Arabia	Bachelor's degree
Singapore	Honors bachelor's degree
Sweden	Filsofie Kandidatexamen or Ekonoexamen
Switzerland	Licence or Diplom of at least a four-year duration
Syria	Lisentiate or bachelor's degree
Rep. of China	Bachelor's degree
Thailand	Bachelor's degree
Trinidad and Tobago	Honors bachelor's degree
Turkey	Lisans or Bachelor's degree
United Kingdom	Honors bachelor's degree

Uruguay	Licenciatura of at least four-year duration
Venezuela	Licenciatura or equivalent

Students from countries whose universities do not provide transcripts, or who experience exceptional difficulty in obtaining transcripts, should contact the Office of University Admissions for special instructions. Students whose credentials cannot be evaluated by the Graduate Admissions Committee will be required to submit a Credential Evaluation Report from an approved agency. For further information, contact World Education Service, Inc., Old Chelsea Station, P.O. Box 745, New York, NY 10113-0745, (212) 966-6311; e-mail: info@wes.org

Office of Alumni Relations

Office of Alumni Relations

The Office of Alumni Relations offers numerous programs and services for graduates of all ages: a free lifetime email address, class reunions, regional clubs, Young Alumni Club, corporate clubs, student and alumni mentor programs; and access to the University Club, Robert W. Van Houten Library, and the Fleisher Athletic Center facilities including swimming pool and tennis courts. (Go to the Alumni Resources Page on our website at www.njit.edu/alumni for a complete program and services listing.)

Office of Alumni Relations
New Jersey Institute of Technology
Eberhardt Hall NJIT Alumni Center
University Heights
Newark, NJ 07102-1982
(973) 596-3441, fax (973) 596-3452,
Email: alumni@njit.edu
Website: http://www.njit.edu/alumni

The Foundation at NJIT

The foundation is a privately incorporated resource development organization that supports excellence in teaching, research and public service programs at NJIT. The NJIT Board of Overseers has leadership and fiduciary responsibility for the foundation. The foundation's mission includes fund-raising and, through the Board of Overseers, soliciting private philanthropy on behalf of the university.

Campus Directory

University Mailing Address

New Jersey Institute of Technology
University Heights
Newark, New Jersey 07102-1982

University Switchboard

(973) 596-3000
In New Jersey: 1 (800) 925-NJIT

NJIT on the Internet: http://www.njit.edu

Many academic and administrative departments have home pages on NJIT's Web site and are accessible from the address above.

Main Offices	Extension
Admissions: Graduate and Undergraduate	3300
Alumni Affairs, Office of	3441
Biological Sciences, Division of	5612
Biomedical Engineering, Department of	5268
Bookstore	3200
Bursar, Office of the	3157
Campus Center	3605
Career Development Services, Division of	3100
Chemical Engineering, Otto H. York Department of	3568
Chemistry and Environmental Science, Department of	3595
Civil and Environmental Engineering, Department of	2444
College of Computing Sciences, Office of the Dean	5304
College of Science and Liberal Arts, Office of the Dean	3677
Computer Science, Department of	3366
Computing Help Desk	2900
Continuing Professional Education, Division of	3061
Cooperative Education and Internships, Office of	3100
Electrical and Computer Engineering, Department of	3513
Employment, Student	3474
Engineering Science Program	3228
Engineering Technology, Department of	3228
Financial Aid, Office of	3479

Graduate Studies, Office of	3462
History, Federated Department of	3377
History, Federated Department of Rutgers-Newark	353-5410
Honors College, Albert Dorman	642-4448
Human Resources, Office of	3140
Humanities, Department of	3266
Industrial and Manufacturing Engineering, Department of	3660
Information Systems Department of	3368
Information Technology Program	5764
Intellectual Property, Office of	5825
International Students and Faculty, Office of	3579
Library, Architecture	3083
Library, Robert W.Van Houten	3206
Mathematical Sciences, Department of	5782
Mechanical Engineering, Department of	3331
Microelectronics Fabrication Center (MFC)	5696
New Jersey School of Architecture, Office of the Dean	3080
Newark College of Engineering, Office of the Dean	3226
Physical Education and Athletics	3636
Physics, Department of	3562
Public Safety, Department of	3111
Registrar, Office of	3236
Research and Development, Office of	3429
Residence Life	3039
School of Management, Office of the Dean	3019
University Advancement, Office of	3400
University Communications, Office of	3433

Continuing Professional Education/Online Learning

NJIT's Division of Continuing Professional Education provides enriching career-long learning opportunities through extension programs, Online Learning, graduate certificates, and through its professional development training and corporate customized training.

Professional development programs include short courses, certificates and license reviews, with some leading to the award of continuing education units (CEUs). The CEU is used nationally to document the type, quality and duration of study. In general, a CEU is defined as being equal to classroom hours. Taught throughout the year, individual classes typically last one to five days. Certificates and license review programs can entail a significant number of hours of instruction spanning several months.

All professional development courses can be adapted to meet a particular organization's needs and conducted as a custom-designed training program at a company site. For more than 50 years, NJIT has been designing and conducting non-credit courses that meet technology-based organizations' needs for high-quality, lifelong workforce education. Since 1990, NJIT has trained over 63,000 professionals as part of over 550 training initiatives for 300 different companies conducting business in New Jersey.

For further information contact the Division of Continuing Professional Education, at (800) 624-9850 or http://cpe.njit.edu.

Online Learning

Online Learning offers five graduate degrees (MS in Computer Science, MS in Engineering Management, MS in Information Systems, MS in Management and MS in Professional and Technical Communication), select Graduate Certificates, and graduate courses in many disciplines including communication, computer science, information systems, information technology, humanities, management, and engineering management. Online Learning offerings can be viewed at http://adultlearner.njit.edu/locations/onlinelearning.php.

Online Learning provides students the opportunity to earn college credit through enrollment in online electronic-based courses. These courses are virtual learning communities with instructor-led online classrooms that utilize various technologies such as WebCT or Moodle for presenting course material, online quizzes, asynchronous and synchronous communication. Online courses are flexible and rigorous educational experiences suited to motivated students.

The program's reach is worldwide. Course material can be accessed through the Internet via learning managements systems utilizing multimedia presentations. Material is also downloadable as podcasts through NJIT on iTunes U and other venues as well streaming video, CD ROM and DVD..

Online Learning furnishes a convenient alternative to graduate distance learners and students who have scheduling conflicts. For more information, contact the Division of Continuing Professional Education at (800) 624-9850 or email cpe@njit.edu.

Course Code Explanation

NJIT Courses

ALPHABETICAL CODES

Acct	Accounting
Arch	Architecture
AS	Aerospace Studies
ART	Art
Biol	Biology
BME	Biomedical Engineering
CE	Civil Engineering
CET	Construction Engineering Technology
ChE	Chemical Engineering
Chem	Chemistry
CIS	Computer and Information Sciences
CMT	Construction Management Technology
COOP	Cooperative Education
CPT	Computer Technology
ECON	Economics
ECE	Electrical and Computer Engineering
ECET	Electrical and Computer Engineering Technology
EG	Engineering Graphics
EnE	Environmental Engineering
Entr	Entrepreneurship
Eng	English
ESC	Engineering Sciences
EPS	Environmental Policy Studies
FED	Fundamentals of Engineering Design
FIN	Finance
Frsh	Freshmen Seminar
Hist	History
HRM	Human Resource Management
HSS	Humanities and Social Sciences
HUM	Humanities
IE	Industrial Engineering
IM	Industrial Management

IT	Information Technology
Lit	Literature
Math	Mathematics
ME	Mechanical Engineering
Mech	Mechanics
MET	Mechanical Engineering Technology
Mgmt	Management
MIS	Management Information Systems
MNET	Manufacturing Engineering Technology
MR	Maintaining Registration
Mrkt	Marketing
MtSE	Materials Science and Engineering
OM	Operations Management
OPSE	Optical Science and Engineering
PE	Physical Education
Phil	Philosophy
Phys	Physics
SET	Surveying Engineering Technology
SS	Social Sciences and Policy Sciences
STS	Science, Technology and Society
Thtr	Theatre
TMT	Telecommunications Management Technology
Tutr	Freshman Tutorial

NUMERICAL CODES

Lower Division Courses
Courses numbered between 100 and 199 are normally taken by first-year students.
Courses numbered 200--299 are normally taken by sophomores.

Upper Division Courses
Courses numbered 300--399 are normally taken by juniors.
Courses numbered 400--499 are normally taken by seniors.

The numbers after each course title (e.g., 3-3-4) represent the lecture/ recitation hours, laboratory/ studio hours, and credit hours respectively.

Rutgers-Newark Courses

The current Rutgers-Newark Schedule of Courses can be viewed for cross-registration along with the Rutgers catalog when planning for cross-registration.

Special Programs

BS/MS and Dual Degree Programs

These accelerated dual degree programs permit undergraduates to earn credits toward a master's degree or a doctoral degree. Students in BS/MS take 6 credits of graduate course work in their senior year. These may be counted toward both a bachelor's degree and a following master's degree if enrollment as a graduate student in the master's degree program occurs within two years of completion of the bachelor's degree. After enrollment as a graduate student, those who wish to apply the 6 credits to the graduate degree program should contact the Office of Graduate Studies. Graduate study may be completed full or part-time.

Full-time undergraduate students become eligible to apply for the BS/MS program after they complete at least five courses in their major and have maintained a GPA of 3.0 or better. Students in the Albert Dorman Honors College are pre-approved for the BS/MS program at the time of admission to NJIT but will receive letters about activating their status in BS/MS if their GPA is still above 3.0 and have earned between 57 and 110 undergraduate credits. The activation letter will instruct Honors College students about contacting the Office of Graduate Studies. All other students with a 3.0 or better GPA will have to submit an application for admission to the BS/MS program to the Office of Graduate Studies no later than one year prior to graduation. Applicants must satisfy all university requirements for admission to graduate programs.

Exceptional students may seek to go into an NJIT doctoral program directly through the BS/PhD program and must have a record consistent with university criteria for doctoral study (3.5 GPA or better). Up to 12 graduate credits may be taken in the senior year and applied later toward an NJIT doctoral program. GRE scores are required for doctoral admission.

Several other combinations of Bachelor’s and Master’s degrees exist or are under development. The number of dual-use credits for these combinations may exceed 6 credits in accordance with specific program requirements. An example is the B. Arch/MS in Management program which allows 12 dual-use credits. Information and applications for BS/MS, BS/PhD, and other accelerated dual degree programs can be obtained from the Office of Graduate Studies, Suite 140 Fenster Hall.

BS/PhD Programs

Undergraduate students with GPAs of 3.5 or greater may wish to consider a direct path from completion of the bachelor's degree into a doctoral program. Students approved for this option may be able to take 12 graduate credits while an undergraduate and use these for completion of the bachelor's degree and later toward the PhD program. The Graduate Studies Office will invite students to consider this option after reviewing undergraduate records each semester. GRE scores will be needed for formal admission to the PhD program.

MS/MS and Dual Master's Programs

The MS/MS program allows students to pursue a second NJIT master of science degree on completion of the first and to count two courses (6 credits) from the first degree toward the second. The option must be exercised within two years of completion of the first degree. The approval of the advisors of the two programs is required. The Office of Graduate Studies will direct the registrar on transfer of the two dual-use courses to the second program. The MS/MS program option is not intended for students who have left the doctoral program without completion of the degree. Up to 6 credits may be transferred to the second master's degree from outside NJIT. Thesis, project, pre-doctoral research, independent research and similar courses may not be used.

Several other master’s degree combinations can allow more than 6 credits to count toward both degrees. In general these apply to situations in which the first or the second degree programs requires considerably more than 30 credits. Examples are the master of Architecture and the Master of Business Administration programs. The allowable dual counting of credits for the Master of Architecture in combination with other programs is described in the catalog sections on Architecture and Infrastructure Planning. Subject to specific course approval and the two year time limit for MS/MS as described above, up to 12 credits from a previously completed NJIT MS program in Computer Science, Information Systems, or Engineering Management may be applied toward completion of the 48 credit master of Business Administration degree program. Subject to course approval, up to 18 credits may be used from a previously completed NJIT MS program in Management toward the completion of the 48 credit Master of Business Administration degree program.

The Collaborative Doctorate

This doctoral student option is designed to meet the workforce needs of the knowledge-dependent global economy of the 21st century recognizing the particular requirements of the practitioner. This option can meet the needs of engineers, managers, scientists, military personnel and educators who wish to pursue doctoral studies while employed full-time in the private, public and non-profit sectors.

Academic requirements are the same as for other NJIT doctoral programs but the collaborative nature of the program also allows participants to draw on the combined expertise and resources of the university and their employer. The program includes significant flexibility with opportunities for distance learning and independent study that are integrated with face-to-face classes.

To participate in this PhD program, students should first confer with their employer. Employees should seek a commitment from their employer that will facilitate participation and commitment to an area of research at an appropriate time. A senior researcher or manager may wish to serve on the student's dissertation committee.

Students must meet university requirements for admission to doctoral programs. Prior work, related research activity, publications and honors will be evaluated in addition to traditional academic criteria.

Doctoral students are expected to have been employed in their field for at least five years, and to have completed a related master's degree. They are expected to continue employment until they complete all degree requirements. Annual reviews of progress will be conducted. Students may perform dissertation research at their employer's facilities. Dissertation research can be derived from interests of the student and may be related to their professional activity.

Dissertation research must satisfy university policies. The student's dissertation committee defines residency requirements. It is expected that the employer will permit a concentrated effort on dissertation research. Seminar requirements are also defined by the dissertation committee and may allow presentations or attendance at professional society meetings in place of on-campus seminars. Credit requirements must meet university standards for the doctorate. Course selection is based on previous activities and the current state of knowledge of the student. Dissertation research is expected to investigate or develop an original contribution to science, technology or management. Research may be experimental, analytical, applied or theoretical provided that it satisfies all criteria set by the dissertation committee.

Employers who have a proprietary interest in dissertation research including patent, copyright and technology transfer rights are expected to execute formal agreements with the university before research begins.

Student Exchange/Study Abroad

NJIT offers a number of international exchange opportunities for both undergraduate and graduate students throughout the world. Through established exchange agreements, participants are provided with opportunities to enhance their technological skills, expand their cultural horizons, and gain educational experience from an international perspective. Students gain firsthand knowledge of political, social, and economic systems of a rapidly changing world.

Students may elect to study for one semester or for a full time academic year. NJIT students pay tuition and fees at NJIT and room and board at the host institution. Financial aid may be applied to these expenses.

With the prior written approval of the student's academic advisor, academic credit may be awarded for courses taken while participating in an international exchange program. Some programs may require proficiency in the language of the host country, especially if the language of instruction for course work is not English.

For further information, contact the Office of International Students and Faculty, (973) 596-2451 or visit http://oisf.njit.edu/study_abroad.php.

Community and Public Service

Graduate students may also receive financial support through participation in the NJIT Service Corps. Through experiential learning activities, students link classroom theory and concepts with practical application, contribute their expertise and develop leadership, decision-making and interpersonal skills through involvement with non-profit and governmental agencies and community-based organizations.

- Community Service Work Study: Off-campus employment that is course- and major-related in non-profit and governmental agencies and community-based organizations for eligible Federal Work Study graduate students.
- Housing Scholars: Merit-based, competitive full-time summer employment in community-based organizations that design and develop plans for affordable housing projects around the state. Students pursuing graduate degrees in civil engineering, management, computer science and computer engineering who are U.S. citizens or permanent residents, have completed 6 credits of graduate study, are in good academic standing, have satisfied all other university requirements for financial support, and are approved by their department's co-op advisor are eligible to apply. Architecture students may apply after completing 14 credits of first-year required graduate courses and if they have an overall cumulative 3.2 GPA or above. However, participation cannot begin until 28 credits are completed.
- Service Learning: Course-based, students can register for classes that include a community Service Learning option or register for faculty-monitored independent study that includes a community Service Learning component.

For more information, contact the Division of Career Development Services, Community and Public Service, (973) 596-3100.

NJIT Faculty Research

NJIT faculty conduct extensive research in the university's research centers and laboratories, and in partnership with other universities, industry and government laboratories. Highlights of major research areas are presented here. www.njit.edu/research

ARCHITECTURE

In addition to independent research, architecture faculty are involved in a wide array of interdisciplinary research, mainly through the Center for Architecture and Building Materials Research and the Multi-lifecycle Engineering Research Center.

Areas of Research

Building Technologies and Sciences - Moisture in buildings, building materials, energy transfer through building envelopes, conservation and passive solar heating, building systems integration and building economics.

Computer-Aided Architecture - Use of computers in architectural practice, modeling and simulation, computer application in architectural design, and data structures and graphic representation.

History and Theory of Architecture - Architectural theory and criticism, history of architecture since 1750, urban history and cultural geography, literary themes in architecture, and contemporary art and architectural criticism.

Housing Studies and Urban Design - Housing for new household types, public policies in design arts, technology and architectural design, social meaning of building form, housing environments, community revitalization and economic development.

Urban Infrastructure Planning - Interdisciplinary project planning and design, infrastructure technology and design principles, public space infrastructure, history and theory of urban infrastructure, and financing and implementation of infrastructure projects.

BIOLOGY

Faculty in Biology are involved in several federally funded independent research projects in laboratories housed in the Department of Biological Sciences at Rutgers-Newark and through collaborations with other institutions.

Areas of Research

Neuroscience - Role of synaptic dynamics, such as short-term depression and facilitation, to the generation and control of oscillatory neuronal activity. Study of mechanisms of neuronal plasticity and homeostasis that determine the excitability and electrical activity of neurons and simple neural networks. Electrophysiology, computer modeling, molecular biology, and imaging techniques are used.

Developmental Neurobiology/Neuroimmunology - The role of prenatal inflammation in the control of brain development with particular reference to the etiology of autism.

Ecology and Evolution - Dynamics of populations, communities, and other complex systems. Patterns of extinction and invasion in space, time, and evolutionary history. Theory and practice of creating and restoring ecosystems. Mathematical tools for conservation.

BIOMEDICAL ENGINEERING

NJIT's interdisciplinary biomedical engineering faculty are involved in research and development in collaboration with the following institutions:

Columbia College of Physicians and Surgeons
Hershey Medical Center
Kessler Institute for Rehabilitation
Saint Barnabas Medical Center

UMDNJ-New Jersey Medical School
UMDNJ-New Jersey Dental School
Veterans Administration Medical Center in East Orange

Areas of Research

Mechanical Engineering - In the area of biomechanics, research is ongoing in knee joints, heart valves, spinal disks, spinal fixation devices and a quantification device for lower back pain. Biomaterials research focuses on artificial ligaments and resorbable fracture fixation materials.

Electrical Engineering - Researchers in biomedical signal processing are developing electrocardiogram analysis as a tool for diagnosing and treating stroke disorders and neuromuscular disorders. Other signal processing research involves electroencephalogram analysis in treating epilepsy and electromyogram analysis in fatigue studies.

Chemical Engineering/Chemistry - Studies involve use of membranes for controlled-release of pharmaceuticals, protein separation using affinity chromatography, molecular modeling of drug-receptor interactions and mixing and mass transfer phenomena in bioreactors.

CHEMICAL ENGINEERING

The chemical engineering research programs are closely associated with these centers:

Center for Membrane Technologies
Center for Engineered Particulates
Otto York Center for Environmental Engineering and Science
Polymer Engineering Center

Areas of Research

Particle Technology - Formation of coated particles with a layered structure – Design of particles (including nanoparticles) with controlled size and/or morphology – Formation of composite particles – Fluidization studies and technologies. Research is being conducted in excellent facilities with capabilities for dry particle processing, supercritical fluid processing, particle size reduction, and flow visualization. For their analytical and characterization needs, researchers use a new state-of-the-art electron microscopy facility equipped with a field emission scanning electron microscope, an energy dispersive X-ray spectroscope, and an energy transmission electron microscope. Research in particle technology is being supported by a number of significant grants from federal, state, and industrial sources.

Polymeric Materials/Polymer Physics - Development and characterization of polymer composites for membrane applications – Smart coatings for green manufacturing – Polymerization in ionic liquids – Biopolymeric scaffolds for biomedical applications – Energetic materials. Research is being conducted in excellent facilities and in close collaboration with the Polymer Process Institute that is internationally known for its expertise in reactive processing, mixing and compounding, thermoplastic foam processing, and materials characterization. Research in this area is being supported by grants from federal agencies.

Membrane Technology - Membrane-based processes for gas/gas, gas/liquid, and solute/liquid separations – Technologies integrating reaction/separation processes – Novel membranes using composite and nanomaterials – Bioseparations. Research is being conducted in excellent facilities. Support comes through various federal and industrial grants, as well as from NJIT's sponsored chair in Membrane Separations and Biotechnology.

Pharmaceutical Engineering- Crystallization – Separation processes, including bioseparations – Membrane technologies for controlled drug release – Experimental and computational studies on mixing and its effects on product purity and distribution – Particle (tablet) coating. Research is being conducted in well-equipped laboratory facilities. Support comes through industrial grants and contracts.

Other Areas - Mathematical modeling of reaction and separation processes – Computational thermodynamics – Neural networks in homeland security applications – Reaction engineering – Hazardous waste treatment.

CHEMISTRY AND ENVIRONMENTAL SCIENCE

The Chemistry and Environmental Science research programs are closely associated with these centers;

Otto York Center for Environmental Engineering and Science

Areas of Research

Environmental Studies - Research is ongoing in policy studies, health, coastal geomorphology, economics, ethics, history, communications and education. The department hosts the nationally acclaimed environmental publication, Terra Nova. Hazardous Waste Treatment and Waste Minimization -Thermodynamic analysis of combustion and pyrolysis processes, catalytic combustion, acid gas treatment, sampling & analysis of organic and inorganic pollutants, treatment of gaseous pollutants by corona discharge, novel routes for solvent-less chemical synthesis.

Biochemical Processing -Chromatographic separations, molecular modeling of enzyme mimics and drug-receptor interactions.

CIVIL AND ENVIRONMENTAL ENGINEERING

Research in civil and environmental engineering is conducted within the department and in these NJIT centers:

Otto York Center for Environmental Engineering and Science
International Intermodal Transportation Center

Areas of Research

Geoenvironmental Engineering Laboratory - This state-of-the-art facility was established with support from a $1 million National Science Foundation (NSF) grant, which was matched with more than $2 million from NJIT. The laboratory provides research support for geoenvironmental projects such as soil decontamination using biological, chemical and/or physical means; modeling of contaminant transformation and transport; and the testing of waste treatment, solidification, and stabilization and containment systems. The equipment includes an environmental scanning electron microscope (ESEM), X-ray fluorescence and X-ray diffraction spectrometers (XRF/XRD), GC/MS and SFE, capillary electrophoresis (CE), UV-VIS, FT/IR, respirometers, particle size analyzer (PSA) and hydraulic conductivity apparatus.

Geospatial - Members of the CEE faculty are engaged in geospatial modeling, a powerful tool for environmental and geographic analysis. Geospatial analysis is being applied on a number of projects involving estuarine water quality, transportation and congestion studies, coastal construction techniques, and hazardous waste site investigation. In addition, remote sensing techniques are being applied to global change studies investigating primary productivity and carbon cycling. Recent research sponsors include: NASA, NOAA, and NJDOT.

High Performance Concrete Laboratory - Equipped with funds from NSF, this laboratory is capable of testing very high strength concretes under uniaxial as well as triaxial states of stress. The primary testing system is capable of applying up to 1 million pounds of axial load on a specimen in a computer-controlled closed-loop environment. The materials processing component includes two computer-controlled micro-sizers, and fractionators for particle size analysis and categorization of industrial by-product additives to concrete, such as fly-ash, microsilica and blast furnace slags.

Smart Sensors and Nondestructive Testing Laboratory - This laboratory provides means for studying self-sensing systems built into structures to monitor excessive strains, deflections, load distributions, temperature variations and corrosion.

Transportation and Planning - The CEE Transportation Group has carved out a strong research "niche" in the areas of traffic analysis, safety issues, and regional transportation planning, with a special strength in computer simulation and modeling. Another major focus area is improvement of productivity of private industry and public sector entities through the scientific analysis of transportation movements and linkages. Projects are also underway in the area of transportation security and disaster routing. Recent research sponsors include USDOT, FHWA, NJDOT, NJ Transit, and Greyhound.

COMPUTER SCIENCE

Computer science (CS) is about the design and development of computing systems. The discipline is very broad, encompassing theory and applications. Its roots are in mathematics and engineering. CS includes the design, analysis, and implementation of computer algorithms and software systems. Application areas include eCommerce, networking, databases, data mining, firewalls, and web servers.

Programming is but one aspect of CS. Computer scientists solve multifaceted problems. They may develop systems, work with engineers, or lead large software development project teams.

Computer science faculty research interests are in the following areas:

- Algorithms
- Bioinformatics

- Computer Vision
- Databases
- eCommerce
- Operating Systems
- Networking
- Parallel Computing
- Pattern Recognition
- Programming Languages
- Security
- Software Engineering
- Storage Technology
- Web Technologies

INFORMATION SYSTEMS

The departments provide research laboratories with infrastructure and coordination for conducting multidisciplinary research and development. Some key areas that the department focuses on are the technology, health care and financial industries, which require research in software engineering, telecommunications, computing systems, artificial intelligence, database, algorithms, and biomedical and information systems. In addition, the department sustains an interdisciplinary research support environment for biomedical and neuroscience applications, computer engineering, computer-mediated communication, enterprise engineering, health care information systems, manufacturing systems, medical imaging and information systems, microelectronics, as well as other disciplines.

ELECTRICAL AND COMPUTER ENGINEERING

In addition to independent research, Department of Electrical and Computer Engineering faculty participate in research at the:

Center for Communications and Signal Processing Research
Electronic Imaging Center
Microelectronics Research Center
New Jersey Center for Wireless Telecommunications

Areas of Research

Ion Beam and Thin Film Laboratory - Studies focus on processing and properties of materials and structures in the form of thin films. The laboratory has a number of thin film deposition systems, including a state-of-the-art ultrahigh vacuum chamber that permits deposition on atomically clean surfaces. Thin film structures, basic elements of modern microelectronic and optoelectronic devices, are increasingly important in almost all areas of technology. Current research includes metal epitaxy on silicon, modification of surfaces with atomic and cluster ions, and development of novel dielectrics with properties controlled by light beams.

Microwave and Lightwave Engineering Laboratory - Research is ongoing in the areas of microwave device modeling and measurement, computer-aided design (CAD) of microwave components and systems, characterization of RF/microwave/optical systems, monolithic microwave integrated circuit design and testing, numerical electomagnetic codes, analysis design and wire antenna multiscattering in vegetation, experimental and theoretical study of linear and semiconductor surfaces, integrated optics, fabrication and characterization.

Multimedia - Research projects are in the areas of multimedia signal processing and compression, multimedia communications, digital content security and data hiding, Internet delivery of multimedia and many others. The multimedia production and Internet delivery studio, with its state-of-the-art webcasting and DVD authoring platforms, facilitates the use of emerging Internet multimedia technologies for education and learning purposes. More than 30 faculty members and about 40 doctoral students are involved in multimedia research.

Communications and Signal Processing - Recent emphasis on wireless and personal communication systems includes multiuser detection and interference cancellation algorithms, smart antennas and space-time processing. Other areas include adaptive systems and arrays, blind signal separation and equalization, synthetic aperture, radar processing and calibration, source encoding and synchronization, detection and estimation and ATM networking. Signal processing research covers wide areas of nonlinear and adaptive signal processing and algorithms, one- and multidimensional signal processing, image-video coding, subband and wavelet transforms, QMF-wavelet filters, and advanced DCT algorithms.

Computer Engineering - Computer engineering faculty members are conducting research in these areas: test generation; fault simulation; design for testability; built-in self-test; data compression; CAD; computer architecture; design verification; computer reliability; fault tolerance; interconnection in high speed digital circuits; microprocessing; Internet-based computer-aided instruction; interconnection networks; multiprocessor systems; nonlinear optimization techniques; genetic algorithms; neural networks; infrared imaging; computer networks; routing in ATM networks; LANs; CEBus; BACnet; parallel computing systems; parallel algorithms; computer vision; Petri nets; discrete event systems; embedded control; computer integrated manufacturing and networking intelligent automation; information display; robotics; ATM switches; and VLSI.

Electronic Imaging - Special filters are widely used in the characterization of chemical or biological systems. Much information on these systems can be deduced from spectral analysis of transmission and reflection of the samples, especially in the infrared (IR) spectral region. Researchers examine tunable filter systems, such as wavefront division interferometers (WDI), together with a two-dimensional IR imager. Such systems are based on multiplexing procedure, which minimizes optical loss. The resolution and the extent of the filtering process is determined by novel electronic processing methods. The goal is to develop a hand-held instrument to monitor harmful molecules in a remote or a nearby environment.

Nonlinear Nanostructures Laboratory - Nanotechnology is a fast-growing interdisciplinary area. While many thin film and granular technologies are within the nano scale, nanotechnology is related to the "added value," i.e., the functionality, of nanostructures. The basic "building block," the nanocluster, is an ultrafine-grained solid with a high percentage of atoms at the grain boundaries. The nonlinear optical properties of nanoclusters are of intense interest for use in optical switching and IR sensing. The confinement of the electronic wave function to small dimensions results in an enormous refractive index change. Experiments are under way on Si nanoclusters grown by either laser ablation or ion implantation.

Wireless Telecommunications - Research activities are distributed among four focus areas: wave propagation models for delivery of advanced broadband services and R.F. engineering of novel devices and systems for wireless digital communications technologies; wideband multiple access systems, and multiuser technologies including adaptive equalization and space-time adaptive processing; wireless networking including architectures, wireless ATM, geolocation, teletraffic modeling, resources allocation; and services, applications and wireless technology transfer.

HISTORY

The Federated History Department of NJIT and Rutgers-Newark conducts research in a wide variety of historical fields, regions and periods. Faculty in the department have obtained many grants from government and private foundations such as the National Endowment for the Humanities; the National Science Foundation; the John Simon Guggenheim Memorial Foundation; the Smithsonian Institute; Fulbright Fellowships; and the Spencer Foundation. The department produces two periodicals:

Eighteenth-Century Scotland
Horn of Africa

Areas of Research

History of Technology, Environment and Medicine - American environmental history; urban environmental history; the social and cultural history of medicine and technology, history of print culture; film, television and history; and technology and warfare.

American History - Social, cultural and diplomatic history; the history of women and the family; African-American history; legal history; public history.

World History - Comparative history; intellectual, cultural, and political history; modern Africa; , and China; Latin America and the Caribbean; medieval Europe and Eurasia; modern France, Germany, Spain and Britain.

HUMANITIES

The department integrates humanities disciplines into NJIT's technological curricula for the purpose of understanding the cultural, social and scientific contexts informing contemporary culture. Special emphasis is given to research in the study of science, technology and society; the study of communication; the study of health policy; professional ethics; and the study of multicultural and international literature. The department is committed to drawing on the humanities as a coherent model for examining human society.

Center for Architecture and Building Science Research
International Intermodal Transportation Center

Areas of Research

Professional and Technical Communication- Multimedia design, usability, technology transfer, writing assessment, environmental communications, technology-enhanced teaching and learning, history of technical communication, electronic publishing, digital communications and design.

Professional and Environmental Ethics - Philosophy of technology, ethics of engineering & technology, nature, technology, music in philosophy, literature and practice, philosophy of scientific explanation.

Modern and Postmodern Literature and Cultural Studies - Poetry, interdisciplinary medieval studies, aesthetics, textual scholarship, electronic media and English studies, computer writing and criticism, hypertext pedagogy, American studies.

Second Language Acquisition, Grammar, Gender & Diversity Issues

INDUSTRIAL AND MANUFACTURING ENGINEERING

The Department of Industrial and Manufacturing Engineering has a significant and diverse research program that includes areas such as industrial and operations research, design for manufacturing, quality, assembly and concurrent engineering, robotics, global networking, logistics and simulation issues of small and medium-sized companies, multimedia, environmental and health/safety and medical engineering. Research also is affiliated with these major NJIT research centers:

Center for Manufacturing Systems
International Intermodal Transportation Center

Areas of Research

Industrial Engineering, Systems and Operations - Research includes the development of control and scheduling algorithms for the optimization of container terminal operations, global networking and logistics operations for small, medium and large corporations, the impact of telecommuting strategies on traffic flow, engineering system modeling and design tools, distributed virtual laboratory networks between research groups, the R&D of quality systems, quality control and management systems.

Manufacturing Systems and Mechatronics Engineering - Focus is on robotics, robot cell design, flexible computer-integrated manufacturing, system integration of automation systems, flexible assembly system modeling, integration, implementation, non-contact sensing and inspection, CAD/CAM integration, servo pneumatic positioning and sensor technology.

Concurrent/Simultaneous and Total Lifecycle Engineering - This new research field includes the development of new methods and toolsets for small batch luxury automobile manufacturers (such as Rolls-Royce Motor Cars), and general methods, tools and technologies for design for manufacturing, design for quality manufacturing, and assembly and maintenance systems.

Medical, Environmental, Health and Safety Engineering - Activity in this area is increasing. Main areas include the assessment of the realistic impact of environmental factors on productivity, devices and methods for the prevention of repetitive motion injuries, microrobotic manipulators for human artery cleaning, and new medical devices coupled with simulators and expert systems that can be used for interacting with the human body and other medical applications.

Multimedia, Simulation and Virtual Reality Modeling - Research activities are spread between discrete event and continuous system modeling and simulation and areas such as graphical modeling of workcells, object-oriented simulation coupled with AI, engineering multimedia developments for the study of servopneumatic positioning, multimedia for total quality management and the ISO9001 standard, flexible automation, concurrent engineering and the virtual reality simulation (and rapid prototyping) of complex electromechanical products and their manufacturing/assembly processes
.

MANAGEMENT

In addition to independent research, School of Management faculty are pursuing research conducted in affiliation with these centers:

Center for Manufacturing Systems
International Intermodal Transportation Center

Areas of Research

Entrepreneurship and Small Business - Assessment of emerging technologies, economics, employment growth, theories and practice in relation to entrepreneurship and private enterprise.

Building Production and Management - Building efficiencies, organization of international construction, environmental technology management, and industrial ecology systems.

Behavioral Science and Organizational Theory - Organizational design and development, organizational behavior, occupational and organizational socialization, legal and ethical issues, public administration, social perception, leadership, attachment and commitment processes in organizations, and transportation behavior.

Economics and Finance - Mathematical programming and multicriteria decision making in financial management, portfolio analysis, emerging international capital markets, applied corporate finance, financial economics, public finance, international competitiveness of U.S. economy, and international economic/financial relationships.

Human Resources Management - Managing new technology, labor management relations, public policy and technological change, and tasks and unit level technologies.

Information Systems Management - Policy analysis, computer auditing, control and security, interface design, systems evaluation, technological forecasting and assessment, management information systems, management and social impacts of computer and information systems, group decision support systems and database analysis.

Information Systems Auditing - Operational auditing, internal auditing.

Marketing Management - Marketing research, new product management, consumer behavior, international marketing, marketing technological innovation, mathematical programming and multicriteria decision making, strategic management, sales management, enhancing global competitiveness and technology transfer, internet marketing.

Operations Management - Project management, industrial quality control, production planning, management of manufacturing systems, and mathematical programming and multicriteria decision making.

Corporate Law and Ethics - Employment law, legal and ethical issues in business, international legal environment of business, job security and unlawful discharge/unjust dismissal.

MATHEMATICAL SCIENCES

The research interests of the faculty focus on the development and use of mathematical and computational tools for solving scientific, technological and industrial problems. The Center for Applied Mathematics and Statistics promotes and represents the research interests of all NJIT mathematical sciences faculty.

Areas of Research

Acoustics and Signal Processing - Faculty involved in acoustics study both the forward and inverse problem of sound propagation in the ocean. Work on the forward problem aims for accurate and computationally efficient solutions of the wave equation for complex oceanic environments. Research on the inverse problem addresses the development of algorithms for source localization and geoacoustic inversion, combining array and statistical signal processing concepts and waveguide physics.

Electromagnetics - The electromagnetics group is concerned with the scattering of electromagnetic waves by complex structures and materials. Methods used include modeling, asymptotics and numerical analysis. Applications to material processing are an important aspect of this work. Current and recent projects include the analysis of microwave sintering of ceramics, including thermal runaway and hot-spot dynamics, electron beam welding of ceramics, nonlinear pulses in optical fibers and the development of numerical methods for Maxwell's equations in free-space and in complex, dispersive media.

Fluid Dynamics and Materials Science - Several faculty are involved in the development of analytical and computational methods and their application to problems arising in fluid dynamics and materials science. A particular area of emphasis is the study of the dynamics of interfaces between two fluids or a fluid and a solid. Research in this area includes liquid jet breakup, bubble dynamics, crystal growth, and flame front propagation as well as related problems in combustion and detonation. Other research areas include stability theory, particulate flows, thin films, nanofluids and electrohydrodynamics..

Mathematical Biology - The majority of the researchers in this group work on experimental, computational, and mathematical neuroscience with particular interest in synaptic dynamics and their role in generating and controlling oscillatory neuronal activity, neuronal networks with application to visual cortex, and electrical activity in excitable cells. Research in developmental biology focuses on the study of patterning in biological systems. Another focus area is biological fluid dynamics with emphasis on microvascular blood flow and oxygen delivery. A new developing area in the Department is mathematical ecology and evolution.

Statistics - Faculty research areas and interests include applied probability modeling, statistical inference, statistical reliability theory and applications, survival analysis and applications in biostatistics, time series analysis and forecasting, signal processing, design and analysis of industrial experiments.

MECHANICAL ENGINEERING

The scope of research in the Department of Mechanical Engineering is broad. Projects are carried out within the department's laboratories as well as in collaboration with the following centers:

Center for Manufacturing Systems
New Jersey Center for Engineered Particulates
New Jersey Center for Microflow Control
Polymer Engineering Center

Areas of Research

Activated Metallic Materials and Combustion - Main objectives are to develop improved metal-based components for propellants, pyrotechnics, and explosive formulations. Mechanisms of combustion and ignition for metals are investigated experimentally and theoretically. New nano-structured and nano-crystalline materials are synthesized using mechanical alloying and arrested reactive milling. Materials are characterized using thermal analysis, electron microscopy, x-ray diffraction, and other techniques. Combustion and ignition processes are studied using unique experimental facilities, including lifted laminar flame aerosol burners, laser ignition apparatus, constant volume explosion apparatus, and heated filament ignition setup.

Bearings and Bearing Lubrication - Research areas include design of hydrodynamic, hydrostatic, rolling element bearings and novel designs of unique bearings, such as composite bearings. Also, the role of bearings in rotor dynamics is investigated. Students are engaged in the design and development of testing machines, which include computer data acquisition, for friction and wear, and for testing bearing materials and lubricant additives. Research is conducted in modeling and compensation of friction in control systems for precise motion control, stick-slip friction, friction-induced vibrations and antilock brakes. Work is conducted in modeling and measurement of dynamic friction in bearings, clutches, vehicle breaks and tires. Other research interests are rheology of lubricants, including viscoelastic and synthetic lubricants.

Computational Fluid Dynamics -- The laboratory for computational fluid dynamics is equipped with state-of-the-art computer equipment consisting of an SGI compute server (Origin 2000), four SGI 02 workstations and PCs. The purpose of the laboratory is the understanding, prediction and control of many fluid flows in the laminar, transitional and turbulent regimes. High performance computing, advanced data analysis, hydrodynamic stability theory and control theory are used for this purpose. Research includes boundary layer and channel flows, wake flows, film flows, ocean water waves and propagating flames. Another thrust area is the numerical simulation of multiphase flows such as particulate and bubbly flows.

Electro-Hydrodynamics Research - The research aims at developing a fundamental theory of the synergism of electric- and shear-induced phenomena in suspensions and to examine the accuracy of predictions regarding the effects of high-gradient strong fields on the particle motions and aggregation. Understanding of these phenomena is used toward the control and manipulation of suspension flows. Applications include the development of a novel filtering technology for online cleaning of in-service fluids in shipboard equipment.

Engineered Particulates - Synthesis of nano-particulates and structured particle composites for applicants such as pharmaceutical, food, electronic and energetic materials. Modeling and development of novel techniques for dry particle coating, film-coated particles, granules and engineered particulates. Nano-particle mixing and nano-particle fluidization. Supercritical fluid processing for particle mixing, coating and particle formation. Particle transport and handling, flow and delivery from hoppers. Numerical simulations and particle-particle interactions.

Granular Flow - The goal of this research is to develop predictive models of flowing granular materials critical to the design of efficient and reliable solids handling systems prevalent in the industrial sector (chemicals, food, agriculture, pharmaceuticals, minerals, energy, materials, munitions, and electronics), as particulates are universally found in most products either as raw materials or as the final product. Investigations aimed at understanding observable bulk behavior are carried out as part of the Particle Technology Center and made through realistic dynamic computer simulations, analytical modeling and physical experiments. Paramount is the connection between microstructure evolution and transport properties. Phenomena of interest include hopper flows, vibrated beds, shearing, percolation in packed beds, and segregation.

Multiphase Flow Research - Research objectives are to develop a fundamental knowledge of hydrodynamic and interfacial interactions of phases in multiphase flows as well as develop advanced technologies related to particulate multiphase flows. Projects include drag forces and collisions of interacting particles in viscous flows, fibrous filtration of particulate-laden flows, membrane separation, wet scrubbing, liquid jet evaporation in gas-solid suspension flows, and filtration applications using rotating fluidized beds.

Non-Newtonian Fluid Dynamics - A knowledge of non-Newtonian fluid dynamics is essential in many industries, including those involving plastics, paints, suspensions, oils, lubricants, rubber and detergents. Projects include theoretical and computational analyses of the popular constitutive equations for a range of flow problems, e.g., injection molding, porous media flows, viscoelastic particulate flows, free-surface flows as well as the modeling of non-Newtonian fluids. Both finite element and finite difference methods are used to solve the governing equations in two and three dimensions.

Pattern Recognition/Cluster Analysis/Image Processing Research - This research focuses on the use of "soft computing" methods for various applications: fuzzy clustering algorithms, robust clustering, clustering of relational data, application of robust statistical techniques in cluster analysis, shape detection in noisy data, generalization of fuzzy clustering algorithms for multicharacteristic shape detection, such as hyper-spherical/ellipsoidal shells as cluster prototypes, or adaptive clustering and cluster validity issues. Clustering methods and evidence collection techniques are used for lines, curves and arc detection in digital images. These algorithms are also used in reverse engineering through development of CAD models from image sensor data. Machine vision applications are also studied.

Plastics Engineering - The New Jersey Bell Plastics Laboratory is well equipped with a wide range of state-of-the-art plastics processing and forming equipment, supported by analytical testing capabilities. The laboratory is used for a wide range of research and development activities. Activities include re-engineering of commingled waste plastics, studies on self-reinforced composites, and combined parametric and experimental studies to develop models to explain the interrelationships between product properties and process parameters for injection molding processes. As part of the research activities, students use CAD and computer-aided engineering (CAE) tools in the design, analysis and manufacture of plastics products.

Rapid Intelligent Manufacturing and Prototyping - The research aims to generate fundamental knowledge and develop advanced technologies to enable the design and manufacture of products to be done more quickly and cost-effectively. Research projects include next-generation CAD/CAM systems with virtual reality, rapid tooling and manufacturing, rapid freezing prototyping, and environmental performance analysis of solid freeform fabrication processes.

System Integration and Robotic - The research applies theoretical analyses, simulations and experiments to the design and control of mechanical and electromechanical systems (mechatronics). Kinematic and dynamic modeling, system calibration and optimization techniques are used to enhance system performance. Projects include development of design, planning, and control methodologies for effective use of parallel kinematics machines and development of ultrafine motion technologies to enable fast, flexible automated assembly of optoelectronics systems.

Waterjet Technology Research - The Waterjet Research facility develops technologies for the use of high- and super high-speed fluid jets for manufacturing complex components from hard-to-machine materials, cleaning and grinding of sensitive surfaces, and bio-medical applications. Projects include numerical modeling of fluid jets, developing expert systems for jet-based processing, precision cleaning of complex surfaces, using ice for machining applications, and using impact and explosion to form jets.

PHYSICS

Interdisciplinary applied physics research is conducted in collaboration with faculties of NJIT, Rutgers-Newark, Rutgers-New Brunswick, and UMDNJ in areas such as electrical engineering, chemistry and chemical engineering, materials science, industrial and manufacturing engineering, biological sciences and geological sciences. Cooperative research efforts are under way with the National Solar Observatory, Bell Labs-Lucent Technologies, U.S. Army Research Lab, and other industrial and federal research laboratories. Research also is conducted at these major NJIT centers and NJIT-maintained facilities:

Microelectronics Research Center
Center for Solar Research
Big Bear Solar Observatory
Owens Valley Radio Observatory

Areas of Research

Device Physics - Research at NJIT is under way in silicon microfabrication, micromachining and fusion bonding for conventional and novel microelectromechanical (MEMS) device applications, metal-insulator-semiconductor device structures and rapid thermal processes in silicon integrated circuits. Studies at Rutgers-Newark involve sensors for biophysics applications. Facilities for this work include state-of-the-art metrology electrical characterization equipment, cryostats for very low temperature measurements and access to NJIT's Class 10 cleanroom with full process capabilities for 6-inch silicon wafers.

Materials Research - Molecular beam epitaxy (MBE) of III-V semiconductors is used to fabricate various photonic devices, digital integrated circuits and optoelectronic integrated circuits. Research on the synthesis and characterization of chemical vapor deposited (CVD) and physical vapor deposited (PVD) silicon-based dielectric films is ongoing. Optical characterization of materials includes visible and far-infrared spectroscopy, photoconductivity, photoluminescence, spectral emissometry and thermal modulation spectroscopy. Materials studies include photoinduced superconductivity in High-Tc materials (i.e., YBCO) and optical properties of SiC, GaN and porous silicon.

Ultrafast Optical and Optoelectronic Phenomena - Terahertz spectroscopy is used to study ultrafast carrier dynamics in semiconductors. Other areas include ultrafast photodetectors, ultrashort nonlinear pulse propagation in optical fibers and planar waveguides, ultrafast photophysics of semiconductor and quantum well devices, and ultrafast optical switching in novel nonlinear materials. The Ultrafast Optics and Optoelectronics Laboratory is capable of producing ultrashort laser pulses of 100 femtosecond duration over a tuning range of 230-nm (ultraviolet) to 2300-nm (infrared).

Optical Science and Engineering Education - The National Science Foundation (NSF) is supporting the development of an optical science and engineering curriculum with optics research collaboration among NJIT's physics, electrical and computer engineering, and chemical engineering, chemistry and environmental science departments.

Solar Physics - The Center for Solar Research operates two world-class observation facilities: Big Bear Solar Observatory (BBSO) and a dedicated array of solar radio telescopes at Owens Valley Radio Observatory (OVRO), both in California and both formerly managed by Caltech. Research focuses on the development of state-of-the-art instruments for solar observations; the study of solar magnetic fields and extended atmosphere; and the study of solar activities and their terrestrial effects. Solar physics interacts closely with other research areas at NJIT, including device physics, image processing and atmospheric chemistry. With the acquisition of BBSO and OVRO, the NJIT physics department has one of the best-known university-based research efforts in solar physics in the world.

Imaging Technology - A developing initiative builds upon NJIT's nationally recognized work in infrared imaging technology, applying it to the promising area of infrared solar physics. State-of-the-art infrared imaging devices are being developed and tested as part of an IR telescope system to be installed at Big Bear Solar Observatory.

Surface Physics - This area focuses on research on laser-induced physical processes on surfaces. One area of current interest is laser-stimulated hydrogen ion desorption from a hydrogenated Si (100) surface. Another area is the interaction of spin polarized atoms with surfaces.

Discharge Physics - Research on glow discharges for plasma processing of semiconductors and other materials is being carried out under an NSF-sponsored program. Related studies on VUV (vacuum ultraviolet) light sources and unique laser pumping schemes are also under way.

Applied Laser Physics - With industry funding, research is being carried out at Rutgers-Newark on laser processing of materials with low thermal conductivity. The physics involves heat transport, laser properties and material properties. New instrumentation to resolve variations in temperature in time and space is being developed. This work is in collaboration with the Department of Ceramics and Engineering in the Rutgers College of Engineering in New Brunswick.

Biophysics - An NSF-funded research training group program in collaboration with the Rutgers-Newark's chemistry department, the federated biological sciences department and Rutgers-Newark's Center for Molecular and Behavioral Neuroscience provides training and research opportunities in frontier interdisciplinary biophysics areas including spectroscopy, signal processing and biomedical instrumentation. One area of great current interest involves the use of stable isotope tracers for medical diagnostics. Another is the development of microsensors to probe nonlinear auditory response in mammals.

TRANSPORTATION

The interdisciplinary program in transportation through the Institute for Transportation involves about 30 NJIT faculty and 25 NJIT graduate students in its research program activities. Congressional legislation requires that TELUS (Transportation Economic and Land Use System) be customized and deployed for use throughout the United States. TELUS is a computerized system for tracking the progress of transportation projects and assessing their economic and land use impacts and interrelationships. Institute research activities are associated with the following centers at NJIT:

International Intermodal Transportation Center
North Jersey Transportation Planning Authority

Areas of Research

Mitigation of Increased Highway Congestion - resulting in reduced productivity, increased gridlock, pollution and fuel consumption.

Advanced Traffic Control and Engineering - are requiring new systems for traffic management and new engineering and management techniques to expand the capacity of the transportation infrastructure.

Intelligent Transportation Systems - resulting in more efficient use and increased safety for the existing transportation infrastructure.

Increased Competition - for railroad, truck and air carriers because of deregulation. Carriers must further reduce costs while providing high-quality service and consider that a smaller number of large companies may dominate the market.

Globalization - of markets requiring the ability to efficiently move goods over long distances often using multiple carriers. Several large transportation consortia are likely to establish themselves in world markets in the next decade.

Reduction in Public Assistance to Transportation - and the high social and political costs of building new transportation systems placing a tremendous emphasis on improved management of existing facilities, thereby requiring the introduction of innovative financing practices and larger participation from the private sector.

Increase in Social Awareness - demonstrated by society's concern with the energy consumption of scarce fossil fuels and the negative by-products of transportation such as noise, air and water pollution.

Streamlining the Logistics Process - to reduce transportation and inventory costs through the expedition of raw materials from origins to production plants, semi-finished products between plants and finished products to consumers.

Intermodalism - to combine the best of two or more modes of transportation for the coordinated movement of people or freight. The economy of line haul with the flexibility of another mode for local collection and distribution is an example.

Aircraft Routing - to reduce aircraft noise and to improve air traffic operation.

Financial Support

Financial Support and Graduate Awards

Various financial support and graduate award options are available to NJIT graduate students. Financial support comes from either NJIT internal funds or from external sources. Information on need-based support is detailed on the office of Financial Aid Services Web site. Eligibility and selection criteria are summarized in the following table for both need-based and merit-based support. Funds for these are not guaranteed.

Type of Support	Contact	Who is Eligible
Federal Loans	Financial Aid 973-596-3479	US citizens, permanent residents; students enrolled at least half time, based on financial need; must file the Free Application for Federal Student Aid.
Private Loans	Financial Aid 973-596-3479	US citizens, permanent and non-resident students enrolled at 3 credits; need is not a factor and filing a Free Application for Federal Student Aid (FAFSA) is not a requirement.
Industry Co-op	Career Development Services 973-596-3100	Full-time students, based on position availability; master's students; doctoral students only by exception with approval by the dean of graduate studies
Work-study	Financial Aid 973-596-3479	US citizens, permanent residents, international students, full-time and part-time students, based on position availability.
Scholarships, Fellowships, Grants	Graduate Studies 973-596-3462	Based on funding source, full-time students, often supporting under-represented groups.
Assistantships	Graduate Studies 973-596-3462	Full-time, based on academic merit or priorities and on funds available.

NJIT AWARDS

Close to 400 teaching, research and graduate assistantships, based on academic merit, are awarded to qualified full-time students.

Prospective students can apply for financial support by using the Application for Admission to Graduate Study. Prospective students seeking financial support are urged to apply no later than January 15th for the fall semester of the following academic year and October 15th for the spring semester of the current academic year. Applications received after these dates may be placed on a waiting list.

Prospective students seeking financial support should indicate their interest on the admissions application form. Continuing students seeking need-based support should contact the Office of Financial Aid. Continuing students seeking merit-based financial support should contact the Office of Graduate Studies. GRE and GMAT scores as required for admission to graduate study at NJIT are acceptable for consideration of applications for merit-based support. It is noted that Master's students whose last degree was from an institution within the United States are not required to supply GRE or GMAT scores as a general university requirement for admission and need not additionally supply these for financial support consideration unless specifically requested by the program or funding source. However, specific Master's programs within NJIT may require GRE or GMAT scores for admission consideration to the specific program. All Master's program applicants whose last degree was from an institution outside of the United States and all PhD program applicants are required to provide GRE or GMAT scores as a requirement of the admissions process.

Competition for financial support is strong and only successful applicants are notified. Teaching, research, and graduate assistantship offers may include full or partial tuition, a stipend or both. Additional funds for the summer may be awarded.

Assistantships

Each year there are more than 400 teaching and research assistantships in academic and research departments, which are funded internally or externally. Teaching assistants conduct recitation, discussion, laboratory, or other sections of elementary or intermediate undergraduate-level courses, under supervision of permanent faculty. These duties are considered part-time work and typically include six to nine class contact hours per week. Research assistants conduct research under the supervision of NJIT faculty. Non-academic departments also sometimes employ students as graduate assistants. Duties range from academic support to day-to-day operation of administrative offices.

Presidential Fellows
A limited number of fellowships with $24,000 stipends ($2,000 per month) are offered to outstanding doctoral students. Funding for room and board, research activities, supplies, travel, and other supplemental needs can supplement the stipend. Full tuition and fee support is provided.

Provost Fellows
A Provost Fellowship provides a $2,000 tuition award each semester to qualified students at the time of admission to full-time study toward a Master's degree; students who are already admitted are not eligible. To be considered for a fellowship, applicants must meet the following criteria: completion of an earned baccalaureate degree from an accredited college or university; achievement of an undergraduate cumulative GPA of at least 3.0 (or its equivalent); and submission of official GRE or GMAT results.

A Provost Fellowship is sustainable for a maximum of three consecutive semesters of full-time study (four semesters for students enrolled in the MBA program; six semesters for students enrolled in the Master of Architecture program) in a student's initial Master's program at NJIT. Students receiving a fellowship must maintain a cumulative graduate GPA of 3.25 or better, and make satisfactory progress toward the Master's degree during enrollment at NJIT. Academic records will be reviewed at the conclusion of each semester to determine a student's eligibility for the subsequent semester. Students who wish to pursue a second master's degree at NJIT and applicants for doctoral study are not eligible for this award.

The Office of Graduate Admissions will review all admitted students who satisfy the criteria. Recipients will be notified in writing. No special application is required.

Grader
A grader is appointed for part-time service and grades course work under the direction and supervision of a faculty member. Graders may either be hired on an hourly basis through the Office of Student Employment, or through the Office of Graduate Studies. Compensation is based on hourly rates established for this position.

Special Awards
Special awards for service may be established each year. Students should contact the Office of Graduate Studies for further information.

Non-Service Fellowships or Scholarships
Private, state, federal or foundation awards that do not require service to NJIT may supplement service-based awards.

Unemployed or Displaced Workers
Students receiving tuition support because of an unemployed or displaced worker's program are alerted to potential loss of this form of support because of any salary or stipend that may be received for any form of on-campus or off-campus employment.

Stipend Support Levels

Teaching/Research Assistant (not supported by grants):

Master's students	$ 9,000	9 months at $1,000/month
Doctoral students	$ 18,000	9 months at $2,000/month

Stipend support levels are re-evaluated each year and the levels reported above are minimum values for 20 hours per week of service for 9 months over the fall and spring semesters.

Research Assistants (on external funds from grants)

Doctoral Students	$26,000 (12 months)

Partial awards are possible for all categories of awards. Award periods are scheduled for two consecutive 4 and ½ month periods for 9 month awards and any following summer periods

Maximum Annual Support
While NJIT does allow multiple sources of support for individual students, there is an annual limit established each year for the maximum amount of support that an individual student may receive from all sources. The limit is established at a reasonably high and competitive level in comparison to reported maxima provided by a number of federal support programs. Students who are receiving support from outside NJIT must report this to

their graduate program advisor and to the Graduate Studies Office to assure their not exceeding NJIT limits. Total support that would be in excess of the NJIT limit may require an adjustment in the support provided by NJIT sources. Excess support can also negatively impact need-based support arrangements.

Summer Support

Depending on availability of funds, students may be eligible for stipends and tuition support for June, July and August. NJIT has two summer award periods, the first covering late May and June, the second covering July and most of August. The split of summer award periods is based on the combination of the semester-based academic calendar used at NJIT and the changeover to a new fiscal year on July 1. Interested students should consult their faculty advisors in March or April.

International Students

Private loans are available through the Office of Financial Aid. These loans require a cosigner who is a U.S. citizen or permanent resident alien.

International students may not receive NJIT support or be employed on-campus during periods of practical training. International students must be in status with the United States Citizenship and Immigration Services (USCIS). International students are eligible only for merit-based NJIT financial support and not for need-based state or federal finds.

USCIS regulations require that international students attest to having funds sufficient to cover the expense of the entire course of study before they will grant a visa. Students are expected to demonstrate the availability of funds for the duration of studies at NJIT as a requirement for admission to the university.

GOVERNMENT-FUNDED SUPPORT FOR GRADUATE STUDIES

Minority Academic Career Program (MAC)

The MAC program supports doctoral students interested in faculty positions in New Jersey. Contact the Office of Graduate Studies for information on this and other state programs.

NSF and NRC Programs

The National Science Foundation (NSF) and the National Research Council (NRC) support doctoral stipends and tuition. Application deadlines for these programs are one year in advance of anticipated study, usually in early fall. Contact the Office of Graduate Studies for information on these and other federal programs. NJIT participates in regional consortia for the Bridges to the Doctorate and Alliance for Graduate Education for the Professorate supported by the NSF.

GEM

The National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. supports graduate students within an industry and academe-based consortia. Contact the Office of Graduate Studies for information on this and other industry programs.

Federal Direct and Perkins Loans, and Work-Study Programs

US citizens and permanent residents are eligible to apply for federal loans through the William D. Ford Federal Direct and Federal Perkins Loan programs and for federal work-study. Applicants for these programs must file the Free Application for Federal Student Aid (FAFSA) with the Federal Student Aid Programs Processing Center. The amount of graduate tuition remission a student receives is considered when determining eligibility for loans and work-study. Before loans are disbursed, students must sign a promissory note and complete entrance counseling. The FAFSA is available at www.fafsa.gov.

For further information, contact the Office of Financial Aid, (973) 596-3479.

TERMS AND CONDITIONS OF AWARDS

Award Selection

All NJIT awards are merit-based and are offered only to academically superior students who meet all selection requirements. Many things are considered in evaluating applications and nominations for NJIT awards. Among these are GPAs, GRE and GMAT scores, undergraduate and graduate academic performance, educational preparation, TOEFL scores for international students, skill and talent required for available positions, institutional priorities, availability of funds, special skills, and prior experience.

Students must take the GRE or GMAT and arrange to have official score reports to be sent to NJIT before they may become eligible to receive awards. Although there is no minimum eligibility score for the GRE or GMAT, NJIT may establish them for certain awards. For instance, GRE mathematical scores between 700 and 800 are typical of NJIT award recipients.

Graduate students who have not already received awards or had not been offered an award on admission must attain a minimum GPA of 3.5 for first-time support from internal funds and 3.0 for first-time support from external funds. Any graduate or undergraduate course taken by a student in graduate studies at NJIT is counted in the GPA (as calculated by the Office of Graduate Studies) for evaluating selection criteria, including courses that were repeated or excluded. GPAs are checked at the beginning of each support period to verify that awards are warranted. GPAs only establish eligibility and neither guarantee nor entitle students to receive financial support.

The Office of Graduate Studies evaluates criteria for support from internal funds each year. The criteria reflect both average grade point performance levels and availability of funds. A student who has received support from NJIT funds for one degree cannot receive NJIT support for another degree of the same or lower level or type. Criteria and full details of terms and conditions of awards are available from the Office of Graduate Studies.

Need-based support programs administered by the Office of Financial Aid and by the Office of Student Employment have different criteria for selection. These offices should be consulted for further information. Funds distributed for hourly employment through the Office of Student Employment are not considered awards. The Provost Fellowship program for applicants to master's program is coordinated by the office of Graduate Admissions.

Service-Based Awards

A service-based award is one in which the student is required to perform a service in return for a stipend. The following awards are service-based: graduate assistants, teaching assistants, research assistants, presidential fellows, teaching fellows, graders, and others as noted.

Terms and Conditions

By accepting an award, students agree to comply with the following terms and conditions unless exceptions are indicated in their award offer letter:

- Students are required to work, up to a maximum of 20 hours per week, for Fall and Spring semetser awards. Students are therefore required to work during semester breaks, either for their supervisor or, with the consent of the supervisor, on their own research.
- Students not receiving the maximum award for their award category and degree status are required to work a prorated number of hours (less than 20) based on a comparison of their award to the stipend level allowed for that award. A maximum of 35 hours per week, with appropriate increase in support level, may be permitted for service during the two summer award periods.
- Full-time registration in one of NJIT's graduate degree programs must be maintained at all times throughout the period of an award. Full-time status is accorded to those who complete at least 9 credits per semester, or to those who are certified by the Office of Graduate Studies or designated as full-time students. Students should review "Refunds for Withdrawal" and "Enrollment Status" in the Tuition and Fees section and the Academic Policies and Procedures section respectively in this catalog to be assured that they are following full-time certification requirements.
- Students who initially register for a full-time load but withdraw during a semester and thus become part-time cannot receive tuition remission for that semester and may have their tuition award terminated and stipend award curtailed.
- No other work for compensation, whether on- or off-campus, may be undertaken during the period of the award unless approved by the dean of graduate studies. Students who do not comply with this requirement may be prohibited from receiving future support and have their current award terminated.
- Unsatisfactory performance, inadequate academic progress, or violation of any of the terms and conditions shall constitute grounds for the immediate cancellation of an award.
- Award offers must be accepted in writing, on an appropriate form, and must be received by the date indicated in the award offer.
- Students who resign, or are dismissed from an appointment during a semester, must repay any tuition remitted for that semester.
- Students must report to their supervisor no later than the first day of each semester. Students who fail to do so will be deemed to have resigned and will have their award cancelled.
- Appointments are made for the period specified in the award offer. Neither renewal nor summer support can be guaranteed.
- Support based on external grant, contract, scholarship or fellowship awards are subject to the limitations established by the external agency.
- Students may not receive an award from NJIT funds to pursue a second master's degree or second doctoral degree when the first degree has been earned at NJIT.
- Students who change to a master's degree program from a doctoral program will have the current award cancelled and no future awards will be permitted. Students who register in courses inappropriate to their program of record or unapproved by their advisor will have the award immediately terminated.

- All doctoral students and students on support are required each semester to attend the seminar course offered by their program unless a specific waiver for sound academic reasons has been granted by the dean of graduate studies. Waivers for doctoral students to allow off-campus employment through precompletion practical training authorization or to accept a cooperative education work assignment will generally not be approved.
- Teaching assistants are required to register for ENG 599: University Teaching Methods / Communication Skills in their first semester.

Tuition Remission Awards

Tuition support has no service condition associated with it. Students accepting this support must not leave the program for which the support is offered without the approval of the support sponsor and the dean of graduate studies. Approval will be granted only for sound academic or other compelling reasons. Departure to accept employment is not considered a valid reason. All tuition support provided will be re-billed to the student if this condition is violated.

Cancellation of Tuition Remission

NJIT reserves the right to cancel tuition remission awards when students do not meet requirements or violate the conditions of an award. NJIT also reserves the right to cancel tuition remission for ineligible courses or courses for which the grades of F, U, W, or I are received. Audited courses, courses outside the approved courses for the program, and excess courses not needed for program completion are ineligible for tuition remission. If tuition remission is cancelled, students are re-billed accordingly and are responsible for payment in full.

Sick Leave

Students receiving awards are entitled to a total of three paid days of sick leave during the academic year. Additional days of sick leave may result in the cancellation of an award or a reduction in a stipend.

Unsatisfactory Performance

A student's performance is considered unsatisfactory if it does not meet the criteria set by the award supervisor.

Criteria for Maintaining Award

Students must earn at least a 3.0 GPA each semester, as well as maintain a cumulative GPA of 3.0 to keep receiving their awards. A 3.0 GPA will also maintain awards that initially required higher GPAs to receive them. Any graduate or undergraduate course taken by a graduate student is counted in the GPA for evaluating maintenance of awards and even includes courses that were repeated or excluded. Except for the specified period of the award offer, these criteria neither guarantee nor entitle students to receive continued financial support. Departments may set higher but reasonable standards (typically 3.5 or above cumulative GPA) for continuation of awards.

Effect of Incomplete Grades and Grade Changes

Students whose transcripts show incomplete (I) grades in the semester before being selected or becoming eligible for an award must resolve them within the four weeks after grades are posted. This also applies to changes in grades that would affect eligibility.

Extension of the deadline to beyond the fourth week of the semester will be considered if the student and the instructor provide written justification. Otherwise, any award offer for that semester will be withdrawn and tuition remission cancelled. Students will be billed for tuition accordingly and will be responsible for payment in full.

Award Duration and Renewal

Student eligibility for awards is evaluated each semester, as is renewal of award offers. Each award has unique eligibility, funding, duration and renewal circumstances. Students are responsible for understanding and following the terms and conditions of the particular award offer made to them. The Office of Graduate Studies should be consulted to determine individual terms and conditions. Award duration is based on calendar time, not on whether awards are full or partial.

- Students enrolled in master of science or masters of arts programs may not receive NJIT-funded, full or partial, assistantship or fellowship support for more than one academic year except in the cases listed below for B.S./M.S. students, and for U.S. nationals and permanent residents who are members of underrepresented groups. The academic year is defined as two semesters and one summer. The summer includes two award periods. The Provost Fellowship, as described earlier, is sustainable for a longer period of time.
- Students enrolled in doctoral degree programs may not receive NJIT-funded, full or partial, assistantship or fellowship support for more than four academic years. This is defined as eight semesters and four summers.
- Students enrolled in the 97-credit Master of Architecture program may not receive NJIT-funded, full or partial assistantship or fellowship support for more than three academic years. Three academic years are defined as six semesters and three summers.
- Students enrolled in the Master in Infrastructure Planning program are considered as master of science students for award duration.
- Full-time master's students in the B.S./M.S. program are eligible to receive three semesters and one summer of financial support from internal funds.
- U.S. nationals and permanent residents enrolled in master of science programs who are members of underrepresented groups are eligible for three semesters and one summer of financial support from internal funds.
- Doctoral students who fail their qualifying examinations may not receive further awards from NJIT funds until they pass. Departments may request a review and continuation of their financial support status if they pass some but not all parts of qualifying examinations.

- When eligibility for NJIT-funded awards is completed, students may receive additional support from external sources. Check with the Office of Graduate Studies to obtain further details.
- Master's students are eligible to receive awards for a maximum of four semesters and two summers from all sources. This does not apply to students in the Master of Architecture program. Doctoral students are eligible to receive awards for a maximum of 10 semesters and 5 summers from all sources.
- No student may receive support for more than 12 semesters and 6 summers from any combination of sources or for any number of degrees.
- The university expects that students receiving NJIT-funded support move off that type of support to external source support no later than two years after the initiation of NJIT-funded support.

Resignations

Students who wish to resign from an award should inform their advisor and the dean of graduate studies at least one calendar month before the resignation is to take effect.

Students who resign during a semester will not be eligible for tuition remission for that semester. The semester in which the resignation is received is counted as a supported semester when determining award renewals.

Taxation of Stipends and Awards

The Internal Revenue Service requires that stipends and awards be taxed at the source, even if students are eligible for a tax refund. All students are exempt from Social Security taxes. Tuition and fee remissions are not subject to tax withholding.

Students should contact the Finance Office and the Office of Graduate Studies for tax information and information about exemption from Social Security taxes. International students should contact the Finance Office and the Office of International Students and Faculty for information on tax treaties.

TUITION REMISSION

Tuition Remission Processing

All students receive bills for tuition. The bill statements for students receiving tuition remission and fees, if applicable, are marked "Possible Tuition Remission." After expiration of the official withdrawal period, a credit for the tuition and fees should appear on the statement.

Students who pay tuition bills in full and then receive tuition remission can expect to receive a refund after expiration of the withdrawal period. Students receiving only partial tuition and fee awards are responsible for payment of the remaining tuition and fees and should pay these promptly. In particular, full-time students should ensure that they have continuous health insurance coverage by payment of appropriate fees.

Students who fail to pay their bills by the due date specified by the Bursar will have their registrations cancelled. Reinstatement is usually very difficult and often unlikely.

Credit Limitation

Awards do not cover tuition for courses that are not part of a student's degree program or courses not approved by their advisor. Students are responsible for payment for these courses.

Tuition remission is allowed for courses taken at other institutions in which there is a cross-registration agreement with NJIT. These courses must be part of the student's degree program and approved by the student's advisor.

A flat rate exists for a range of credits representative of full-time registration. Any credits over that range will not be included in tuition remission awards. Students will be billed for credits in excess of their awards.

GRADUATE COOPERATIVE EDUCATION

Graduate students have the opportunity to work off-campus while studying full-time through the cooperative education program administered by the Office of Career Development Services (CDS). Policies on eligibility, application for participation, procedures, and required regular and co-op course registrations are defined in a detailed statement developed by the Graduate Studies Office (GSO), CDS, and the Office of International Students and Faculty (ISO). This opportunity is especially valuable for international students, pursuing the Master's degree, and for some PhD students lacking other forms of support. CDS should be contacted by students interested in this option. Each year, a large number of international graduate students are involved in cooperative education under Curricular Practical Training. Students pursuing this option are required to be registered in specifically numbered graduate courses for co-op as defined in each program's course listing.

Graduate Certificates

Twelve-credit graduate certificates are offered in "fast track" professional fields externally-validated with expanding employment opportunities.
The following list is the current selection of Graduate Certificates:

Applied Statistical Methods
Biostatistics Essentials (NEW)
Business and Information Systems Implementation (REVISED) *
Business and Computing (NEW) *
Construction Management *
Critical Infrastructure Lifestyle & Security Management (NEW)
Data Mining *
Emergency Management & Business Continuity (NEW)
Emergency Management & Information Assurance (NEW)
Environmental Sustainability (NEW)
Finance for Managers (NEW) *
Information Management for Managers
International Commerce (NEW) *
Management Essentials *
Management of Technology *
Network Security & Information Assurance
Pharmaceutical Management
Pharmaceutical Manufacturing
Pharmaceutical Technology
Practice of Technical Communications *
Project Management *
Sustainable Design
Venture and Innovation Management (NEW) *

*** Now or shortly available entirely online**

Graduate Studies

NJIT offers advanced studies in numerous disciplines leading to master's degrees, doctoral degrees and graduate certificates. Programs are available to full-time students and to working professionals who are interested in part-time study. Some programs are offered jointly or in cooperation with Rutgers-Newark and with UMDNJ as part of continuing collaborations. Graduate programs at NJIT are overseen by the Office of Graduate Studies, Fenster Hall, Room 140, 973-596-3462.

Full-time students are involved in the university's extensive research activities through association with renowned faculty and research centers. Financial support is available through a variety of programs that permit students to become part of the teaching, administrative and research functions of the university. Other non-service-based support is also available.

Graduate Degrees

The doctoral and masters degree programs offered at NJIT are listed below. All doctoral programs lead to the Doctor of Philosophy (PhD) degree. Master's programs lead to either the Master of Arts (MA), Master of Arts in Teaching (MAT), Master of Architecture (M.Arch.), Master in Infrastructure Planning (MIP), Master of Public Health (MPH), Master of Science (MS), or the Master of Business Administration (MBA) degree, as indicated below. Numerous dual degree options exist that allow dual use of courses in one degree program toward a second degree program. The Office of Graduate Studies may be consulted about BS/MS, MS/MS, BS/PhD and similar combinations.

- Applied Mathematics (MS)
- Applied Physics (MS, PhD) joint with Rutgers-Newark
- Applied Statistics (MS)
- Architecture (M.Arch.)
- Architectural Studies (MS)
- Bioelectronics (MS)
- Biology (MS, PhD) joint with Rutgers-Newark
- Biomedical Engineering (MS)
- Biomedical Engineering (PhD) joint with UMDNJ
- Biostatistics (MS)
- Business and Information Systems (MS)
- Chemical Engineering (MS, PhD)
- Chemistry (MS, PhD)
- Computational Biology (MS) joint with Rutgers-Newark
- Computing and Business (MS)
- Computer Engineering (MS, PhD)
- Computer Science (MS, PhD)
- Civil Engineering (MS, PhD)
- Electrical Engineering (MS, PhD)
- Emergency Management & Business Continuity (MS)
- Engineering Management (MS)
- Engineering Science (MS)
- Enterprise Development (MS)
- Environmental Engineering (MS, PhD)
- Environmental Policy Studies (MS)
- Environmental Science (MS, PhD) joint with Rutgers-Newark
- Healthcare Systems Management (MS)
- History (MA, MAT) joint with Rutgers-Newark
- Industrial Engineering (MS, PhD)
- Information Systems (MS, PhD)
- Infrastructure Planning (MIP)
- International Business (MS)
- Internet Engineering (MS)
- Management (MS)
- Management of Technology (MBA)
- Manufacturing Systems Engineering (MS)
- Materials Science and Engineering (MS, PhD)
- Mathematical Sciences (PhD) joint with Rutgers-Newark
- Mechanical Engineering (MS, PhD)
- Occupational Safety and Health Engineering (MS)
- Pharmaceutical Engineering (MS)
- Power and Energy Systems (MS)
- Professional and Technical Communication (MS)
- Public Health (MPH) joint with Rutgers-Newark and UMDNJ
- Telecommunications (MS)
- Transportation (MS, PhD)
- Urban Systems (PhD) with joint Rutgers-Newark and UMDNJ

The Collaborative Doctorate

This doctoral student option is designed to meet the workforce needs of the knowledge-dependent global economy of the 21st century recognizing the particular requirements of the practitioner. This option can meet the needs of engineers, managers, scientists, military personnel and educators who wish to pursue doctoral studies while employed full-time in the private, public and non-profit sectors.

Academic requirements are the same as for other NJIT doctoral programs but the collaborative nature of the program also allows participants to draw on the combined expertise and resources of the university and their employer. The program includes significant flexibility with opportunities for distance learning and independent study that are integrated with face-to-face classes.

To participate in this PhD program, students should first confer with their employer. Employees should seek a commitment from their employer that will facilitate participation and commitment to an area of research at an appropriate time. A senior researcher or manager may wish to serve on the student's dissertation committee.

Students must meet university requirements for admission to doctoral programs. Prior work, related research activity, publications and honors will be evaluated in addition to traditional academic criteria.

Doctoral students are expected to have been employed in their field for at least five years, and to have completed a related master's degree. They are expected to continue employment until they complete all degree requirements. Annual reviews of progress will be conducted. Students may perform dissertation research at their employer's facilities. Dissertation research can be derived from interests of the student and may be related to their professional activity.

Dissertation research must satisfy university policies. The student's dissertation committee defines residency requirements. It is expected that the employer will permit a concentrated effort on dissertation research. Seminar requirements are also defined by the dissertation committee and may allow presentations or attendance at professional society meetings in place of on-campus seminars. Credit requirements must meet university standards for the doctorate. Course selection is based on previous activities and the current state of knowledge of the student. Dissertation research is expected to investigate or develop an original contribution to science, technology or management. Research may be experimental, analytical, applied or theoretical provided that it satisfies all criteria set by the dissertation committee.

Employers who have a proprietary interest in dissertation research including patent, copyright and technology transfer rights are expected to execute formal agreements with the university before research begins.

Research Centers and Labs

Major Research and Public Service Centers

Engineering and Applied Science

Center for Applied Mathematics and Statistics (CAMS)
Fosters and supports the application of advanced mathematical and statistical methods to scientific, engineering and management problems. The statistical consulting facility assists internal and external clients with problems in data analysis, time series, design of experiments and estimation and reliability theory. (973) 596-8465

Center for Membrane Technologies[1]
The center focuses on research in new membrane structures, materials and devices, novel membrane-based processes and techniques and applications, development of membrane technologies for separations and other applications. NJIT leads an academic consortium whose other members include Rowan, Rutgers-New Brunswick and Stevens. Training of professionals, graduate and undergraduate students, developing new membrane technologies and their applications and transferring them to corporate partners are prime objectives of the center. (973) 596-8479

Center for Solar-Terrestrial Research
The center focuses on observational and theoretical astrophysics and operates the Big Bear Solar Observatory, at Big Bear Lake, California, and a dedicated array of solar radio telescopes at Owens Valley Radio Observatory, in Owens Valley, California. The facilities at both locations have the unique capacity to study the sun and its extended magnetic atmosphere simultaneously. (973) 596-3565

New Jersey Center for Engineered Particulates[1]
The center focuses on fundamental and applied research in particle technology for industry and promotes technology development and transfer to industrial partners. The research thrust areas include particle storage and transport, particle and surface property modification (engineered particulate materials), particle segregation, mixing and separations, simulations and modeling. Undergraduate and graduate education and professional training complement the research. (973) 596-3352

New Jersey Center for Wireless Networking and Internet Security
New approaches and new software tools for integrated wireless and wired network management, including data and network security, are the goals of the newly established New Jersey Center for Wireless Networking and Internet Security. A partnership between NJIT's Department of Electrical and Computer Engineering and Princeton University, the center is supported by a $2.6 million R&D Excellence Grant from New Jersey Commission on Science and Technology. Its main objective is to provide optimized efficiency and security in the multimedia environment. Led by Atam Dhawan, professor and chair of electrical and computer engineering, the new center builds on NJIT's established strengths in wireless communication, signal processing, multimedia and networking. Other NJIT members of the center team include Associate Professors Constantine Manikopoulos and Yun-Qing Shi and Assistant Professors Symeon Papavassiliou and Sirin Tekinay, all of electrical and computer engineering. Center researchers are collaborating with leading organizations, including Panasonic, Prediction Systems, AT&T, the U.S. Army and Mitre Corp. (973)596-3524.

New Jersey Center for Microflow Control
Research at the New Jersey Center for Micro-Flow Control (MFC), an increasingly important technology, involves the manipulation of fluid --- gas or liquid --- flow fields by creating small disturbances in the flow.

The New Jersey Commission on Science and Technology R&D excellence program partially builds upon the work of the W.M. Keck Foundation Laboratory for Electro-Hydrodynamics of Suspensions, headed at NJIT by Nadine Aubry, F. Leslie and Mildred Jacobus Professor of mechanical engineering, professor of mathematics and chair of the Mechanical Engineering Department, and Boris Khusid, associate professor of mechanical engineering. The laboratory is funded by a $500,000 grant from the W.M. Keck Foundation. The New Jersey MFC Center is led by professor Aubry.

MFC technology has a wide range of applications, including devices for medical diagnosis and treatment, telecommunications, environmental remediation, chemical and materials processing. In collaboration with researchers from Princeton University and industrial partners, the NJIT center will focus on the development of new technologies such as miniaturized systems on a microchip for the characterization and manipulation of cells, bacteria, spores or other microscopic particles, and high-precision microprocessing tools using microjets.

With their collaborators from the City University of New York, the research team has also received funding from the U.S. Office of Naval Research to develop an electro-hydrodynamic technology for monitoring and cleaning contaminants from oils, lubricants and coolants and other fluids used in shipboard equipment. Many machine failures are caused by contamination of hydraulic fluids, coolants and other liquids with micron- or sub-micron-sized particles due to corrosion or aging of fluids, but mechanical filtering is ineffective for such fine debris. In contrast, a strong high-gradient AC electric field can be used to control and manipulate the motion and aggregation of particles in flowing liquids. The team is developing a field prototype of online filtering hardware and will test it aboard a naval ship. (973) 642-7268.

Environmental Engineering and Science

Otto H. York Center for Environmental Engineering and Science (CEES)
CEES is the home for many of NJIT's environmental centers, programs and initiatives. The $11 million center, containing $2.4 million in state-of-the-art laboratory equipment, is the first building in the nation especially constructed for cooperative public and private research in hazardous waste management. (973) 596-3233

Manufacturing

Center for Manufacturing Systems (CMS)[1]
CMS is NJIT's focal point for industrial interaction in research, technology extension, education and training pertinent to manufacturing. Project work spans aspects of materials production, component part fabrication and automated assembly. (973) 596-2874

Polymer Engineering Center (PEC)
PEC seeks to advance the foundations of design and control of polymer production and part-fabrication technologies with facilities that include a production scale, multilayer co-extrusion line with thermoforming unit and extruders, injection molding machines, and test and characterization equipment. (973) 642-4582

Polymer Processing Institute (PPI)
PPI is a not-for-profit institute with special areas of expertise in the development of high-performance products and processes for advanced compounding, property characterization and computer modeling. PPI includes the professionally managed Characterization Lab, Computer Center and Process Lab, which contains a number of single- and twin-screw extruders and several injection machines along with downstream equipment. (973) 642-4582

Transportation

International Intermodal Transportation Center (IITC)
The institute conducts interdisciplinary research on the transportation needs of the public and private sectors. Affiliated centers include the National Center for Transportation and Industrial Productivity, which investigates methods for increasing productivity through transportation improvements and provides technical, administrative and fiscal management necessary to conduct research projects in the field of transportation (973) 596-3355; and the New Jersey Center for Transportation Information and Decision Engineering (TIDE) Center, a partnership of NJIT, Princeton and Rutgers that develops and markets technologies that will help individuals and commercial enterprises make better transportation-related decisions. (973) 642-7214.

New Jersey Transportation Planning Authority
The North Jersey Transportation Planning Authority is the federally authorized Metropolitan Planning Organization for 6 million people in the 13-county northern New Jersey region. Each year, the NJTPA oversees more than $2 billion in transportation improvement projects and provides a forum for interagency cooperation and public input into funding decisions. It also sponsors and conducts studies, assists county planning agencies and monitors compliance with national air quality goald. (973) 639-8400.

Electronics and Communications

Center for Communications and Signal Processing Research
The center promotes research on the theoretical and practical aspects of communications and signal processing in collaboration with government organizations and local industry with emphasis on wireless and personal communications. (973) 596-8474

Electronic Imaging Center
The center's research emphasizes novel diffractive methods in spectral filtering, which are combined with visible and infrared imaging systems. Of particular interest are applications of infrared imaging and radiometry with industrial and commercial partners. (973) 596-3538

Microelectronics Fabrication Center
Research focuses on advanced semiconductor and micromachined device design, simulation and fabrication. The center features a complete Class 10 cleanroom with 6-inch silicon wafer processing capability, one of only a few such university cleanrooms in the nation. Recent state-of-the-art equipment additions include wafer bonding and deep reactive etching tools. The center provides industry and university clients with technical support and prototype development in MEMS and/or CMOS technologies. (973) 596-5736

Architecture
Center for Architecture and Building Science Research
This applied research group investigates the building environment within a social and economic context. Major areas of study include housing, learning environments, healthcare and aging, disabilities, preservation technologies and the utilization of waste materials for construction and infrastructure. (973) 596-3097

Public Policy

Small Business Assistance
Center for Information Age Technology (CIAT)
CIAT provides impartial, professional computer-related assistance to government, education, non-profit and business organizations. The center assists with a wide range of projects such as assessment of current hardware and software, identification of systems requirements, vendor and package evaluation, implementation, training and Web site development. (973) 596-3035

Defense Procurement Technical Assistance Center
The center provides individualized marketing, contractual and technical assistance to businesses currently selling or seeking to sell goods/services to the federal, state or local government and prime contractors. (973) 596-5807

Enterprise Development Centers (EDC I, II & III)
EDC I,II and III operate technology-oriented small business incubators committed to the long-term economic vitality and growth of entrepreneurial ventures in New Jersey. EDC addresses problems inherent to these businesses and helps to commercialize companies' new products, processes and services. (973) 596-5740

New Jersey Manufacturing Extension Program, Inc. (MEP)
MEP is a not-for-profit organization headquartered at NJIT that serves as a gateway for small to medium-sized manufacturers to access statewide services in the public and private sectors that address business, financial and technical issues essential to forming high-performance firms. (973) 642-7099

1. Supported by the N.J. Commission on Science and Technology
2. A National Science Foundation Industry/University Cooperative Research Center
3. Supported by the U.S. Environmental Protection Agency
4. Supported by the U.S. Department of Transportation
5. Supported by the N.J. Department of Environmental Protection

Residence Life

Over 1450 students live on campus in four co-ed residence halls. Approximately 50 graduate students live on campus. Rooms are fully furnished, air-conditioned and wired for networking to the University's main computer system and to the Internet. Each hall has common areas and facilities including lounges, study areas, kitchens and laundry rooms. Rooms are wired for phone and provided approximately 50 cable TV channels. Other services include: washers and dryers, snack and soda machines, recreational equipment (pool, ping-pong, large screen televisions, etc.) and mail service Monday-Friday. Graduate students are not required to have meal plans.

Graduate students usually live in Laurel or Oak halls.

Laurel Hall is a suite-style building with approximately 582 upper class students in single, double and triple rooms. Any combination of two types of rooms can make a suite. Suites have a shared bathroom and foyer.

Oak Hall has approximately 213 upper class and graduate students housed in both suite-style rooms and apartments. Each suite-style room has a kitchenette and shared bathroom. Each apartment has a kitchen, living room and bathroom. Suites are comprised of two doubles or a double and triple bedroom. Apartment can have: a single with a double bedroom, two doubles or a double with a triple bedroom.

NJIT students use electronic cards for access to a residence hall. Desk attendants are on duty 24 hours a day and provide security for the residence halls by monitoring hall entrances and swiping resident IDs. All guests must have a valid photo ID and must be signed into the residence hall by a resident host. Guests must be accompanied by their hosts at all times.

Residence Life has staff on-duty in each hall during non-business hours. In addition, NJIT's Public Safety Office has patrols by their force of police officers and public safety officers, 24 hours a day. Patrols are conducted on foot, in cars, motor scooters and bicycles. Rooftop surveillance cameras are mounted throughout campus and monitored around the clock.

Once you have been admitted to NJIT, you can complete the Housing Application and Contract located on our website: https://mis3.njit.edu/housingapplication/login.aspx. A $50 non-refundable deposit is required and can be paid by credit card or check/money order payable to NJIT. Checks/money orders must be sent to the Residence Life Office, 180 Bleeker Street, Newark, NJ 07103-3514.

Applications for graduate students are assigned housing based on the distance you live from campus, need and date of application. We anticipate a wait list for the fall for all students. You may also be assigned to a triple room. We will send a confirmation letter three-four weeks after receiving your application.

While some graduate students choose to live on campus, many live off campus. Off-campus housing is available in a number of towns in close proximity to NJIT. Monthly rents typically begin at $300 and increase depending on the specific living conditions. Most rental space will require one month's rent and one month's deposit before moving in. Have a sufficient amount of money available when you begin your apartment search. It is recommended that you arrive as early as possible to allow yourself time to search for suitable accommodations (temporary housing is available (http://oisf.njit.edu/new_students_prearrival.php). The Residence Life Office provides an "Off-Campus Housing" newsletter and a list of available rentals in the area (updated weekly). You can view the newsletter and the list of available rentals by visiting http://www.njit.edu/reslife/offcampus.php. In addition, Residence Life staff will be available to assist you in finding housing upon your arrival. You can email the Off Campus Housing Coordinator in the Residence Life Office at offcampus.housing@njit.edu with any questions. For additional information please review our website http://www.njit.edu/reslife For additional questions, contact us via email reslife@njit.edu or call 973.596.3039.

Food Services

Dining facilities are located in the Campus Center. NJIT's private food services vendor, Gourmet Dining Services, operates the Dining Room, The Highlander Club, Leafs, Grains, The Grill, The Tech Café, Hershey's Ice Cream, the Trattoria and the Convenience Store.

For 2008-2009 the "all you can eat" board plan will feature continuous dining with unlimited returns. This means if you are on Meal Plans A-E, you have unlimited access to the board dining area all day long, seven days a week. The board plan dining hall will feature the following food service stations that will be open various times during the day:

- Bread and Breakfast
- Grill
- Halal Grill
- Fruitopia
- Waffle Bar
- Deli and Panini's
- Organic "Steamed to Perfection"
- Salad Bar
- Sweet Dreams
- Beverage Stations
- Create Your Own Soup
- Pasta
- Vegan
- International
- Chef's Choice Entrees
- Baked to Perfection
- Baked Potato Bar
- Brick Oven Pizza
- Make Your Own Pizza
- Wok It Up
- Sushi
- Carving and Rotisserie
- Fajita Island
- Beverages

Flex dollars can be used at the Dining Room, The Highlander Club, Leafs, Grains, The Grill, The Tech Café, Hershey's Ice Cream, the Trattoria and the Convenience Store. For hours and a complete listing of what is available via flex, please check http://www.njitdining.com.

Graduate Student Life

NJIT offers a wide range of extracurricular programs from sports to professional societies. There is also an extensive intercollegiate sports program. Men's sports are baseball, basketball, cross-country, fencing, judo, soccer, swimming, tennis and volleyball. Currently, the NJIT teams compete in NCAA Division II with the exception of men's soccer which competes at Division I. Women's sports include basketball, cross-country, fencing, judo, soccer, swimming, tennis and volleyball. The intramural program includes all sports available at the intercollegiate team level plus track and field, racquetball, flag football, badminton, softball and archery.

Graduate Student Association

The Graduate Student Association was founded in 1983 to promote the interests of graduate students, enhance program quality, foster student-faculty communication, and provide for the needs of advanced degree students. All students currently enrolled in NJIT graduate degree programs and paying the Graduate Student Association fee are members of GSA. A current graduate student and an alternate from each degree program are represented on the GSA Council. Students interested in serving on the GSA council or learning more about GSA should contact the GSA office (973) 596-2993 or the Office of Graduate Studies (973) 596-3462. The dean of graduate studies is the GSA advisor.

The Graduate Student Association sponsors a wide range of activities and supports many clubs as Tier 1 clubs and Tier 2 clubs. The Tier 1 clubs are generally culturally based and the Tier 2 clubs are generally professional interest based. Graduate students may belong to any or all of the clubs supported by GSA. Specific activities offered annually may be social, cultural, or professional. Some annual cultural festivals include the Chinese Moon festival, Indian Festival of Lights, international food fair, and others representative of the diverse culture of our full-time and part-time United States and international graduate students.

Trips with discounted cost to the New York City theater, the New Jersey Performing Arts Center, east coast cities such as Boston, Philadelphia, and Washington, countries such as Canada and Mexico, and other locations are often scheduled. These take full advantage of the unique location of Newark as transportation hub within the New York /New Jersey metropolitan region. Professional programs each semester include a thesis/dissertation workshop sponsored by GSA on behalf of the Graduate Studies Office. The GSA website gives a full schedule of activities. The NJIT GSA is also active in the National Association of Graduate and Professional Students and develops programs with them as well.

Graduate Honor and Professional Societies

Alpha Epsilon Lambda Honor Society

The Sigma Chapter of Alpha Epsilon Lambda, the National Honor Society for Graduate and Professional School Students, was established in 1995 at NJIT and is the first chapter in New Jersey. Membership is based on standards of scholarship, leadership and character, and is by invitation. Contact the Dean of Graduate Studies, (973) 596-3462, for more information.

Other Honor and Professional Societies

Each program offering graduate degrees at NJIT will have information about honor and professional societies open to graduate students in particular disciplines. Contact the dean of the appropriate school or college or the dean of graduate studies for further information. NJIT also has active chapters of Omicron Delta Kappa, a service-oriented society, and Sigma Xi, which focuses on research.

Student / Campus Life

There are 15 social fraternities, most with residential facilities, and 9 sororities, 10 honor societies and 27 professional recognition societies. The latter include Tau Alpha Phi, Phi Eta Sigma, Tau Beta Pi, Sigma Xi, Alpha Epsilon Lambda, the American Chemical Society, the American Institute of Aeronautics and Astronautics, the Society for Technology, the Society of Women Engineers, and the Society for Advancement of Management, to name a few. There is an active professional society for almost every major field of study offered by the university.

The Student Senate administers a wide range of programs through the Student Activities Council, various honor societies, and the Cabinet for Professional Societies and Cultural Organizations. Some of these activities include chess, lacrosse, the Vector newspaper, the Nucleus yearbook, ham radio, photography, and theater and radio broadcasting. Graduate students also enjoy participating in the NJIT chapter of Pugwash USA and Computer Club 2 (YACC2).

NJIT is within walking distance of the Newark downtown area and the campuses of neighboring universities which, along with NJIT, are located in Newark's University Heights section. Students may take advantage of Newark's nationally renowned museum, library, Symphony Hall, and New Jersey Performing Arts Center (NJPAC) and may enjoy the city's burgeoning art and jazz scene. In addition, students have easy access to the vast cultural resources of the New York/New Jersey metropolitan area. NJIT is only 20 minutes from midtown and downtown Manhattan, and the city is easy to reach by bus, train or car. A joint Rutgers/NJIT shuttle bus provides regular free commuting service to principal transportation centers.

Parking

Every vehicle parked in NJIT lots must be registered with the Photo Identification and Parking Services Department, and must display a valid parking permit for the semester. Student parking registration must be completed on-line at www.njit.edu/parking and is available to NJIT students who have registered for classes. Upon registering for parking, a separate fee will be charged to your student bursar account and a parking permit will be mailed to the address you choose on-line. Additional information is available on-line, or at the Photo Identification and Parking Services Department located in Laurel Hall Extension, 131 Summit Street, at the corner of Warren and Summit Streets.

Photo ID

All students must carry an NJIT identification card while on campus. An ID card must be presented at the request of a university administrator, faculty member or public safety officer. Facilities, parking, building access, and services of the university require presentation of a valid university ID. Students should obtain an ID card as soon as possible after class registration is completed. Photographs are taken throughout the semester in the Photo Identification and Parking Services Department located in Laurel Hall Extension,131 Summit Street, at the corner of Warren and Summit Streets. Hours are posted at the ID Office. Proof of registration in the form of a tuition or registrar receipt is required. These receipts will also serve as temporary identification until a photo ID card is issued. ID validation stickers are issued each semester and are available at the Photo Identification and Parking Services Department or the Department of Public Safety. Lost or stolen ID cards should be reported as soon as possible to the ID Office. A replacement card is obtained by paying a $25 fee at the bursar office cashier window in the Student Mall and presenting the receipt at the ID Office where a replacement card will be issued. Photo ID cards are not transferable. Cards may not be loaned to anyone for any reason. ID cards are the property of NJIT and must be returned upon request.

Physical Education and Athletics

The Division of Physical Education and Athletics encourages students to develop individual physical skills that can be used throughout life, and provides a variety of programs that will meet the diverse needs and interests of the NJIT community. These include programs of skills instruction, intramural and intercollegiate competition, sports clubs and open recreation. The Estelle and Zoom Fleisher Athletic Center houses a swimming pool; locker rooms; Fleisher fitness center with a 1/16-mile indoor track; an athletic training room; dance, exercise and fencing areas; conference room; four racquet sport courts; and three gymnasia. Lubetkin Field is a multipurpose, lighted recreational area with a regulation soccer field and a jogging track. There are four lighted tennis courts behind the athletic center. Opening hours for recreational areas vary seasonally, but during the semester are typically open from 7 a.m. to 11 p.m. Monday through Friday, from 9 a.m. to 7 p.m. on Saturday, and from noon to 9 p.m. on Sunday. For more specific information, contact the division office in the Physical Education Building at (973) 596-3636. For general information, the phone number for the front desk in (973) 596-5730.

The Campus Center

The final phase of NJIT's $83 million campus construction program has taken shape. This centerpiece is a new four-story student center with an outdoor roof garden with seating, a two-story student lounge and an expanded woman's center. Additional features include a bookstore, a Starbucks and a six-lane bowling alley.

The Campus Center is a place for cultural, educational and social activities for the NJIT community. The Campus Center staff strives to provide students, faculty and staff with a relaxing environment where they can enjoy a meal, study, watch a film, play billiards or a variety of other games, participate in the many activities offered or just socialize with friends. The Offices of Student Activities, Greek Life, Women's Center and Miniversity are located within the building. The center also houses a wide variety of student clubs and organizations including the Student Senate, Graduate Student Association (GSA), Student Activities Council (SAC), university newspaper (Vector), yearbook (Nucleus) and radio station (WJTB). More than 50 student-run cultural, professional, special interest and social clubs and organizations have office space in the Campus Center.

On the lower level of the center is a recreation area with bowling, billiards, table tennis and video games. A variety of tournaments is offered each semester. The main level of the center houses the Food Court, Student Dining Room, Information Desk, Bookstore and offices of the director of the Campus Center, assistant director for Greek Life and the reservation manager. The second floor of the center houses the offices of the Associate Director for student activities, the Women's Center, Miniversity (and for '05/'06, the Dean of Student Services), and several student organizations. The third floor of the center houses the Faculty/Staff Dining Room and the Highlander Club..

The Campus Center Information Desk personnel provide information about the campus, community events and public transportation. The Information Desk also has a university telephone directory, campus maps, discount tickets for Broadway shows, postage stamps and mail service. Two computers are provided for students to check class schedules, grades and registration information. The Campus Center Office also provides fax service for a nominal charge. The phone number for the Information Desk is (973) 596-3605.

Student Services

The dean of student services administers and coordinates the activities of the Student Services Division, including the Campus Center, the Counseling Center, Health Services, Residence Life, the University Learning Center and the University Research Experience. Special services for evening and disabled students are provided. The office also is the liaison for Food Services, The Highlander Cafe and the NJIT Bookstore.

The office is located on the second floor of the Campus Center. The phone number is (973) 596-3466/3470.

The Murray Center for Women in Technology

The Murray Center for Women in Technology provides a hospitable environment for all women at NJIT. Located on the second floor of the Campus Center, the women's center offers a wide range of resources, including a multimedia library, computer workstations and access to a World Wide Web database about women in technology. The center contains space for small group meetings, study, tutoring and research. It provides a forum for women to discuss matters of mutual concern, including issues related to the academic and social environment at NJIT. It sponsors programs and events especially designed to facilitate mentoring and career networking among women. The center also supports research about women and technology and fosters efforts to explore the continued integration of gender into the curriculum. The lounge/study area is open to all members of the NJIT community daily, Monday through Friday.

International Students

The Office of International Students and Faculty offers numerous services and programs to aid students in their adjustment to NJIT. Because immigration regulations frequently change, affecting the status of students, all international students holding non-immigrant visas (especially F and J visas) must attend a mandatory orientation program prior to the beginning of their first semester. F-1 and J-1 undergraduate students must maintain full-time registration (12 credits per semester), except for special cases as defined by immigration regulations. F-1 and J-1 full-time graduate students must maintain full-time registration (9 credits per semester), except for special cases as defined by immigration regulations. Students on dependent visas (such as F-2, J-2 and H-4) should consult with the Office of International Students and Faculty if change in status or full-time study is contemplated. The office is located in Fenster Hall, Room 140. The phone number is (973) 596-2451. Their web address is http://oisf.njit.edu/.

Students with Disabilities

The coordinator of Student Disability Services assists students with disabilities in the NJIT Counseling Center. Assistance services may include: providing general information; counseling; coordinating academic accommodations such as special testing arrangements or adaptive equipment; coordinating the provision of auxiliary services such as note takers, sign language interpreters, readers; and liaison with faculty, staff and other agencies. Services are provided to students with documented disabilities and require meeting with the coordinator, submitting documentation and completing appropriate forms. For further information or to discuss accommodations, please contact the coordinator of student disability services in the Counseling Center. The Counseling Center, located in Student Services, Campbell Hall, is open from 8 a.m. to 6 p.m. Monday through Thursday and 8 a.m. to 5 p.m. Friday during fall and spring semesters; from 8 a.m. to 5 p.m. Monday through Thursday and 8 a.m. to 4 p.m. The office is closed on Friday during summer sessions. The phone number is (973) 596-3414. Scheduling an appointment is important to ensure availability and make arrangements for appropriate accessibility.

Immunizations

The State of New Jersey and NJIT require all matriculating students to submit proof of the following:

1. Two doses of MMR (measles, mumps and rubella) vaccination given on or after the first birthday. Blood work showing immunity to measles, mumps, and rubella is also acceptable.
2. Hepatitis B vaccination, 3 doses, or blood work showing immunity to Hepatitis B.
3. For students living in on-campus housing, meningitis vaccination (A,C,Y,W135 types) , 1 dose prior to moving onto campus.

If documentation for any of the vaccines is unavailable, then re-immunization is required. For further information, go to: www.njit.edu/healthservices or call 973-596-3621. Registration will not be allowed for subsequent semesters until all records have been submitted.

Health Insurance

The State of New Jersey and NJIT require all students enrolled full-time and all international students to maintain health insurance coverage that provides basic hospital and medical benefits. Coverage must be maintained throughout the student's enrollment. Insurance may be provided by the student or may be purchased through the university. Students may waive participation in the NJIT plan for the full academic year.

To waive the insurance, the student must go on-line to http://www.njit.edu/insurancewaiver to complete the on-line waiver form within the 30 day enrollment period at the beginning of the semester. Insurance brochures are available in the Health Services and also on-line at http://www.studentplanscenter.com. International students with J-1 visa status must be covered by an insurance package at all times as specified by the US Department of State, which generally exceeds NJIT's plan coverage. Further information about required coverage and/or enrollment can be obtained from the Office of International Students and Faculty. Part-time students also may purchase health insurance through NJIT within the 30-day enrollment period at the beginning of the semester. Insurance also may be purchased for dependents.

US citizens and permanent residents who are full-time by virtue of their carrying 12 or more credits (9 for graduate students) and all international students, carrying 3 or more credits are automatically billed for insurance in the NJIT plan. US citizens and permanent residents carrying less than 9 credits and international students carrying less than 3 credits are not automatically billed for the NJIT plan. US citizens and permanent residents who have been certified as full-time with less than 12 credits, even if on financial support, are not automatically billed and should take immediate steps to assure that they have continuous health insurance coverage either through the NJIT plan or through separate insurance. International students with less then 3 credits, whether certified full-time or not, should also take immediate steps to assure continuous health insurance coverage. Students on support should verify whether or not the support includes the cost of Health Insurance. Some support packages include this coverage and some do not particularly support packages that cannot support student fees.

Health Services

To function well in a college setting, a student must be physically healthy. To ensure the good health of our students, Health Services provides primary health care to enrolled students who have submitted a complete medical examination form. Services offered to eligible students include the assessment and treatment of health problems and injuries, laboratory tests, health counseling and education. Referrals are made to specialists, area hospitals and diagnostic sites when necessary. The office also coordinates mandatory immunization requirements (see above). The office, located in the Estelle and Zoom Athletic Center, is open 8:30 a.m. to 4:30 p.m., Monday through Friday during the fall and spring semesters. Summer hours are 8:30 a.m. to 5 p.m., Monday through Thursday. The physician is available by appointment during the academic year. Walk-ins will be seen based on urgency of medical illness and time availability. For further information go to: www.njit.edu/healthservices.

Child Care Center

The NJIT child care center, currently operated by Sarah Ward Nursery, is located on the first floor of NJIT's Enterprise Development Center II building, 105 Lock Street. The center is available to children of NJIT employees and students, employees of tenants in the university's incubator program and residents in the neighboring community. The center is licensed by the State of New Jersey.

The center is for children age 6 weeks to 5 years. Programs and activities are divided into levels for infant, young toddler, toddler, young preschooler and preschooler. Developmentally appropriate activities for each age group include hands-on pre- math, science, language and reading activities. An after-school program is also offered to children ages 5 through 13.

The center operates year-round, 6:30 a.m. to 6:30 p.m. Monday through Friday, excluding university holidays. For further information, call Sarah Ward Nursery at (973) 645-0442.

Counseling Center

The Counseling Center, staffed by experienced psychologists and professional counselors, provides services for students seeking psychological, academic and substance abuse counseling. In addition to the professional counseling staff, a psychiatrist is available for consultation as needed. The Counseling Center also offers workshops on different topics, maintains a library of career and graduate school information, coordinates services for students with disabilities and administers supportive testing. Students are welcome to come in and browse through the informational materials or call for an appointment with a counselor. Office hours are scheduled so that services are also accessible to adult evening students.The Counseling Center is open from 8 a.m. to 6 p.m. Monday through Thursday and 8 a.m. to 5 p.m. Friday during fall and spring semesters; from 8 a.m. to 5 p.m. Monday through Thursday and 8 a.m. to 4 p.m. The Counseling Center offers professional counseling to adult students facing stress from academic, personal, family or employment responsibilities. Counseling services are confidential, with limited exceptions. Call us at (973) 596-3414 for an appointment. The center is located in Student Services, Campbell Hall.

Stop-In Center

The Stop-In Center, staffed by trained student peers, provides on-the-spot information and assistance about all aspects of college life. Peer counselors are prepared to talk with fellow students about a wide range of questions or concerns - academic or personal - as well as provide relevant information. If they are unable to resolve a problem directly, they refer students to the person or office that can. No appointment is necessary and students are invited to stop by and become familiar with the staff and services available. The phone number is (973) 596-3422 and the Stop-In Center is open weekdays during the fall and spring semesters.

Evening Students

Office of the Dean of Student Services staff members are available until 5:45 p.m., Tuesday through Thursday, to provide advisement and needed information to evening students. The Counseling Center is open to evening students until 6 p.m., Monday through Thursday and until 5 p. m. Friday during fall and spring semesters, offering confidential professional counseling to adult students who face stress from academic, personal or employment responsibilities. Many other offices, including the Registrar's Office, remain open after regular hours to assist students taking evening courses. Students should contact individual offices to determine availability.The Campus Center features weekly films and activities in the evening. All forums are held in the evening to allow evening students' participation.

Division of Career Development Services

The Division of Career development Services (CDS) is responsible for planning and advising, cooperative education and internships, community and public services, and alumni career services. Students may utilize these services by calling CDS at (973) 596-3100, by emailing a career counselor responsible for your discipline (listed on www.njit.edu/cds under Contact Us) or by stopping by to set up an appointment.

CDS offers students a broad range of career planning services. Included are career advising, career development workshops led by staff and industry representatives, career fairs, access to the Career Resource Center (both in Campbell Hall, 4th floor and online at www.njit.edu/cds under Career Resource Center), career counseling, experiential education through cooperative education, on-campus recruitment by a wide range of prospective employers and access to job postings at www.njit.edu/cds under CDS online.

The office is open Mondays through Fridays, 8:30 a.m.- 4:30 p.m. during the school year, with a rotating schedule from 4:30 p.m.-6:00 p.m. in the Student Center. (Summer hours are 8:30 a.m.-5:00 p.m. Mondays through Thursdays).

Community and Public Service

See the Academic Programs section in this catalog for more information.

Cooperative Education and Internships

See the Academic Programs section in this catalog for more information.

Career Planning and Placement

The Division of Career Development Services offers students a broad range of career investigation and preparation services. Included are career advising, career development workshops led by staff and industry representatives, job fairs, access to the Career Resource Center, career counseling, and on-campus recruitment by a wide range of prospective employers. Access to information is provided on site and remotely through the CDS Online Internet service. In addition, the office maintains full-time job listings. SIGI+, a computerized career assessment instrument, and company information are located in the Career Resource Center. The center is open Monday through Thursday, 8:30 a.m. to 6 p.m., and Fridays, 8:30 a.m. to 4:30 p.m.

For more information, contact the Division of Career Development Services, (973) 596-3100 or www.njit.edu/CDS.

Student Employment

The Office of Student Employment offers services and programs to help NJIT students earn money to finance college expenses and acquire practical work experiences through part-time and summer employment. Opportunities are provided for on-campus and off-campus employment for eligible students in all academic disciplines. Through the student employee training and development service, students are helped to succeed on the job. Students may participate in the following programs.

Federal Work Study (FWS)

Students who are U.S. citizens or permanent residents and have received a FWS allocation as a part of their Financial Aid award are eligible to participate. Students may earn up to the amount specified on the award letter from the Financial Aid Office. FWS jobs are available both on- and off-campus.

University Work Study (UWS)

UWS provides on-campus employment opportunities for NJIT students not eligible for the FWS program. Students must be enrolled full- or half-time, accepted into a degree-granting academic program and attending classes to apply for UWS jobs. Eligible international students must also have on-campus employment clearance from the Office of International Students and Faculty.

Grant/Contract Hourly Employment

NJIT's faculty and staff are often awarded grants or contracts from governmental agencies, foundations or private corporations to conduct research projects or special programs. Eligible NJIT students may be hired for on-campus jobs funded by these grants or contracts. Students should contact their academic departments and/or professors about available positions.

Job Location and Development Services (JLDS)

JLDS provides assistance for any NJIT student seeking part-time or summer employment off-campus. Private and public employers in the New Jersey/New York area send numerous job announcements daily to NJIT. Students may view job postings in the Career Resource Center or access the part-time job listings on the Internet via CDS Online. Also, a six-week Summer Job Search Club is offered each spring semester to help students find off-campus summer jobs related to their academic major.

For additional information, contact the Division of Career Development Services, (973) 596-6590.

Graduate Tuition and Fees

New Jersey Institute of Technology reserves the right to increase tuition and fees as required.

Students incur a legal obligation to pay tuition and fees when they register for classes. Unless the registrar receives written notice by the fifth day of the semester that a student will not be attending classes, the student will be billed for payment.

Liability for Charges

A student who registers for a course is liable for all tuition and fees. Receipt of a properly completed withdrawal notice by the Registrar's Office will affect the amount of refund, if any, to be issued. The Office of the Bursar (http://www.njit.edu/bursar/index.php) is responsible for the collection of all payments.

Tuition and Fees 2008-2009 (in US dollars)

Full-time Tuition rates do not apply during the summer.

	In-State			Out-of-State		
Credits	Tuition	Fees	Total	Tuition	Fees	Total
1	750.00	197.00	947.00	1,033.00	197.00	1,230.00
1.5	1,125.00	244.50	1,369.50	1,549.50	244.50	1,794.00
2	1,500.00	292.00	1,792.00	2,062.00	292.00	2,358.00
3	2,250.00	387.00	2,637.00	3,099.00	387.00	3,486.00
4	3,000.00	482.00	3,482.00	4,132.00	482.00	4,614.00
5	3,750.00	577.00	4,327.00	5,165.00	577.00	5,742.00
6	4,500.00	672.00	5,172.00	6,198.00	672.00	6,870.00
7	5,250.00	767.00	6,017.00	7,231.00	767.00	7,998.00
8	6,000.00	862.00	6,862.00	8,264.00	862.00	9,126.00
9	6,750.00	957.00	7,707.00	9,297.00	957.00	10,254.00
10	7,500.00	1,052.00	8,552.00	10,330.00	1,052.00	11,382.00
11	8,250.00	1,147.00	9,397.00	11,363.00	1,147.00	12,510.00
12-19 (full-time)	6,890.00	978.00	7,868.00	9,790.00	978.00	10,768.00

Full-time students will be assessed a $278 Health Insurance fee. International students on F-1 or J-1 visas will be assessed a $316 fee when registered for 3 or more credits.

Additional credits above 19 are assessed at the appropriate per credit rate.
NOTE: Full-Time status: 12 credits for billing purposes
9 credits for academic and Financial Aid purposes

Academic Fees Assessed (*per semester*)

Part-time Fee Structure	Full-time Fee Structure

Flat charge (***at all credit levels)***: $80.00 Registration Fee $22.00 Health Services Fee Per-credit ($95 per): $50.00 Academic Facilities Fee $9.00 Student Services Fee $4.00 Graduate Assoc. Fee $10.00 Athletics Fee $22.00 Technology Infrastructure Fee	$80.00 Registration Fee $475.00 Academic Facilities Fee $65.00 Student Services Fee $40.00 Activities Fee $125.00 Athletics Fee $171.00 Technology Infrastructure Fee $22.00 Health Services Fee

NOTE: These fees are approved by the Board of Trustees. All fees are mandatory for Full-Time and Part-Time students and are considered non-negotiable.
There is a $90.00 charge per semester for all international students.

Summer / Winter Session Fees
During the summer & winter sessions there is a flat fee of $160.00 in lieu of the fees noted above.

Additional Fees

$60.00 Application /Readmission Graduate $100.00 Commencement Fee $50.00 Deferred Fee $100.00 Dissertation Project Fee $75.00 Distance Learning Fee $100.00 Late fee $90.00 International Student Fee $50.00 Maintaining Registration Fee Graduate	$60.00 Graduate Non-Matriculation $125.00 Parking Full-time $65.00 Parking Part-time ** 7% Commuter Parking Tax $25.00 Schedule Change Fee $50.00 Make Up Exam $75.00 Master Thesis $200.00 Reinstatement Fee

** The state of New Jersey mandates a 7% sales tax for commuter students parking on campus

Room & Board

Housing and Meal Plan Fees Per Semester
Cypress Hall, Laurel Hall, Oak Hall Double Rooms $ 3,340.00
Redwood Hall Double Room $ 3,145.00

- The single room rate is $3,900.00 per semester. Single rooms are available only to upper-class students based on room selection criteria and processes.
- Twelve-month housing contracts are available. The charge is an additional $1,000 per semester.

Meal Plans Per Semester

A - Plan $1,458.00 -- Unlimited, continuous dining, 5 guest entries per semester*

B - Plan $1,563.00 -- Unlimited, continuous dining, 5 guest entries per semester, 100 flex points

C - Plan $1,668.00 --Unlimited, continuous dining, 5 guest entries per semester, 200 flex points

D - Plan $1,773.00 -- Unlimited, continuous dining, 5 guest entries per semester, 300 flex points

E - Plan $2,088.00 -- Unlimited, continuous dining, 5 guest entries per semester, 600 flex points

F - Plan $1,038.00 -- 5 anytime entries per week, 5 guest entries per semester, 400 flex points *

G - Plan $1,414.00 -- 1047 flex points ($300 fixed expenses) *

H- Plan $723.00 -- 80 anytime entries per semester, 5 guest entries per semester *

These are the rates for 2008-2009 academic year.

* F, G, H Plans are for Juniors, Seniors and Commuters Only.

Cancellation of Housing Contract Prior to Check-In

NEW STUDENTS ---- All new students are required to provide a $50 non-refundable room reservation deposit. If a contract is cancelled prior to check-in, a $750 (less the $50 non-refundable room reservation deposit) cancellation fee will be assessed.

CONTINUING STUDENTS ---- All students must complete and sign a housing contract. If a contract is cancelled prior to check-in, a $750 cancellation fee will be assessed.

Cancellation of Housing Contract After Check-In

Residents may cancel their contract by contacting the Residence Life office in person or in writing. Residents canceling their contract must complete an official check-out and that will determine the final date of the resident's occupation of the residence hall space. Residents canceling their contract will be charged to the final date of their official check-out plus one half of the remainder of their contract.

Meal Plan Refund Policy

If a student cancels their contract during the semester, they are charged until the date of checkout for meals and flex dollars. If a resident student places cash in their flex account, they are entitled to a refund anytime, or may carry the flex amounts over from one semester to the next.

Meal Plans for Commuter Students

Commuter students may elect to have a meal plan, the Commuter Meal Plan ($446) or place money in their account. Students must pay for the option at the Bursar's Office and then take the receipt to the Gourmet Dining Service Office in the Campus Center.

Continuing Professional Education (CPE) Tuition and Fees

In some cases, there is a differentiation in fees for CPE programs. See www.cpe.njit.edu/dl for a current listing of fee labels and fee amounts or call CPE at 1 (800) 624-9850.

Refunds for Withdrawal

Total Withdrawals During Fall or Spring Semesters

When students withdraw from all courses voluntarily (a complete withdrawal) they may receive a refund of some part of the tuition provided they have properly completed a withdrawal on the Highlander website.

INSTITUTIONAL REFUND SCHEDULE

Students receive refunds of tuition for complete withdrawal according to the following schedule

Through the end of	% Refund
Week 1	100 (plus all fees)
Week 2	90
Week 3 and 4	50
Week 5,6 and 7	25
After Week 7	0

Partial Withdrawals During Fall or Spring Semesters

The percentage of tuition refunded for credit reductions short of complete withdrawal (a partial withdrawal) in a semester is:

Week 1	100% (plus all fees)
Week 2	90%
Week 3-15	0%

FEDERAL STUDENT FINANCIAL AID RECIPIENTS

See Financial Aid

For more information on policies and procedures for the treatment of financial aid due to withdrawal, go to www.njit.edu/finaid/withdr.php

After the last day of the second week of classes each semester, students who reduce credits but remain enrolled will not receive any refund of tuition or other charges. For federal and state financial aid purposes, enrollment status is determined on the 15th day of classes, no adjustment from full-time to part-time status is made after the end of the second week of classes.

Refund policy and procedures for summer sessions are published in summer session registration materials.

Emergency Withdrawal

When the Office of the Dean of Graduate Studies approves emergency withdrawals, those students shall receive a refund prorated according to the number of weeks the student attended in the term. Students may request emergency withdrawal for the following reasons: medical circumstances that prevent completing the term; call to military service that prevents completing the term; and mental conditions that prevent completing the term.

Unofficial Withdrawal

Financial aid recipients whose term record shows zero (0) earned credits because of F and/or W grades will be reviewed for class attendance. A withdrawal date will be assigned to any student whose attendance or participation in class cannot be documented, and any federal aid may be reduced or canceled.

Students are strongly encouraged to use the official withdrawal procedure through the Registrar's Office should it become necessary to cease attendance in all courses. Students should also contact the Office of Graduate Studies to complete a discontinuance form.

Payment

Payment for tuition and fees may be made using any of the following methods:

Checks and Money Orders

Checks or money orders must be made payable to NJIT. Write the NJIT ID number on the face of the check or money order. The university reserves the right to add missing ID numbers to checks for payment.

Cash

Cash payments can be made only in person at the Bursar's Office, which is located in the student mall area on the lower level of the Parking Deck.

Credit Cards

At this time, the university only accepts Visa, MasterCard and Discover. For your convenience we allow the use of credit card payment over the web. Go directly to http://my.njit.edu and sign on to Highlander Pipeline, then select view and pay your bill. You may also use the back portion of your invoice to authorize use of the above credit cards or you can opt to pay in person.

Deferred Payment

Students may use the NJIT deferred payment plan. In order to take advantage of this plan, the student must pay one-half of the bill plus a $50 deferral fee. All prior debts must be paid on order to take advantage of the deferral plan.

Student Residency for Tuition Purposes

Residency status for the purpose of tuition assessment will be made by the university based upon N.J.S.A. 18:62-1 et seq. and New Jersey Administrative Code Title 9. These statutes set forth the standards for individuals to legally reside in the state for 12 months prior to enrollment to be eligible for in-state tuition rates. The procedures outlined below will govern the determination of residency status for the purpose of calculating tuition. All students who are not legal residents of New Jersey within the meaning of the statutes will be assessed out-of-state tuition rates.

Initial Determination of Residency

When an application is submitted for admission to any graduate or undergraduate program the admissions office will determine the applicant's resident status for tuition assessment. This determination will be based upon information supplied by the applicant on the application for admission. Applicants who are not citizens of the United States must complete the non-resident portion of the application and supply documentation of their non-immigrant status.

The university reserves the right to correct any errors in resident status based upon incorrect or insufficient information supplied by the student which directly or by inference leads to an inaccurate tuition assessment. When an error has been identified and corrected, tuition will be recalculated for the terms affected, and the student will be held liable for any additional tuition.

Legal Determination of Residence

The following statement from the New Jersey Statutes Annotated defines residence for higher-education purposes: "Persons who have been domiciled within this State for a period of 12 months prior to initial enrollment in a public institution of higher education are presumed to be domiciled in this State for tuition purposes. Persons who have been domiciled within this State for less than 12 months prior to initial enrollment are presumed to be non-domiciliaries for tuition purposes."

The university reserves the right to request the student to have the Internal Revenue Service or the New Jersey Division of Taxation forward tax records to the appropriate university office for review or to request same directly from the student.

An individual who claims to have established a new domicile in New Jersey must show (1) a physical abandonment of the previous domicile, together with an intent not to return to it, and (2) actual presence in New Jersey with the intention of remaining permanently in the state for reasons other than attending school.

An individual from another state or country who has enrolled in any type of educational institution in New Jersey prior to applying to NJIT will be presumed to be in New Jersey primarily for educational purposes and will be presumed not to have established domicile in New Jersey. Although the student may present proof to overcome these presumptions, it must be noted that continued residence in New Jersey during vacation periods or occasional periods of interruption to the course of study does not of itself overcome the presumptions.

THE EFFECTS OF MARRIAGE ON RESIDENCY

A U.S. citizen or permanent resident who marries a bona fide New Jersey legal resident assumes the domicile of that spouse for tuition purposes in the term following marriage. The same test for residency will be applied to spouses when marriage is claimed as the basis for domicile.

No change in status will occur when a legal resident student marries a non-legal resident.

FOREIGN NATIONALS

International students studying under a non-immigrant status (such as F, J, and all others) may be eligible to pay resident tuition upon receipt of their permanent resident card. In addition to receipt of permanent resident status in the United States, students must comply with the definition of "Domicile" as described in that section of the catalog. Any other non-immigrant alien (H-1, E-1, etc., status) will be classified as a non-resident for the assessment of tuition.

Residency will be determined as of the first term following the admission date on the permanent resident card. Applications for residency will not be processed unless a photocopy of both sides of the permanent resident card is included with the application. A tuition refund will be issued if the admission date on the permanent resident card precedes the start date of the current term.

Residence established solely for the purpose of attending a particular college or university cannot be considered as fulfilling the definition of domicile.

Refugees Students attending NJIT as documented refugees may be eligible to pay resident tuition rates provided they are domiciled in New Jersey and maintain good academic standing. Their status will be reviewed each semester by the director of financial aid.

Political Asylum Students who have been granted political asylum are not permanent residents of the United States and are not eligible to pay resident tuition rates. Employment Authorization Visas issued by INS do not qualify students for NJ resident tuition status.

Request for a Change of Residency Status

Requests for a change in residency status must be submitted to the registrar no later than four weeks before the end of the term for which a change in status is sought. A Residency Analysis Form with all supporting affidavits, deemed appropriate by the registrar pursuant to N.J.A.C. 9A:5-1.1 et seq., must be filed at the time of application. Students who qualify for resident tuition assessment based on the information supplied with their request will have their status changed only for the current and subsequent terms. No adjustments in tuition assessments will be made for prior terms.

Residency Appeals

Appeals for a change in residency status will be made to the registrar and will be accepted no later than one month after the date of notification of any such determination. Unresolved appeals will be forwarded to the assistant vice president for academic affairs: enrollment planning. The assistant vice president will respond to the appeal within 30 working days of receipt of the appeal.

The decision of the assistant vice president for academic affairs: enrollment planning will be final.

Student Responsibilities

Students are responsible for providing relevant and accurate information upon which a residency determination can be made. The burden of proving residency status lies solely upon the student. Moreover, it is considered the obligation of the student to seek advice when in doubt regarding eligibility for in-state tuition assessment. If the student delays or neglects to question eligibility status beyond the period specified above, the student forfeits the right to a residency assessment to which he or she might have been deemed eligible had an appeal been filed at the appropriate time. Students who are classified as resident students but who become non-residents at any time by virtue of a change of legal residence are required to notify the registrar immediately. An independent student loses residency status for in-state tuition payment immediately upon abandonment of the New Jersey domicile. Assessment of non-resident tuition charges will take effect the term following the date of abandonment.

Penalties

If a student has obtained or seeks to obtain resident classification by deliberate concealment of facts or misrepresentation of facts or fails to come forward with notification upon becoming a non-resident, he or she is subject to disciplinary action before the university's professional conduct committee.

Factors Considered in Determining Residence for Tuition Assessment

CLASSIFICATION

Students residing in New Jersey for a period of 12 months before first enrolling at a public institution of higher education in the State of New Jersey are presumed to be state residents for tuition purposes.

Students who have been domiciled within this state for less than 12 months prior to the date of enrollment are presumed to be non-residents for the purpose of calculating tuition. Students who assert residency but whose resident status is challenged by the university, must prove their domicile according to the following regulations.

DOMICILE

"Domicile" means the place where a person has his or her true, fixed, permanent home and principal living establishment, and to which, whenever he or she is absent, he or she has the intention of returning.

Although actual presence is not necessary to preserve domicile once it has been acquired, a person, if absent from the state, must have the intention of returning to New Jersey in order to remain a legal resident.

In determining whether legal resident status has been shown, mere physical presence and the assertion of a declaration of intent to remain in the state may not be sufficient. To assist in determining whether a person is a New Jersey legal resident, the primary evidence of residency, although not dispositive, is a notarized affidavit setting forth domicile and a copy of New Jersey income tax return substantiating employment in New Jersey as the applicant's primary reason for residing in the state. In the case of dependent students, a copy of the parent's or legal guardian's New Jersey tax return will be required in addition to the affidavit. The following additional items may be considered: voter registration of the individual in New Jersey; a New Jersey driver's license and/or a registration or such other information as the university deems acceptable. In unusual circumstances, if primary evidence is not available, the institution may make a determination of New Jersey domicile based exclusively on supplementary evidence; however, supplementary evidence may not be deemed sufficient to justify a determination of legal resident status.

If a student resides with his or her parents or legal guardians for more than six consecutive weeks last or this year, or is dependent upon them for food, clothing, or shelter during the present or prior year, or is claimed, or will be claimed, as a dependent for income tax purposes for the last or current year, the student is deemed to be financially dependent. In such case, the domicile of the individual's parent or legal guardian for the year prior to the term of admission will determine the domicile of the dependent student.

Conversely, if a student has not lived, and will not live, with parents or legal guardians for more than six consecutive weeks during the present or prior year; and has not received and will not receive financial assistance from parents or legal guardians of more than $750 in support of any kind including food, clothing and shelter last year and this year; and has not been claimed as an exemption on parents' or legal guardians' tax return last and this year; and has resources, which should be at least equal to the level of public assistance in the preceding calendar year, the individual is deemed to be financially independent and student's own domicile, for the year prior to the term for which New Jersey domiciliary status is sought, will determine his or her legal resident status.

PRESENCE IN NEW JERSEY DUE TO MILITARY SERVICE

As a general rule, in the absence of any intention to effect a change of domicile, the domicile of a person is not affected or changed by reason of his or her entry into the military service.

United States military personnel and their dependents who are living in New Jersey are regarded as residents of the state for tuition purposes.

2009-2010 Graduate Degree Programs

Administered By: New Jersey Institute of Technology

- Applied Mathematics
- Applied Statistics
- Architecture
- Bioinformatics
- Biology
- Biomedical Engineering
- Biostatistics
- Business Administration in Management of Technology
- Business and Information Systems
- Chemical Engineering
- Chemistry
- Civil Engineering
- Computational Biology
- Computer Engineering
- Computer Science
- Computing and Business
- Electrical Engineering
- Emergency Management and Business Continuity
- Engineering Management
- Engineering Science
- Environmental Engineering
- Environmental Policy Studies
- Environmental Science
- Healthcare Systems Management
- History
- Industrial Engineering
- Information Systems
- Infrastructure Planning
- Internet Engineering
- Management
- Manufacturing Systems Engineering
- Materials Science and Engineering
- Mathematical Sciences
- Mechanical Engineering
- Occupational Safety and Health Engineering
- Pharmaceutical Engineering
- Physics
- Power and Energy Systems
- Professional and Technical Communication
- Public Health
- Telecommunications
- Transportation

- Urban Systems

Mathematics

Administered By: Department of Mathematical Sciences

Administration

Chair	Daljit S. Ahluwalia
Associate Chair.	Jonathan H. Luke
Director, Undergraduate Program	Victor V. Matveev
Director, Graduate Studies	Michael R. Booty
Director, Statistics Program	Aridaman K. Jain
Departmental Coordinator	Padma Gulati

Faculty

Foundation Chair	Gregory A. Kriegsmann
Distinguished Professors	Gregory A. Kriegsmann, Robert M. Miura*
Professors	Daljit S. Ahluwalia, Roman I. Andrushkiw, John K. Bechtold, Manish Bhattacharjee, Denis L. Blackmore, Amitabha K. Bose, Michael R. Booty, Wooyoung Choi, Fadi Deek** , Lou Kondic, H M. Lacker* , Dorothy Levy, Jonathan H. Luke, Petronije Milojevic, Manuel Perez, Zoi-heleni Michalopoulou**** , Michael S. Siegel, Farzan Nadim***
Associate Professors	Bruce G. Bukiet, Hamilton A. Chase, Linda J. Cummings, Sunil K. Dhar, Rose Dios, Roy H. Goodman, Jorge P. Golowasch*** , David J. Horntrop, Jay M. Kappraff, Martin Katzen, Murray I. Lieb, Victor V. Matveev, Richard O. Moore, Peter G. Petropoulos, Roy A. Plastock, Horacio G. Rotstein, Sundarraman Subramanian, Cyrill B. Muratov
Assistant Professors	Shahriar Afkhami zakerzadeh, Yassine Boubendir, Chung Chang, Peter Gordon, Shidong Jiang, Yuan-nan Young
Senior University Lecturers	Aridaman K. Jain, Karen D. Rappaport, Jeyakumaran Ratnaswamy
Lecturers	Soha R. Abdeljaber, John Hunter, Diana P. Klimek, Soroosh Mohebbi Forushani, Jonathan J. Porus, Nemanja Nikitovic, Joseph Zaleski
Post Doctoral Fellows	Ricardo A. Lopes barros, Arnaud B. Goullet, Myongkeun Oh
Research Professors	Booth, Thomas Erneux, Christopher E. Elmer, Georgiev, Roberto Mauri, dalc, Jean Vanden-Broeck, Demetrius Papageorgiou, Christopher S. Raymond
Visiting Assistant Professors	Daniel E. Bunker***** , Kenneth A. Johnson, Ronald Sverdlove******

* Joint appointment with Department of Biomedical Engineering

** Joint appointment with the Department of Information Systems

*** Joint appointment with the Federated Department of Biological Sciences

**** Joint appointment with the Department of Electrical and Computer Engineering

***** With Biological Sciences

****** With School of Management

Degrees Offered:

- Master of Science in Applied Mathematics
- Master of Science in Applied Statistics
- Doctor of Philosophy in Mathematical Sciences

Master of Science in Applied Mathematics

This program is intended for students with a strong interest in Applied Mathematics. Applied Mathematics is the application of classical and modern mathematical techniques to the solution of practical problems in the physical and biological sciences and engineering. The applied mathematician develops and analyzes mathematical models of physical and biological phenomena and engineering systems, interprets solutions to mathematical problems and uses the results to identify relationships, patterns, and the effects of altering one or more variables or modeling assumptions. Many of the courses in the program illustrate how mathematics can be used to predict the behavior of physical, biological, and engineering systems.

The Master of Science in Applied Mathematics, with its areas of specialization in analysis, applied mathematics, computational methods, and mathematical biology is designed to serve the needs of students who may be interested in pursuing a doctoral degree in the mathematical, physical, or biological sciences. The program also strengthens the quantitative and analytical skills of students with a baccalaureate degree who are planning to work in industry, commerce, or education, as well as practicing engineers and others already employed in industry and commerce.

Admission Requirements:

It is expected that students applying for admission will have an undergraduate education in mathematics, the physical or biological sciences, or engineering. For additional information, see the Admissions section of this catalog. An undergraduate GPA of at least 2.8 on a 4.0 scale or equivalent is normally required. GRE scores are required for those students applying for financial support, or if the most recent degree was earned at a school outside the United States. Applications are considered on a case-by-case basis.

Bridge Program: Students with a baccalaureate degree in an area different from mathematics may be admitted and required by the department to take an individually-designed program of courses that may include undergraduate courses before proceeding to the graduate curriculum. Such courses do not count towards a graduate degree.

Degree Requirements:

The Master of Science in Applied Mathematics requires 30 credits: 15 credits in core courses, 15 credits in an area of specialization, of which six credits are required and nine credits are electives. Students must successfully complete at least 24 of these credits at the 600-level or higher, and no more than six credits at the 500-level will be counted towards the degree. Specific course requirements depend on the area of specialization. A master's thesis or a master's project is optional. (Advisor's permission is required)

Seminar: In addition to the minimum 30 degree credits required, all students who receive departmental or research-based awards must enroll every semester in Math 791 Graduate Seminar.

Core:
15 credits:

		Math 613	Advanced Applied Mathematics I: Modeling (3 credits)
		Math 631	Linear Algebra (3 credits)
	#	Math 645	Analysis I (3 credits)
		Math 656	Complex Variables I (3 credits)
		Math 689	Advanced Applied Mathematics II: Ordinary Differential Equations (3 credits)

Project, Thesis (optional):

		Math 700	Master's Project (3 credits)
		Math 701	Master's Thesis (6 credits)

Required Courses in Areas of Specialization:
6 credits:
Analysis:

		Math 745	Analysis II (3 credits)
		Math 756	Complex Variables II (3 credits)

Applied Mathematics:

		Math 614	Numerical Methods I (3 credits)
		Math 690	Advanced Applied Mathematics III: Partial Differential Equations (3 credits)

Computational Mathematics:

		Math 614	Numerical Methods I (3 credits)
		Math 712	Numerical Methods II (3 credits)

Mathematical Biology:

		Math 635	Analytical Computational Neuroscience (3 credits)
		Math 637	Foundations of Mathematical Biology (3 credits)

Elective:
9 credits selected with approval of graduate advisor.

Electives are chosen in consultation with a Departmental Graduate Advisor and consist of advanced courses in mathematics and advanced courses from biology, physics, computer science, and engineering, for example. Courses offered by appropriate departments at NJIT, UMDNJ, and Rutgers-Newark can be used as electives within the limits of the NJIT transfer policy. All elective courses must be approved by the graduate advisor.

Master of Science in Applied Statistics

The objective of the Master of Science in Applied Statistics is to prepare students for a wide range of professional activities as practicing statisticians in both academia and industry. A statistician develops and analyzes models of data-driven situations where uncertainty of the outcomes plays a major role, identifies statistical relationships among observable variables, forecasts probable future outcomes, and draws inferences about background parameters that impact the phenomenon of interest. Thus the program is designed to provide students with the comprehensive knowledge and technical skills that are needed for the planning, execution, and analysis of statistical studies. These statistical studies are increasingly used as advisory instruments for policy decisions in the corporate and other sectors of the economy.

The Master of Science in Applied Statistics program will serve the needs of students with a baccalaureate degree who are planning to work in industry, commerce, or education, as well as practicing engineers and others already employed in industry and commerce. The program also strengthens the analytical and quantitative skills of graduate students who may be interested in pursuing a doctoral degree in Applied Probability and Statistics, since it equips them with basic training in the foundations of statistics in preparation for further advanced studies and research.

Admission Requirements:
Applicants must have a degree from an accredited institution with at least 12 credits in mathematics, including calculus. Students who do not meet these requirements may be admitted if they satisfy the university's requirements for admission. An undergraduate GPA of at least 2.8 on a 4.0 scale or equivalent is normally required. GRE scores are required for those students applying for financial support, or if the most recent degree was earned at a school outside the United States. Applications are considered on a case-by-case basis.

Bridge Program: Students who do not satisfy the credit requirement in mathematics will be required to take a bridge program of six credits in appropriate mathematics courses. Such courses do not count towards a graduate degree.

Degree Requirements:
The Master of Science in Applied Statistics requires 30 credits: 21 credits in core courses and 9 credits of elective courses. Students must successfully complete at least 24 of these credits at the 600-level or higher, and no more than six credits at the 500-level will be counted towards the degree. A master's thesis or a master's project is optional.

Seminar: In addition to the minimum 30 degree credits required, all students who receive departmental or research-based awards must enroll every semester in Math 791 Graduate Seminar.

Core:

21 credits:

{		Math 611	Numerical Methods for Computation (3 credits) ***or***
		Math 630	Linear Algebra and Applications (3 credits)
		Math 644	Regression Analysis Methods (3 credits)
	*	Math 661	Applied Statistics (3 credits)
		Math 662	Probability Distributions (3 credits)
		Math 664	Methods for Statistical Consulting (3 credits)
		Math 699	Design and Analysis of Experiments (3 credits)
		Math 762	Statistical Inference (3 credits)

Project, Thesis (optional):

		Math 700	Master's Project (3 credits)
		Math 701	Master's Thesis (6 credits)

Elective:

9 credits selected with approval of graduate advisor.

Electives are chosen in consultation with a departmental graduate advisor and consist of advanced courses in mathematics and statistics and advanced courses from engineering, computer science, and biology that have a significant statistics content. Students are encouraged to choose courses in application areas. Courses offered by appropriate departments at NJIT, UMDNJ, and Rutgers University-Newark can be used as electives within the limits of the NJIT transfer policy. All elective courses must be approved by the graduate advisor.

Master of Science in BioStatistics

The Master of Science program in Biostatistics will provide advanced graduate education and training to students interested in applying statistical methods to the health sciences in general and clinical studies in particular. It will focus on training students in quantitative methods that will prepare them for careers in the health, life sciences, and pharmaceutical areas. Graduates, upon satisfactory completion of the degree program, are expected to have acquired appropriate skills in data analysis and computing that are typically required in their profession. This program will address the growing demand for trained biostatisticians in these fields, especially in New Jersey.

Admission Requirements:

Applicants must have a baccalauareate degree in Statistics, Mathematics, Sciences, or Engineering, with at least 12 credits in mathematics, including calculus and at least one upper division course in statistics. Applicants with other baccalaureate degrees will also be considered and may be subject to a suitable bridge program. An undergraduate GPA of at least 3.0 on a 4.0 scale or equivalent is required.

Bridge Program:

Students who do not satisfy the credit requirement in mathematics will be required to take a suitable bridge program of appropriate mathematics/ statistics courses. Such courses do not count towards the graduate degree.

Degree Requirements:

A minimum of 30 credits is required for the degree. Bridge courses, if any, will not count toward degree credits. The graduate curriculum consists of seven core courses in background statistical theory and biostatistics, as described in the curriculum below. The remaining courses are electives, chosen in consultation with a departmental graduate advisor and consist of topics courses in statistics, biostatistics, epidemiology and biology that have significant statistics content or/and applications thereof. Students will be encouraged to choose courses in application areas. Courses offered by appropriate departments at NJIT, UMDNJ, and Rutgers University-Newark can be used as electives within the limits of the NJIT transfer policy. A masters project is optional, and is in addition to the minimum 30 approved credits, required for the degree.

Core Courses:

		Math 644	Regression Analysis Methods (3 credits)
		Math 654	Clinical Trials Design and Analysis (3 credits)
		Math 659	Survival Analysis (3 credits)
		Math 662	Probability Distributions (3 credits)
		Math 663	Introduction to Biostatistics (3-0-3)
		Math 665	Statistical Inference (3 credits)
		Math 699	Design and Analysis of Experiments (3 credits)

Electives:

At least three from the following illustrative list:

		Math 664	Methods for Statistical Consulting (3 credits)
		Math 691	Stochastic Processes with Applications (3 credits)
		Math 698	Sampling Theory (3 credits)
		Math 707	Advanced Applied Mathematics IV: Special Topics (3 credits)
		Math 786	Large Sample Theory and Inference (3 credits)
		Math 787	Non-Parametric Statistics (3 credits)
		UMDNJ	(UMDNJ Courses)
		PHCO-0502J	(Introduction to Epidemiology) (3 credits)

Electives are chosen in consultation with a departmental graduate advisor. Subject to such approval, courses offered by appropriate departments at NJIT, UMDNJ, and Rutgers University-Newark can be used as electives within the limits of the NJIT transfer policy. All elective courses must be approved by the graduate advisor.

Doctor of Philosophy in Mathematical Sciences

The Doctor of Philosophy in Mathematical Sciences is offered in collaboration with the Department of Mathematics and Computer Science at Rutgers University-Newark. The doctoral program in Mathematical Sciences is designed to prepare students for a wide range of professional activities in science and engineering. Prospective students must choose one of the following tracks:

- Applied Mathematics
- Applied Probability and Statistics
- Pure Mathematics

The doctoral program reflects the research interests of the faculty and is focused on the development and use of mathematical tools for solving modern scientific, technological and industrial problems, and advancing the research knowledge and methodology in various fields of specialization.

The Applied Mathematics track emphasizes the applications of mathematical methods to the physical and biological sciences and engineering, including acoustics, electromagnetics, fluid dynamics, materials science, biology, and medicine. Mathematical modeling, asymptotic analysis, and scientific computing are emphasized. Students are expected to develop a broad range of capabilities both in mathematics and in an area of application.

The Applied Probability and Statistics track emphasizes directed instruction and independent research in areas that are specializations of the faculty. Current research interest areas of the faculty include applied probability, nonparametric statistics, and statistical reliability theory and applications.

The Pure Mathematics track offers research opportunities in many fields of specialization, including representation theory, number theory, low-dimensional topology, Riemann surfaces and Kleinian groups, geometric group theory, and 4-manifolds.

Admission Requirements:

Admission to the program is based on a review of the applicant's credentials and interests as expressed in academic transcripts, GRE scores, letters of recommendation, statement of interests, and TOEFL scores (for students whose native language is not English). Applicants with strong academic records whose abilities and interests complement the research of the faculty are sought. In general, applicants should have a bachelor's or master's degree in mathematics, an engineering discipline, or a branch of the natural sciences. Students choosing the Applied Mathematics track or the Applied Probability and Statistics track must fulfill the admissions requirements specified in the Admissions section of this catalog.

Students interested in either the Applied Mathematics track or the Applied Probability and Statistics track should apply to NJIT. Students interested in the Pure Mathematics track should apply to Rutgers-Newark.

Degree Requirements:

Applied Mathematics Track (NJIT)

Students choosing the applied mathematics track must fulfill the requirements for the doctor of philosophy as specified in this catalog. Specific courses of study are planned in consultation with a faculty advisor and are subject to approval. In general, students are encouraged to take courses both in mathematics and in areas of application.

Semester 1

		Math 599	Teaching in Mathematics (3 credits)
		Math 613	Advanced Applied Mathematics I: Modeling (3 credits)
		Math 631	Linear Algebra (3 credits)
		Math 645	Analysis I (3 credits)

Semester II

		Math 614	Numerical Methods I (3 credits)
		Math 656	Complex Variables I (3 credits)
		Math 689	Advanced Applied Mathematics II: Ordinary Differential Equations (3 credits)
		Math 745	Analysis II (3 credits)

Semester III

		Math 671	Asymptotic Methods I (3 credits)
		Math 690	Advanced Applied Mathematics III: Partial Differential Equations (3 credits)
		Math 712	Numerical Methods II (3 credits)
		Math 756	Complex Variables II (3 credits)

Semester IV

		Math 676	Advanced Ordinary Differential Equations (3 credits)
		Math 707	Advanced Applied Mathematics IV: Special Topics (3 credits)
		Math 713	Advanced Scientific Computing: Multi-Dimensional Finite-Difference Schemes and Spectral Methods (3 credits)
		Elective	(Course from Natural Sciences or Engineering Relevant to Student's Interests.)

In addition to these courses, there are advanced courses in:

- Mathematical Fluid Dynamics I and Mathematical Fluid Dynamics II (Math 715 , Math 716)
- Mathematical Biology (Math 637 , Math 672 , Math 673)
- Wave Propagation (Math 722)
- Asymptotic Methods II (Math 771)
- Mathematical Modeling II (Math 639)
- Partial Differential Equations (Math 675)
- Inverse Problems and Global Optimization (Math 717)

Also, there are special topics courses in:

- computational electromagnetics
- computational fluid dynamics
- computational neuroscience
- financial mathematics
- integral equations

- materials science
- microwave processing of materials
- courses in probability and statistics

Qualifying Examination: The qualifying examination for the applied mathematics track consists of three components: Analysis, Linear Algebra - Numerical Methods, and Applied Mathematics. Students must achieve a grade of A in each component to pass the qualifying examination. Components may be passed at different times. However, a student may attempt each component at most twice and must pass all three components by the end of the second year in the program. Typically, two opportunities to take each component are provided each year: Analysis and Linear Algebra - Numerical Methods (August and January), Applied Mathematics (January and May).

The following courses will be useful in helping the students to prepare for the qualifying examinations : Math 645, Math 656, and Math 745 for Analysis; Math 614 and Math 631 for Linear Algebra Numerical Methods; and Math 613, Math 689, and Math 690 for Applied Mathematics. It should be noted that taking the above courses is not mandatory but students are strongly encouraged to take them before attempting the qualifying examinations. The scope of the qualifying examinations is not limited to the specific list of topics covered in these courses, but these topics are indicative of the overall scope of these examinations.

Dissertation Committee: The dissertation committee is an important resource for the doctoral student in the conduct of research for their dissertation. Within six months of passing the qualifying examination a dissertation committee must be formed according to the regulations specified in this catalog.

Dissertation Proposal: Doctoral students must prepare a research proposal for approval by their dissertation committee. The student must offer an oral defense of this proposal before the dissertation committee and obtain its approval within one year of passing the qualifying examination. The committee determines if the proposal has an appropriate objective, if there is a reasonable plan to reach that objective, and if the student possesses the knowledge and skills needed to carry out the plan. The dissertation proposal can only be approved by unanimous consent of the committee members.

Dissertation Defense: A public oral defense of the dissertation before the dissertation committee is required. All members of the committee must be present for the defense. Success of the defense is determined by a majority vote of the dissertation committee.

Applied Probability and Statistics Track (NJIT)

Students choosing the applied probability and statistics track must fulfill the requirements for the doctor of philosophy as specified in this catalog. Specific courses of study are planned in consultation with a faculty graduate advisor and are subject to approval. In general, students are encouraged to take courses both in mathematics and in areas of application.

Seminar: In addition to the minimum degree credits required, all doctoral students must enroll each semester Math 791 Graduate Seminar

Courses: A typical schedule of courses for the first four semesters in Applied Probability and Statistics consists of the following:

Semester I

Math 599	Teaching in Mathematics (3 credits)
Math 631	Linear Algebra (3 credits)
Math 645	Analysis I (3 credits)
Math 662	Probability Distributions (3 credits)

Semester II

Math 644	Regression Analysis Methods (3 credits)
Math 668	Probability Theory (3 credits)
Math 745	Analysis II (3 credits)
Math 762	Statistical Inference (3 credits)

Semester III

		Math 646	Time Series Analysis (3 credits)
		Math 699	Design and Analysis of Experiments (3 credits)
		Math 787	Non-Parametric Statistics (3 credits)
		Elective	(Course in statistics/mathematics/engineering/computing sciences relevant to student's interest.)

Semester IV

		Math 664	Methods for Statistical Consulting (3 credits)
		Math 698	Sampling Theory (3 credits)
		Math 707	Advanced Applied Mathematics IV: Special Topics (3 credits)
		Elective	(Course in statistics/mathematics/engineering/computing sciences relevant to student's interest.)

In addition to these courses, there are advanced courses in:

- Time Series Analysis - II (Math 647)
- Stochastic processes with applications (Math 691)
- Statistical reliability theory and applications (Math 761)
- Large sample theory and inference (Math 786)

Also, there are special topics courses (Math 707), in:

- Categorical data analysis,
- Financial mathematics.
- Generalized linear models,
- Markov chain Monte Carlo methods,

Qualifying Examination: The qualifying examination for the applied probability and statistics track consists of three components: Analysis, Linear Algebra, and Statistics. Students must achieve a grade of A in each component to pass the qualifying examination. Components may be passed at different times. However, a student may attempt each component at most twice and must pass all three components by the end of the second year in the program. Typically, two opportunities to take each component are provided each year: Real Analysis and Probability, Linear Algebra, Distribution Theory and Statistical Inference (August and January); Topics in Statistics (January and May).

The following courses will be useful in helping the students to prepare for the qualifying examinations : Math 645, Math 668, and Math 745 for Real Analysis and Probability; Math 631, Math 662, and Math 762 for Linear Algebra, Distribution Theory and Statistical Inference; Math 644, Math 699, and Math 707 (Linear Models) for Topics in Statistics. The scope of the "Topics in Statistics" examination may include additional advanced courses in statistics that the students may have taken. It should be noted that taking the above courses are not mandatory but students are strongly encouraged to take them before attempting the qualifying examinations. The scope of the qualifying examinations is not limited to the specific list of topics covered in these courses, but these topics are indicative of the overall scope of these examinations.

Dissertation Committee: The dissertation committee is an important resource for the doctoral student in the conduct of research for their dissertation. Within six months of passing the qualifying examination a dissertation committee must be formed according to the regulations specified in this catalog.

Dissertation Proposal: Doctoral students must prepare a research proposal for approval by their dissertation committee. The student must offer an oral defense of this proposal before the dissertation committee and obtain its approval within one year of passing the qualifying examination. The committee determines if the proposal has an appropriate objective, if there is a reasonable plan to reach that objective, and if the student possesses the knowledge and skills needed to carry out the plan. The dissertation proposal can only be approved by unanimous consent of the committee members.

Dissertation Defense: A public oral defense of the dissertation before the dissertation committee is required. All members of the committee must be present for the defense. Success of the defense is determined by a majority vote of the dissertation committee.

Pure Mathematics Track (Rutgers-Newark)

Students interested in the Pure Mathematics track should contact the Department of Mathematics and Computer Science at Rutgers-Newark.

Students specializing in Applied Mathematics or Computational Mathematics may take Math 545 Introductory Mathematical Analysis and Math 546 Advanced Calculus, instead of Math 645 and 3 credits of elective.

* The requirements of Math 661 may, in individual cases, be substituted by Math 663, Introduction of Biostatistics, at the discretion of the Graduate Advisor. Both Math 661 and Math 663 cannot be used towards degree credits at NJIT.

Catalog and curricula information approved by the relevant academic department.

Architecture

Administered By: College of Architecture and Design

Administration

Dean	Urs P. Gauchat
Associate Dean	Margaret Fitzpatrick
Graduate Program Director (Acting)	Anthony W. Schuman
MIP Planning Program Director	Antonio P. De Sousa Santos
Graduate Program and Admissions Coordinator	Frederick A. Little
Undergraduate Program Director	Donald R. Wall

Faculty

Distinguished Professor	Zeynep Celik, G M. Mostoller
Professors	Karen A. Franck, Urs P. Gauchat, Glenn Goldman, David L. Hawk* , Peter C. Papademetriou, Antonio P. De Sousa Santos
Associate Professors	David H. Elwell, Gabrielle Esperdy, Sandy Moore, Anthony W. Schuman, Darius T. Sollohub, Donald R. Wall, Michael S. Zdepski
Assistant Professors	Richard J. Garber, Wassim Jabi, Georgeen Theodore
Research Professors	Ervin Bales, Richard V. Olsen

Advisors

Graduate Advisor	Anthony W. Schuman
Advisor	
Undergraduate Advisor	Eloise S. Matzko
Interim Undergraduate Advisor	Frederick A. Little

* Joint appointee with the School of Management.

Degrees Offered: Master of Architecture (professional and post-professional options); Master of Science in Architectural Studies; Master in Infrastructure Planning; and dual Master of Architecture (professional, or post-professional) and either Master in Infrastructure Planning, or Master of Science in Management or Master of Science in Civil Engineering

Graduate architectural education exposes students to the broad intellectual inquiry of the academy and the specific technical knowledge required in the world of professional practice. Sustainable design is a basic attitude which informs our entire curriculum. Communication skills move from basic visual literacy to instruction in the principles and techniques of digital design: computer-aided design (CAD), computer-aided manufacturing (CAM), three-dimensional digital rendering, and digital animation. Students gain experience through individual design studio projects that range from the small-scale design and manufacture of a single object to a large-scale design of communities.

Our location-five minutes from Newark Penn Station by subway, and thirty minutes from Midtown Manhattan-gives students access to a faculty drawn from the largest concentration of design professionals in the country, and enables those faculty to treat design as a diverse series of real projects on real sites in a vital metropolitan region. In combination with the unparalleled internship opportunities available in New York and Northern New Jersey and the availability of dual degree programs, this approach allows students to both prepare for a career in architecture and to find a direction within the field. The architect envisions and imagines both what is possible, and what ought to be. As a process, design gives form to society and the economic and technological aspects of environmental order.

For students in the Professional M.Arch. Program, partnerships through dual degree tracks in infrastructure planning, management and civil engineering can broaden a general education in architecture. Post-professional opportunities for specialized career directions, scholarly inquiry and research are also offered through degree programs in architectural studies and infrastructure planning.

The faculty comprises practitioners and scholars whose expertise and professional reputation are based on both breadth and depth of achievement. Their work directly engages the architectural discourse through research, publication, public lectures, symposia and professional practice. Many members have received scholarly recognition and design awards.

The New Jersey School of Architecture offers the only publicly supported professional program in New Jersey and is committed to NJIT's reputation as a nationally recognized technological university.

To become registered as a licensed architect in the State of New Jersey, you must earn a degree accredited by the National Architectural Accrediting Board (NAAB). NJIT's M.Arch. degree program is one of only two NAAB-accredited degree programs in the State of New Jersey.

The following statement is taken from the current edition of NAAB's *Conditions and Procedures for Professional Degree Programs in Architecture*: "In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB), which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes three types of degrees: the Bachelor of Architecture, the Master of Architecture and the Doctor of Architecture. A program may be granted a 6-year, 3-year, or 2-year term of accreditation, depending on its degree of conformance with established educational standards.

Master's degree programs may consist of a pre-professional undergraduate degree and a professional graduate degree, which when earned sequentially, constitute an accredited professional education. However, the pre-professional degree is not, by itself, recognized as an accredited degree."

The NJIT Master of Architecture (M.Arch.) is a professional degree fully accredited by the NAAB.

Master of Architecture (M.Arch.)

There are two degree options in the M.Arch. program: professional M.Arch. and post-professional M.Arch.

Professional M.Arch.: For students with undergraduate or graduate degrees who do not have previous architectural design courses or experience; the full-time program of study comprises seven semesters and meets the education requirements for the Architecture Registration Examination (ARE). It is also appropriate for students who have undergraduate degrees in architecture or related fields, those who have a non-NAAB accredited architecture degree, and all international students who would enter the program with advanced placement. Advanced placement, which reduces the 97-credit degree requirement, is determined at the time of admission through an evaluation of previous academic work.

Post-professional M.Arch.: For students who have an NAAB-accredited professional Bachelor of Architecture (B.Arch.) or an equivalent international degree. International students who intend to pursue professional licensure in the U.S. should apply to the Professional M. Arch Program.

Dual Degree M.Arch. and Master of Infrastructure Planning (M.I.P.): Open only to students in the M.Arch. program options, the dual degree program permits students to obtain an M.I.P. in substantially less time than if taken separately; in some cases in only one more semester of full-time study. Also see the program description under "Infrastructure Planning" in this catalog.

Dual Degree M.Arch. and M.S. in Management: Open only to students in the M.Arch. program options, the dual degree program permits students to obtain an M.S. in Management in substantially less time; in some cases in only one more semester of full-time study. Also see the program description under "Management" in this catalog.

Dual Degree M.Arch. and M.S. in Civil Engineering: Open only to students in the M.Arch. program options. The dual degree program permits students to obtain an M.S. in Civil Engineering in substantially less time; in some cases in only one more semester of full-time study. Also see the program description under "Civil Engineering" in this catalog.

Admission Requirements for all M.Arch. Options:

In addition to completing the application required by NJIT's Office of University Admissions, M.Arch. applicants must also submit School of Architecture supplementary materials forms. To ensure prompt consideration, students should request the forms when they apply for admission to the university.

Applicants are expected to have a minimum undergraduate GPA of 3.0. GRE (general test) scores are required. Applicants to the M.Arch./M.S. in Management degree option may submit GRE scores in lieu of the GMAT scores which are normally required for admission to the M.S. in Management program. Exclusive of the GMAT/GRE requirements, dual degree applicants must satisfy admission requirements for both the School of Architecture and the School of Management.

Admission to the M.Arch. program is based on the applicant's personal statement, letters of recommendation, design portfolio, and previous academic and work experience. Applicants should have an appropriate academic background in calculus, or statistics; students who lack such a background will be expected to take equivalent course work before entering the second year of the M.Arch. program. Applicants from non-architectural backgrounds are strongly advised that coursework in drawing, studio art, and AutoCAD is useful preparation for graduate study in architecture, and helpful in the process of generating work for inclusion in the portfolio required as an element in all applications. International students with professional degrees in architecture are required to have transcripts evaluated by Educational Credential Evaluators (information is included with School of Architecture supplementary materials). TOEFL scores are required for all international students, 550 (pencil and paper) and 213 (computer-based).

Graduate Certificate Programs: A 12-credit graduate certificate in Sustainable Architecture is available as a step toward either the Post-Professional M.Arch. or the MSAS degrees. Students in the Professional M.Arch. Program may use some or all of the courses in this certificate program to satisfy upper-level architecture and free electives. See Graduate Certificates in this catalog for further information. For more information on continuing and distance education, contact the Division of Continuing Professional Education, 1-800-624-9850 or 973-596-3060; email: cpe@njit.edu.

Degree Requirements for Professional M.Arch.:
This 97-credit program consists of a 61-credit core and an options sequence of 21 credits of required and 15 credits of elective courses. Students are expected to complete the core sequence in a minimum of two years. Before registering for courses, all students must consult with the graduate advisor to plan an appropriate course of study.

Students must submit a portfolio of design work at completion of the core courses. The portfolio will be reviewed in connection with advising students on their further program of study.

Core courses in the M.Arch. program represent the minimum background necessary to meet NAAB standards. If students demonstrate that they have previously completed equivalent course work, degree credit requirements may be reduced to less than the 97 credits required for the program.

To remain in good academic standing, students must maintain a cumulative GPA of 3.0 in graduate courses. Students must repeat any design studio course in which they receive a grade of C. A grade of C+ in any design studio must be followed by a subsequent grade sufficient to raise the annual cumulative design studio GPA to 2.75. Incomplete (I) grades for studio and prerequisite courses must be removed before students will be permitted to register for continuing course work in the program.

Degree credits appear in parentheses following the course titles below.

CORE:
61 credits as follows:

		Arch 500G	Computer Programming and Graphics Problems (2 credits)
		Arch 501G	Architectural Design I (5 credits)
		Arch 502G	Architectural Design II (5 credits)
		Arch 503G	Architectural Design III (5 credits)
		Arch 504G	Architectural Design IV (5 credits)
		Arch 511G	Structures I (3 credits)
		Arch 512G	Structures II (3 credits)
		Arch 513G	Structures III (3 credits)
		Arch 521G	Construction I (3 credits)
		Arch 522G	Construction II (3 credits)
		Arch 523G	Building Performance (3 credits)
		Arch 524G	Environmental Control Systems (3 credits)

		Arch 528G	History of Architecture I (3 credits)
		Arch 529G	History of Architecture II (3 credits)
		Arch 555G	Architectural Graphics (3 credits)
		Arch 569G	Building and Development (3 credits)

6 additional credits of architectural history, selected in consultation with graduate advisor

Core courses must be completed before proceeding to the options sequence.

Option Sequence:
Required:
21 credits minimum:

		ARCH505G	
		ARCH506G	
{		ARCH507G	***or***
	*	MARC 701	Master's Thesis (6 credits)
		Arch 579G	Professional Architectural Practice (3 credits)

Elective:
15 credits selected in consultation with graduate advisor, of which a minimum of 9 credits are architecture electives.

Degree Requirements for Post-Professional M.Arch.

Consists of a minimum of 30 credits. Thesis is optional.

Required:

		ARCH506G	
{		ARCH507G	***or***
	*	MARC 701	Master's Thesis (6 credits)

Elective:
18 credits consisting of 12 credits of architecture electives and 6 credits of free electives selected in consultation with graduate advisor.

Degree Requirements for Dual M.Arch. and M.I.P.:
This dual degree option is available to students in the M.Arch. degree program. The dual degree program permits students to obtain the M.Arch. and the M.I.P. in substantially less time than if each degree was pursued separately. M.Arch. students may partially fulfill M.I.P. course work while completing the M.Arch. program of study. A maximum of 15 credits may be used to satisfy requirements of both degrees.

For more information about the M.I.P. program, see �Infrastructure Planning� in this catalog.

Required:
15 credits:

		ARCH507G	
		Arch 631H	History and Theory of Infrastructure (3 credits)
{		Arch 673	Infrastructure Planning in Practice (3 credits) ***or***
		Arch 674	Infrastructure and Architecture (3 credits)
		Arch 675	Elements of Infrastructure Planning (3 credits)

Additional requirements to complete M.I.P. program:

Required:

21 credits:

		MIP 602	Interdisciplinary Infrastructure Studio II (6 credits)
		MIP 612	Introduction to Environmental Policy Studies (3 credits)
		MIP 615	Introduction to Transportation Studies (3 credits)
		MIP 618	Public and Private Financing of Urban Areas (3 credits)
		MIP 652	Geographic Information Systems (3 credits)
		MIP 655	Land Use Planning (3 credits)

Degree Requirements for Dual M.Arch. and M.S. in Management:

The dual degree option is only available to students pursuing the M.Arch. The dual degree program permits students to obtain both an M.Arch. and a M.S. in Management in substantially less time; in some cases in only one more semester of full-time study. A maximum of 15 credits may be used to satisfy the requirements of both degrees.

Students take additional credits shown below to fulfill requirements for the M.S. in Management. There is no thesis requirement.

At the time of admission to the dual degree program, the School of Management graduate advisor will determine if any M.S. in Management course requirements can be waived.

The requirements to obtain the M.S. in Management degree are:

** Core:

18 credits:

		Arch 650	Economy of Building (3 credits)
		Arch 651	Real Estate Analysis for Architects (3 credits)
		Arch 652	Architectural Project Management (3 credits)
		Fin 516	Principles of Financial Management (3 credits)
		HRM 601	Organizational Behavior (3 credits)
{		Mgmt 680	Entrepreneurial Strategy (3 credits) ***or***
		Mgmt 692	Strategic Management (3 credits)

Required:

3 credits:

		Fin 618	Public and Private Financing of Urban Areas (3 credits)

Elective:

9 credits from:

		Acct 615	Management Accounting (3 credits)
		Fin 624	Corporate Finance II (3 credits)
		Mgmt 640	New Venture Management (3 credits)
		Mgmt 645	New Venture Finance (3 credits)
		MIS 645	Information Systems Principles (3 credits)
		Mrkt 630	Models of Consumer Behavior (3 credits)
		Mrkt 638	Sales Management for Technical Professionals (3 credits)

Degree Requirements for Dual M.Arch. and M.S. in Civil Engineering:

This dual degree option is a specific tailoring of the construction engineering and management specialization in the M.S. in Civil Engineering program and is only available to students pursuing the M.Arch. degree.

The dual degree program permits students to obtain both an M.Arch. and a M.S. in Civil Engineering in substantially less time than if each degree was pursued separately. A maximum of 15 credits may be used to satisfy requirements of both degrees.

Students take courses shown below to fulfill requirements for the M.S. in Civil Engineering, or their equivalent. There is no thesis requirement. Students without a bachelor�s degree in civil engineering must complete the bridge program; these courses do not count toward degree requirements.See the undergraduate catalog for descriptions of these courses.

At the time of admission to the dual degree program, the civil engineering graduate advisor will determine if any M.S. in Civil Engineering course requirements can be waived.

The requirements to obtain the M.S. in Civil Engineering degree are:

Bridge:

CE 200	Surveying (3-0-3)
CE 200A	Surveying Laboratory (0-3-1)
CE 501	Introduction to Soil Behavior (3 credits)
Math 105	Elementary Probability and Statistics (3-0-3)
MATH119	

Core:

CE 610	Construction Management (3 credits)
CE 611	Project Planning and Control (3 credits)
CE 616	Construction Cost Estimating (3 credits)
EM 632	Legal Aspects in Construction (3 credits)

Required:
12 credits:

Arch 650	Economy of Building (3 credits)
Arch 652	Architectural Project Management (3 credits)
Arch 675	Elements of Infrastructure Planning (3 credits)
MIS 645	Information Systems Principles (3 credits)

Elective:
6 credits from:

CE 615	Infrastructure and Facilities Remediation (3 credits)
CE 631	Advanced Reinforced Concrete Design (3 credits)
CE 642	Foundation Engineering (3 credits)
CE 702	Special Topics in Civil Engineering (3 credits)
CE 710	Systems in Building Construction (3 credits)
CE 711	Methods Improvement in Construction (3 credits)
EnE 662	Site Remediation (3 credits)
EnE 671	Environmental Impact Analysis (3 credits)

Co-op Work Experience in Architecture and the Housing Scholars Program give students an opportunity to gain additive credits and salaried employment.

To become eligible to take the architecture registration examination in New Jersey, professional M.Arch. graduates must complete three years of practical work experience apprenticeship that meet specific criteria set by the New Jersey State Board of Architects. Co-op internship work experiences in architecture meeting these criteria are acceptable equivalents for such apprenticeships, and are available to NJIT students. Students become eligible after completing the first year of M.Arch. core courses.

The Housing Scholars Program provides college students with paid summer internships at non-profit, community-based affordable housing organizations, and is jointly administered by NJIT's Division of Career Development Services and the New Jersey Department of Community Affairs. Housing Fellows are placed with community-based, non-profit organizations that initiate affordable housing and related projects. Graduate students who have completed at least 28 credits of core courses and who have an overall cumulative GPA of 3.2 or above are eligible to participate. Scholars are selected through a competitive application to the Division of Career Development Services and an interview process throughout February and March, and begin their internship in early June.

Students should consult the School of Architecture co-op advisor for details on work experience and the Housing Scholars program.

Master of Science in Architecture (MSARCH)

A non-professional, non-design degree program for careers in architectural research and scholarship. Studies often involve interdisciplinary course work.

Admission Requirements:

Applicants are expected to have either an NAAB-accredited B.Arch., or a bachelor�s degree in architecture or disciplines related to production, operation or use of buildings.

In addition to completing the application required by NJIT�s Office of University Admissions, M.S.ARCH applicants must also submit School of Architecture supplementary materials forms. To ensure prompt consideration, students should request the forms when they apply for admission to the university.

Applicants are expected to have a minimum undergraduate GPA of 3.0. GRE (general test) scores are required.

Degree Requirements:

The program consists of 36 credits of required and elective courses and may be taken either full- or part-time. A thesis is required. Students are required to design their programs in consultation with the graduate advisor.

To remain in good academic standing, students must maintain a cumulative GPA of 3.0 in graduate courses.

Required:

18 credits:

		Arch 661	Directed Studies of Architecture (3 credits)
	***	Arch 686	Research Methods for Environmental Design (3 credits)
	***	Math 687	Quantitative Analysis for Environmental Design Research (3 credits)
		MSAS 701	Master of Science in Architectural Studies Thesis (6 credits)

Elective:

18 credits selected in consultation with the graduate advisor.

MASTER IN INFRASTRUCTURE PLANNING:

See "Infrastructure Planning" in this catalog for program description.

* Arch 661 Directed Studies of Architecture (3) is prerequisite for MARC 701 Master of Architecture Thesis. Arch 661 may be taken as an elective.

** For those pursuing the dual M.Arch. and M.S. in Management, Arch 579G fulfills Mgmt 691 Legal and Ethical Issues required for the M.S. in Management.

*** Or appropriate substitute selected with approval of Graduate Advisor

Biology

Administered By: Division of Biological Sciences / Department of Mathematical Sciences

Administration

Chair	Jorge P. Golowasch
Academic Coordinator	Karen Roach

NJIT Faculty

Distinguished Professor	Gene M. Jonakait
Professor	Farzan Nadim
Associate Professor	Jorge P. Golowasch
Assistant Professor	Andrew Hill, Gareth J. Russell

Rutgers-Newark Faculty

Chair.	Edward M. Bonder
Professors	Ann Cali, Harvey Feder(Associate Provost), Gerald Frenkel, Doina Ganea, David Kafkewitz, Edward Kirby(Dean: FASN), Judith Weis
Associate Professors	Edward M. Bonder, John Crow, Lion Gardiner, Andrew Kasper, John Maiello, Douglas Morrison
Assistant Professors	Jonathan Adams, Erik Paul Hamerlynk, Claus Holzapfel, Wilma Friedman, Haesum Kim

Advisors

Undergraduate Advisor	Jorge P. Golowasch
Undergraduate Advisor	Gene M. Jonakait
Undergraduate Advisor	Gareth J. Russell
Undergraduate Advisor	Karen Roach
Undergraduate Advisor	Andrew Hill
Graduate Advisor	Farzan Nadim

Degrees Offered: Master of Science in Biology; Doctor of Philosophy in Biology. Both degrees are offered jointly by NJIT and Rutgers-Newark.

Admission Requirements:

Applicants are expected to have an accredited undergraduate degree in biology from an accredited institution. Candidates with other appropriate backgrounds will be considered. The following cognate undergraduate courses are required: general chemistry, organic chemistry, physics, and calculus.

In addition to the application form, a personal statement, three letters of recommendation, undergraduate and graduate transcripts and GRE general test scores are required for admission. The subject test in biology is recommended. If applicable, TOEFL scores are also required.

Bridge Program: To ensure academic success in their graduate studies, students may be required to take additional undergraduate or graduate courses before beginning graduate curricula. Such courses are not counted toward degree requirements.

Facilities:
Departmental equipment, housed at Rutgers-Newark, includes a microscope facility second-to-none in the state of New Jersey. This facility comprises scanning and transmission-electron microscopes, a confocal microscope, and five image-processing stations. In addition, the department boasts an oligo synthesizer, automated DNA sequencer, ultracentrifuges, phosphor-imager, scintillation and gamma counters, FPLC, and AAALAC-approved animal facility, and a greenhouse. Individual research laboratories house tissue culture facilities, electrophysiological equipment, fluorescence microscopes, and thermal cyclers. Additional facilities are available at neighboring institutions. Affiliations are maintained with UMDNJ and industrial research laboratories.

Master of Science in Biology

The Master of Science in Biology is designed to provide students with advanced knowledge of both plant and animal biology and microbiology.

Degree Requirements:
A minimum of 30 credits is required. These must include at least one 3-credit course in each of four of the following five areas: cell biology and biochemistry, molecular biology, physiology, ecology, and plant biology. After taking one course from each of four of the five areas, students may choose to concentrate their remaining credits in any of these five areas. A research component may be satisfied by either writing a thesis or submitting a research paper. Students electing to write a thesis must complete a minimum of 24 credits of course work and 6 credits of research and must pass an oral defense of the submitted thesis. Students who choose the research paper option are required to take 30 credits of course work, pass a written comprehensive exam and complete a research paper.

Required:
30 credits selected in consultation with graduate advisor.

Thesis or Research Paper (required):
6 credits: master's thesis research, topic selected in consultation with graduate advisor or non-credit bearing research paper written on completion of 30 credits of course work.

Doctor of Philosophy in Biology

The Ph.D. in Biology is designed to provide students with advanced knowledge of research in the areas of cell/mollecular/biochemistry, ecology/evolution, or computational biology.

Degree Requirements:

The doctoral curriculum in biology is divided into three tracks. Students may select the cell/molecular/biochemical, the ecology/evolution or computational biology track. Each track has a set of required courses that provide a formal foundation in research fields covered in each track. Students must earn at least a grade of B in order to receive credit for these courses. The remainder of the course work is chosen in consultation between the student and the advisor and the Standards Committee with permission of the graduate program director. During the first year all doctoral students undertake rotations through at least two departmental research laboratories.

Required:
36 credits of course work, including:

- Core courses.
- Advanced Problems in Biology (R120:509/510) Laboratory Rotations.
- Biology Colloquium (R120:651/652).
- Electives

36 credits minimum of doctoral dissertation research

CORE (required):
Computational Biology Track:
15 *credits:*

		BIOL601	
		6 credits	(Mathematical and Computational Courses)
		6 credits	(Graduate level Biology courses pertinent to field of specialization)

Cell/Molecular/Biochemical Track:

10 credits:

		R120:515	Molecular Biology of Eukaryotes (3 credits)
		R120:524	
		R120:571	Biochemistry (4 credits)
		R120:652	Biology Colloquium (1)

Ecology/Evolution Track:

9 credits:

3 Credits from: Landscape Ecosystem and Community Ecology

		R120:586	Landscape Ecology (3 credits)
		R120:587	Systems Ecology: Ecosystems in the Landscape (3 credits)
		R215:589	

3 credits from: Organismal Ecology

		R215:533	The Behavior of Animal Populations (3 credits)
		R215:590	Population Ecology (4 credits)
		R120:593	Physiological Ecology (3 credits)

3 credits from: Evolution and Systemics

		R120:503	Plant Morphology (3 credits)
		R120:532	Evolution (3 credits)
		R120:594	Systematics (3 credits)

Qualifying Examination - At the completion of the core course requirements and of 6 credits of successful laboratory rotations, the student takes the qualifying examination. The examination consists of a written and oral examination in the cell/molecular/biochemical track; and a written review paper, an oral presentation, and an oral examination in the ecology/evolution track.

Formation of Dissertation Committee - After successful completion of the qualifying examination, the student chooses an advisor, begins research for the dissertation, and forms a dissertation committee. The dissertation committee for all students is composed of the student�s thesis advisor, and at least three other members of the graduate faculty. One member must be from outside the program. The dissertation committee administers at least one dissertation prospectus meeting and the final defense of the dissertation. In addition, the dissertation committee may meet with the student once every six months to assess the student's progress.

Biomedical Engineering

Administered By: Department of Biomedical Engineering

Adminstration

Interim Chairperson	Treena L. Arinzeh
Interim Undergraduate Program Director	David Kristol
MS Program Director.	Max Roman
Ph.D. Program Director	Richard A. Foulds

Faculty

Foundation Professor	William C. Van Buskirk(Biomechanics)
Distinguished Professor	William C. Van Buskirk
Professors	William C. Hunter, H M. Lacker
Research Professors	Michael Jaffe, Dentcho V. Ivanov, Hans R. Chaudhry, George Collins, Zohar Ophir, Willis B. Hammond
Associate Professors	Richard A. Foulds, Tara L. Alvarez, Treena L. Arinzeh
Assistant Professors	Sergei Adamovich, Mesut Sahin, Bryan J. Pfister, Cheul H. Cho
Special Lecturer	Bruno A. Mantilla, Joel Schesser, Judith D. Redling
Emeritus Professors	David Kristol, Stanley Reisman

Degrees Offered: Master of Science in Biomedical Engineering

Biomedical engineering is currently the fastest growing field of engineering in the U. S. and requires an education that draws from advanced engineering and computing as well as the biological and medical sciences. NJIT offers an extremely flexible Masters program that encourages students to contribute to an individualized plan of study that builds upon the strengths of their B.S. and develop expertise in an area of concentration leading to careers in research and/or product development, or to prepare for further study in medicine, dentistry, law, and management. Major areas in which NJIT offers courses and conducts research are bioinstrumentation, biomaterials and tissue engineering, biomechanics, neural engineering and rehabilitation engineering.

The M.S. in Biomedical Engineering program at NJIT currently has one of the top five enrollments among biomedical engineering masters programs in the nation. This allows the department to offer a comprehensive set of courses specifically in biomedical engineering, which are augmented by related engineering courses taught in other departments. NJIT's location, in the middle of the nation's largest concentration of biomedical industries, provides access to expert instructors who offer specialized courses, which add to the richness of the academic environment. These industries also support graduate internships and thesis work, and often provide employment after graduation. The NJIT campus is within walking distance of both the University of Medicine and Dentistry of New Jersey flagship campus and Rutgers University-Newark. Graduate education at the three institutions is enhanced by collaboration agreements that allow cross-registration for courses, use of libraries, and opportunities for independent research. This benefits biomedical engineering by opening the possibilities for MS students to take advanced biological and medical science courses in addition to engineering courses.

The NJIT Department of Biomedical Engineering has a very active research program that is accessible to Masters students and provides opportunities for thesis or other independent study, which integrates engineering and the medical sciences. Research is conducted cooperatively between NJIT and the medical and dental schools of UMDNJ, the Kessler Institute for Rehabilitation, St. Barnabas Medical Center, Veteran's Administration Medical Center in East Orange, the Children's Specialized Hospital, the Public Health Research Institute, the Rutgers Center for Biological and Molecular Neuroscience and other institutions in the New Jersey-New York metropolitan area. In addition, cooperative research opportunities exist with a number of biomedical device and pharmaceutical companies within a short commuting distance from NJIT.

Aim of the Program

This program provides the opportunity for individuals with degrees in biomedical engineering to focus on a specialized area to a much greater degree than could be done in their undergraduate studies. Similarly, it also allows those with engineering and science backgrounds in other fields to acquire knowledge and skill that will allow them to join this growing field. The intentional flexibility in the selection of courses reflects the expected maturity of the graduate students as they assume significant responsibility for planning their concentrations. This flexibility also encourages students to exhibit some curiosity about unfamiliar areas of biomedical engineering and allows them to take two courses that may be peripheral to their academic focus.

The opportunity to pursue a thesis has the benefit of allowing students to choose a topic in which they will demonstrate the ability to integrate what they have learned, execute a 2-semester technical project, and communicate their results. Students not electing to pursue a thesis may choose three additional courses (replacing the 6-credit thesis) that increase their depth in engineering and breadth in the life sciences. A 3-credit MS Project may replace one of these three additional courses and provide some of the same experiences as the thesis.

Eligibility for the Program

Students who have a B. S. degree in science or engineering are eligible. All applicants must have had courses in scientific computer programming, differential equations, statistics, and physiology. Students who are missing one or more of these can be conditionally admitted with a requirement to take undergraduate bridge courses. Certain graduate courses or concentrations may require additional background, such as, statics and/or dynamics, thermodynamics, and electronics. Students who do not have these prerequisites may be asked to take additional courses or acquire the necessary material through tutoring and independent study. Prospective students may contact the MS Program Director for advice regarding their specific needs.

Course Offerings

The courses offered through this program allow students to choose concentrations that genuinely reflect their needs and interests. The sample course concentrations listed below reflect a curriculum that is rich in cutting edge engineering and science, and deep in its content. This critical mass of courses at NJIT, UMDNJ and Rutgers allows students to acquire a level of expertise that is uncommon among most biomedical engineering programs. The students in this program are nearly evenly split between those continuing their education immediately following their BS and those who are returning to study after a number of years of employment. The same is true for the educational backgrounds of the students, with approximately half having studied biomedical engineering and the other half coming from different fields. Most candidates for the Masters degree enroll as full-time students. However, the degree can be completed on a part-time basis for those who wish to study while continuing to work. Most courses are offered in the late afternoon and in the evening.

In October 2005, the BME faculty voted to allow a non-thesis option. While the faculty believe that the thesis is very important, it also understands that many students (particularly those with experience in industry) may already have experienced the equivalent of an in-depth, year-long project, and can be better served by taking additional courses. Students who are entering the program directly from their BS studies, or are transitioning from a non-engineering field to biomedical engineering are strongly urged to choose the thesis option. Students considering a thesis are directed to the NJIT Library's web site where most recent theses are available online. Those who have questions about the scope and content of biomedical engineering theses should review several that fall within their areas of interest. These can be found at http://www.library.njit.edu/etd/list-majors.cfm?d=Biomedical-Engineering

Co-op Opportunities and Internships

Students have the opportunity to participate in the co-op and internship programs at neighboring medical institutions or at biomedical engineering firms to gain practical experience. NJIT is situated in an area that contains many major biomedical engineering and pharmaceutical companies. The biomedical engineering department has a part-time advisor for co-op and internship experiences.

Prospects for Employment

Considerable opportunity exists in the field of biomedical engineering. This takes the form of basic and applied research and product development. Employment may be found in medical institutes, government agencies, corporations and hospitals, all of which are involved in the design, manufacture and utilization of equipment and procedures intimately involved in health care improvement. Many students go on to obtain professional degrees in medicine, dentistry, law or administration for which an engineering background is becoming ever more important.

Specifics of the M.S. in Biomedical Engineering

Admission Requirements:

Prospective students seeking admission to the Program must have an undergraduate degree in engineering, science or mathematics and satisfy the admission and academic requirements of the Graduate School.

1. General Guidelines:
   Each program of study must satisfy the Graduate School academic requirements (see the latest graduate catalog at www.njit.edu).
2. Prerequisite Courses
   Minimum Undergraduate Requirements for the Program: B.S. in Biomedical, Chemical, Electrical, Computer, or Mechanical Engineering. Applicants with a B.S. in Computer Science are expected to have had Calculus through differential equations, one full year of Physics, one full year of Chemistry, and a course in Physiology. Applicants with strong life science or medical education, including the equivalent of one full year of Physics as well as Calculus through differential equations, will be considered on a case-by-case basis. Conditional admission may be granted to applicants lacking full preparation with a requirement to take undergraduate bridge courses that will not carry graduate credit.

Admitted students who have not previously taken an upper level physiology course will be required to take BME 669-Engineering Physiology or an equivalent course as one of their graduate courses.

Specific Program Requirements:

Thesis Option 30 Credits
Required Graduate Courses:

21 credits	Seven graduate courses appropriate for Biomedical Engineering.
3 credits	One graduate course in experimental design, biostatistics or clinical studies.
BME 701	Thesis (6 credits)
BME 791	Graduate Seminar--required for two semesters (0 credits)

Non-Thesis Option
Required Graduate Courses:

30 credits	Ten graduate courses appropriate for Biomedical Engineering (may include a 3-credit project)
3 credits	One graduate course in experimental design, biostatistics or clinical studies.
BME 791	Graduate Seminar--required for two semesters (0 credits)

Program Options

The BME MS Program offers two options. The Thesis option requires a total of 30 credits including a 6-credit thesis. The Non-Thesis option requires a total of 33 credits which may include a 3-credit MS Project and 10 courses, or 11 courses without a project.

Area of Concentration:

Unlike many other programs in biomedical engineering, the NJIT M.S. Program does not require prescribed core courses. Students are given the responsibility of planning a concentration of a minimum of six (6) courses (18 credits) that define a concentration that meets their career goals and intellectual needs. Possible areas of concentrations include:

Neural Engineering
Biomaterials and Tissue Engineering
Biomechanics
Bioinstrumentation
Rehabilitation Engineering
Biomedical Imaging

Concentrations can be combined into new cross-disciplinary areas or can be further specialized to focus on either research or product design.

Breadth Courses:

Students may enroll in two (2) graduate courses (6 credits) in areas outside of their concentration but appropriate for the M.S. in Biomedical Engineering. Alternatively, these two courses could be selected as additional courses within the concentration.

Life and/or Medical Science Courses:

Within the eight (8) courses (24 credits) of the Thesis Option of the eleven (11) courses (33 credits of the Non-Thesis Option described above, students are strongly encouraged to take at least one (1) course in an area of life or medical science that supports the concentration. Non-Thesis students may wish to take additional life or medical science courses. This emphasizes the important link between engineering and the biological and medical sciences and can include basic or clinical science courses at the University of Medicine and Dentistry of New Jersey and Rutgers University-Newark, which are available to NJIT students via a cross-registration agreement.

Seminars:

MS students are required to register for the 0 credit graduate seminar in each of a minimum of two semesters. This is a non-additive credit (i. e. it does not count toward the 30 required credits), however participation in the seminar is required for graduation. Graduate seminars are offered weekly during the semesters and include guest speakers as well as NJIT graduate students. The Department also maintains lists of seminars in other departments and in neighboring institutions that are of interest to biomedical engineering. Part-time graduate students may request a waiver of this requirement.

Thesis Requirement:

The Thesis Option requires a six (6) credit thesis. Because biomedical engineering exists at the intersection of several traditional engineering and computing fields, and the biological and medical sciences, the thesis demonstrates the student's ability to define a problem, plan two semesters of independent work in an interdisciplinary environment, and execute a research and/or design that meets NJIT's standards for a Masters Thesis. The thesis document conforms to the format of the Office of Graduate Studies and is evaluated by a committee of three members, two of whom must be from the NJIT biomedical faculty. External members from industry, medicine or other universities are encouraged. An oral defense before the committee and the departmental community is also required. All NJIT theses are archived in the University Library and are available via the Library's web site.

Thesis topics are selected by the student in consultation with faculty and other potential advisors. Thesis content can include a research study, the development/design of new technology including software, or the design, execution and evaluation of an experiment. A thesis may be conducted in an NJIT laboratory or in another institutional or industrial facility. The individual nature of the work must be clearly identifiable, as should its novelty and importance to biomedical engineering.

In cases where the intellectual property of an industrial sponsor may be in conflict with the public presentation of the thesis or its availability through the NJIT Library, special arrangements can be made by the MS Program Director to protect the firm's property.

Planning of Courses:

Students are responsible for identifying their area of concentration and proposing a coherent collection of courses to the MS Program Director or other designated advisor. The Department maintains an electronic list of graduate courses appropriate to biomedical engineering, which are offered at NJIT, UMDNJ and Rutgers-Newark on a semester by semester basis on the department web site. Course descriptions are available elsewhere in the catalog. Students are advised to continually review their selected set of courses, as there is generally some variability in the scheduling of established and new courses. The Program Director and/or other designated advisor will be available to assist in planning the course selection.

Sample clusters of courses are shown below for different areas of concentration. These clusters are intended to serve as examples of the flexibility students have in choosing a balanced set of courses to meet their educational objectives. They are not program requirements. Students may propose considerably altered clusters that better meet their academic needs. Courses marked with an * meet the requirement for a course in experimental design and statistics. Note: only the Thesis Option is shown. the Non-Thesis Option replaces the six-credit thesis with three additional courses (totaling 9 credits)

BME MS students are encouraged to consider appropriate courses offered by other NJIT departments as well as by departments at Rutgers-Newark and UMDNJ. Students are cautioned that such courses may have prerequisites and other enrollment restrictions, are advised to check with the appropriate department for clarification. The procedures for cross-registration at Rutgers-Newark and UMDNJ are explained elsewhere in this catalog.

Neural Engineering

		BME661	
		BME 698	Selected Topics (3 credits)
		BME 681	Medical Imaging (3 credits)
		BME 673	Biorobotics (3 credits)
		Math 635	Analytical Computational Neuroscience (3 credits)
		NEUR5110	
		NEUR5111	
		NEUR509	
		BME 701	Master's Thesis (6 credits)

Biomaterials and Tissue Engineering

		BME 672	Biomaterials (3 credits)
		BME 651	Principles of Tissue Engineering (3-0-3)
		MtSE 601	Fundamentals of Engineering Materials (3 credits)
		BME 788	Selected Topics (3 credits)
		BME 698	Selected Topics (3 credits)
		ME 619	Nano-scale Characterization of Materials (3 credits)
		MSBS5130	
	*	Math 663	Introduction to Biostatistics (3-0-3)
		BME 701	Master's Thesis (6 credits)

Biomechanics

		BME 670	Introduction to Biomechanical Engineering (3 credits)
		BME 671	Biomechanics of Human Structure and Motion (3 credits)
		BME 672	Biomaterials (3 credits)
		BME 698	Selected Topics (3 credits)
		ME 614	Continuum Mechanics (3 credits)
		ME 622	Finite Element Methods in Mechanical Engineering (3 credits)
		CBMM5350	
	*	IE 604	Advanced Engineering Statistics (3 credits)
		BME 701	Master's Thesis (6 credits)

Biomedical Instrumentation

		BME 687	Design of Medical Instrumentation (3 credits)
		BME 698	Selected Topics (3 credits)
		BME 667	Bio-Control Systems (3 credits)
		BME 698	Selected Topics (3 credits)
		BME693	
		OPSE788	
		ECE 692	Embedded Computing Systems (3)
	*	PhEn 604	Validation and Regulatory Issues in the Pharmaceutical Industry (3 credits)
		BME 701	Master's Thesis (6 credits)

Rehabilitation Engineering

		BME 671	Biomechanics of Human Structure and Motion (3 credits)
		BME 698	Selected Topics (3 credits)
		BME 698	Selected Topics (3 credits)
		BME 673	Biorobotics (3 credits)
		IE 661	Man-Machine Systems (3 credits)
		Arch 662	Special Topics in Architecture (3 credits)
		PTDR6150	
		PTDR7311	
		BME 701	Master's Thesis (6 credits)

Biomedical Imaging

		BME 681	Medical Imaging (3 credits)
		BME 698	Selected Topics (3 credits)
		BME 687	Design of Medical Instrumentation (3 credits)
		BME661	
		PHYS671	
		PHYS675	
		BINF5035	
	*	Math 663	Introduction to Biostatistics (3-0-3)
		BME 701	Master's Thesis (6 credits)

The blank table below can be used to start building a personal concentration of courses that supports individual educational objectives. Note that courses are generally offered only once in each academic year so there could be conflicts. Occasionally courses are discontinued and new courses are added. Please check the list of courses that is posted online by the NJIT Registrar prior to each semester.

Personal Concentration (Thesis Option 8 courses plus thesis)

		*	(Course with statistical/experimental design content)
		BME 701	Master's Thesis (6 credits)

Personal Concentration (Non-Thesis Option 11 courses)

		*	(Course with statistical/experimental design content)

Ph.D. in Biomedical Engineering

The Doctor of Philosophy in Biomedical Engineering offers advanced graduate education providing students with the skills necessary for careers in basic and applied research, as well as the intellectual foundation to provide leadership in academia and industry. This program will emphasize depth in both engineering and basic science, as well as the integration of interdisciplinary concepts to address complex problems.

The new program builds upon the collaboration that currently exists between faculty at NJIT and UMDNJ. The physical proximity of the two institutions facilitates access to courses, laboratories, libraries, and seminars, as well as blends scientific and clinical opportunities in education and research. In addition, the location of NJIT and UMDNJ in Newark promotes interaction with New Jersey's pharmaceutical and medical device industries and medical facilities.

Biomedical Engineering research at NJIT and UMDNJ is presently clustered in the following areas:

Biomaterials
Biosensors
Biomechanics and Sensory-motor Control of Human Motion
Biomedical Signal Processing and Instrumentation
Computational Biomedical Engineering
Neural Engineering

The proposed Ph.D. program requires 60 credits beyond the M.S. degree in bioengineering or a related field. Of these, 24 credits must be in graduate level courses and 36 credits in dissertation research. The student will be required to successfully complete a comprehensive examination demonstrating depth and breadth of understanding in engineering and basic medical science necessary to pursue scholarly research and to make an important contribution in the area. A written and oral presentation of a dissertation proposal will also be required which identifies a problem, provides a critical review of related literature, proposes an appropriate hypothesis and presents a rigorous methodology that addresses the problem. A final oral dissertation defense will complete the process.

Highly qualified students may be admitted directly to the Ph.D. program following their B.S. degree. They will be required to complete a total of 78 credits of which 36 credits will be dissertation and 42 credits will be course credits.

Application to this program may be made to either NJIT or UMDNJ. A joint Admissions Committee comprised of faculty from both institutions recommends admission. Funding decisions are made by the Program Steering Committee. (Please note that this procedure differs from the MS Program).

Curriculum:

A student, upon admission to the program, will choose one of the following six areas of specialization. Each area will have an entry-level course and a sequence of advanced courses.

Biomaterials - orthopedic implants, dental materials, tissue engineering.
Biosensors - DNA chips, bioMEMS technology.
Biomechanics and Sensory-motor Control of Human Motion - sensory integration, neuromuscular control, human gait analysis, rehabilitation engineering.
Biomedical Signal Processing and Instrumentation - cardiac dynamics, medical imaging, medical image processing.
Computational Biomedical Engineering - modeling of physiological systems, bioinformatics.
Neural Engineering - neural plasticity, neural growth, neural signal processing.

The academic Progress Committee, comprised of NJIT and UMDNJ faculty, monitors the progress of students in the completion of their degrees.

Course requirements include the following:

A student entering with a Masters degree is required to complete 24 course credits and 36 credits of doctoral dissertation. A student entering without a master's degree is required to complete 42 course credits and 36 credits of doctoral dissertation.

All students must complete. In addition, all students must complete at least 12 of the 24 course credits at the 700-level of which 8 credits are the UMDNJ core course in molecular and cellular biology, and 3 credits are in laboratory rotation. Within the student's major area of specialization, all students must complete at least 12 credits at the 600 and 700 levels. The student must also complete the entry-level course in another (minor) area chosen from among the five areas of specialization and 3 credits in research methods and practices in Biomedical Engineering.

Since students may enter the doctoral program with a variety of academic backgrounds, the admissions committee and/or the student's advisor may require additional courses beyond the 24 credits (42 credits for those without a master's degree).

Qualifying Examination:

Before becoming a doctoral candidate, a student must demonstrate his/her ability to integrate the knowledge acquired in earlier studies. These examinations will include a written examination in the students's chosen area, demonstrating depth and breadth of understanding in engineering and basic medical science necessary to pursue scholarly research. There will also be an examination in a second area, which is not the student's major area. This will assure breadth in biomedical engineering. An oral examination will also be required.

Dissertation:

The dissertation represents an original research contribution, and reflects a student's ability to critically understand the significance of a problem and conduct novel, high quality, and independent research, which advances the state of the art.

Before beginning the dissertation, the student will present a dissertation proposal, in both written and oral form. the proposal will identify a unique scholarly problem, provide a critical review of related literature, propose an appropriate hypothesis, and present a methodology to address the problem.

The dissertation will conclude with a written dissertation and an oral defense. All students must complete 36 credits of dissertation research.

Graduate Courses

The following is a list of graduate courses that are appropriate for students in the BME MS and Ph.D. programs.

Key to abbreviations: BME-Biomedical Engineering, BIOL-Biology at NJIT, CHE-Chemical Engineering, CIS-Computer and Information Science, ECE-Electrical and Computer Engineering, IE-Industrial Engineering, MATH-Mathematical Sciences, ME-Mechanical Engineering, MTSE-Materials Science and Engineering, OPSE-Optical Sciences and Engineering, PHEN-Pharmaceutical Engineering.

Courses offered by the Department of Biomedical Engineering (generally offered once each academic year-please see the department web site for details).

		BME 651	Principles of Tissue Engineering (3-0-3)
		BME661	
		BME 667	Bio-Control Systems (3 credits)
		BME 670	Introduction to Biomechanical Engineering (3 credits)
		BME 671	Biomechanics of Human Structure and Motion (3 credits)
		BME 672	Biomaterials (3 credits)
		BME 687	Design of Medical Instrumentation (3 credits)
		BME 698	Selected Topics (3 credits)
		BME 698	Selected Topics (3 credits)
		BME 698	Selected Topics (3 credits)
		BME 698	Selected Topics (3 credits)
		BME 698	Selected Topics (3 credits)
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		BME 698	Selected Topics (3 credits)
		BME 698	Selected Topics (3 credits)
		BME 698	Selected Topics (3 credits)
		BME 698	Selected Topics (3 credits)
		BME 788	Selected Topics (3 credits)
		BME 788	Selected Topics (3 credits)
		BME 788	Selected Topics (3 credits)
		BME 788	Selected Topics (3 credits)

Courses numbered 698 are new courses that are offered as special topics courses pending formal assignment of course numbers.

The following courses from other graduate programs may be appropriate for BME students when forming a cluster of related courses. Please note that many of these courses have prerequisites that will determine the possibility of registration. The time schedule and availability of these courses is found at the NJIT Registrar's web site: http://www.njit.edu/v2/Directory/Admin/Registrar/Courses.

		BIOL601	
		Biol 698	Selected topics in Biology (3-0-3)
		Biol 698	Selected topics in Biology (3-0-3)
		ChE 628	Biochemical Engineering (3 credits)
		CS 657	Principles of Interactive Computer Graphics (3 credits)
		CS 659	Image Processing and Analysis (3 credits)
		BNFO615	
		IS 686	Pervasive Computing: An HCI Perspective (3 credits)
		ECE 643	Digital Image Processing I (3 credits)
		ECE 660	Control Systems I (3 credits)
		ECE 664	Real-time Computer Control Systems (3 credits)
		ECE 692	Embedded Computing Systems (3)

		IE 604	Advanced Engineering Statistics (3 credits)
		IE 615	Industrial Hygiene and Occupational Health (3 credits)
		IE 661	Man-Machine Systems (3 credits)
		IE 682	Industrial Safety and Health Evaluation (3 credits)
		IE 665	Applied Industrial Ergonomics (3 credits)
		IE 699	Special Topics in Industrial Engineering (3 credits)
		Math 635	Analytical Computational Neuroscience (3 credits)
		Math 637	Foundations of Mathematical Biology (3 credits)
		Math 663	Introduction to Biostatistics (3-0-3)
		Math 661	Applied Statistics (3 credits)
		Math 699	Design and Analysis of Experiments (3 credits)
		ME 619	Nano-scale Characterization of Materials (3 credits)
		ME 622	Finite Element Methods in Mechanical Engineering (3 credits)
		ME 635	Computer-Aided Design (3 credits)
		ME 678	Engineering Design of Plastic Products (3 credits)
		ME 614	Continuum Mechanics (3 credits)
		ME 622	Finite Element Methods in Mechanical Engineering (3 credits)
		ME 630	Analytical Methods in Machine Design (3 credits)
		ME 635	Computer-Aided Design (3 credits)
		ME 655	Introduction to Modern Control Methods (3 credits)
		ME718	
		MtSE 601	Fundamentals of Engineering Materials (3 credits)
		MtSE 648	NanoMaterials (3 credits)
		MtSE 682	Introduction to Ceramics (3 credits)
		OPSE788	
		PhEn 601	Principles of Pharmaceutical Engineering (3 credits)
		PhEn 603	Pharmaceutical Unit Operations: Processing of Liquid and Dispersed Phase Systems (3 credits)
		PhEn 604	Validation and Regulatory Issues in the Pharmaceutical Industry (3 credits)
		PhEn 618	Principles of Pharmacokinetics and Drug Delivery (3 credits)

Cross Registration at UMDNJ and Rutgers-Newark

Biomedical Engineering graduate students also have the opportunity to cross-register in courses at the University of Medicine and Dentistry's Graduate School of Biomedical Sciences and School of Health-Related Professions, as well as in courses at Rutgers University-Newark. Students are advised to confer with the BME MS Program Director to verify that a specific course at UMDNJ or Rutgers is appropriate for credit towards their degree. Students should also be aware that many courses at UMDNJ and Rutgers often have prerequisites that may preclude their enrollment. Descriptions of courses can be found at the following web sites.

Courses at UMDNJ Graduatae School of Biomedical of Biomedical Sciences

http://www.umdnj.edu/gsbsnweb/descriptions.htm

Courses at Rutgers Institute on Molecular and Behavioral Neuroscience

http://ins.rutgers.edu/html/course_description.html

Courses the Rutgers-NJIT Federated Department of Biological Sciences

http://newarkbiosci.rutgers.edu/graduate.htm

Courses at UMDNJ in the School of Health-Related Professions-Biomedical Informatics

http://coursecatalog.umdnj.edu/shrp/byprogram.asp?mnuProgram=BIOMEDICAL+INFORMATICS+-+MS&Submit2=Submit

Courses at UMDNJ in the School of Health-Related Professions-Physical Therapy

http://coursecatalog.umdnj.edu/shrp/byprogram.asp?mnuProgram=PHYSICAL+THERAPY+%28ENTRY+LEVEL%29+-+DPT&Submit2=Submit

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Management

Administered By: School of Management

Administration

Interim Dean	Robert English
Associate Dean	Shanthi Gopalakrishnan
Sponsored Chairs	Katia Passerini(Hurlbut Professor)* , William V. Rapp(Henry J. Leir Chair in International Business)
Director, Executive Program	Delores E. Frazier

Advisors

Undergraduate Advisor	Mary K. Naatus
Graduate Advisor	Lilia A. Lozarito

Faculty

Distinguished Professors	Bruce A. Kirchhoff
Professors	Asokan Anandarajan, Shanthi Gopalakrishnan, David L. Hawk** , Kenneth D. Lawrence, Rajiv Mehta, Naomi G. Rotter, Hindy L. Schachter, Mark Somers
Associate Professors	Theologos H. Bonitsis, Rene Cordero, Larry Eisenberg, Jerry L. Fjermestad* , Katia Passerini* , Marguerite A. Schneider, Annaleena Parhankangas, Cheickna Sylla
Assistant Professors	Michael A. Ehrlich, Stephan P. Kudyba, Aron S. Spencer, Wei Xu, Zhipeng Yan, Ronald Sverdlove
Special Lecturer	Frederic B. Bogui, Jose C. Casal, Porchiung B. Chou, Barbara Tedesco, Diana Walsh

* Joint appointee with the Department of Computer and Information Science

** Joint appointee with the School of Architecture

Degrees Offered: Master of Business Administration in Management of Technology; Master of Science in Management.

Master of Business Administration in Management of Technology (48 credits)

NJIT's MBA in the Management of Technology is designed to prepare a new generation of technology savvy business leaders.The curriculum integrates fundamental business knowledge with applications of technology to business to prepare students to think strategically about business and technology.The program is built upon four themes that are transforming business: a) the transition to a knowledge based economy; b) the emergence of the digital firm; c) the globalization of business; and d) innovation as the primary source of competitive advantage.

Concentration areas are offered in Management Information Systems, e-Commerce, Marketing, Finance, Operations Management, Infrastructure Management and Transportation and Logistics.

Admission Requirements:

Applicants to the MBA must submit complete transcripts of all undergraduate work and scores on the Graduate Management Admissions Test (GMAT). The GMAT is required of all applicants except those holding master's or doctoral degrees from an accredited U.S. university. Up to nine credits of graduate work may be transferred from another school, provided that they are not counted towards a terminal degree at that school.

MBA Pre-Qualifying Requirements : Students are expected to demonstrate competency in the area of accounting, finance, quantitive methods, information systems and economics. Depending on the applicant's undergraduate degree program all or part of the pre-qualifier requirements can be met with prior undergraduate course work. Applicants who do not meet pre-qualifying requirements will be required to complete up to 12 credits of course work.

Degree Requirements:

Pre-Qualifying Courses (Conditional Admits only):

Mgmt 501	Management Foundations (3-0-3)
Mgmt 580	Managerial Science (3 credits)
MIS 246	Tools and Technologies for the Digital Firm (3-0-3)
Econ 565	Managerial Economics (3 credits)

MODULE I : Core Courses (All courses required. No substitutions) 27 Credits:

Acct 615	Management Accounting (3 credits)
Fin 600	Corporate Finance I (3 credits)
Fin 624	Corporate Finance II (3 credits)
Mrkt 620	Competing in Global Markets (3 credits)
MIS 680	Management Science (3 credits)
MIS 645	Information Systems Principles (3 credits)
HRM 601	Organizational Behavior (3 credits)
Mgmt 691	Legal and Ethical Issues (3 credits)
Mgmt 692	Strategic Management (3 credits) ***or***
Mgmt 680	Entrepreneurial Strategy (3 credits)

MODULE II : Managing Knowledge and Information (Choose 2 Courses) 6 Credits:

Mgmt 650	Knowledge Management (3 credits)
Mgmt 635	Data Mining and Analysis (3 credits)
Mgmt 660	Managing Supply and Value Chains (3 credits)
MIS 648	Decision Support Systems for Managers (3 credits)
Mgmt 710	Forecasting Methods for Business Decisions (3 credits)

MODULE III : Managing Technology, Innovation and Change (Choose 2 Courses) 6 Credits:

Mgmt 620	Management of Technology (3 credits)
HRM 630	Managing Technological and Organizational Change (3 credits)
Mgmt 676	Managing the Digital Firm (3 credits)
Mgmt 690	Electronic Communities in Organizations (3 credits)

MODULE IV : CONCENTRATION AREA:
Choose 3 Courses in one concentration for 9 credits (MIS, Finance, Marketing, e-Commerce, Operations Management, Transportations and Logistics):

MIS Concentration Courses - Choose Three Courses:

		CS 631	Data Management System Design (3 credits)
		CS 632	Advanced Database System Design (3 credits)
		MIS 625	Management Strategies for E-Commerce (3 credits)
		MIS 635	Management of Telecommunications (3 credits)
		MIS 690	Executive Information Systems (3 credits)
		Mgmt 630	Decision Analysis (3 credits)

Finance Concentration Courses- Choose Three Courses:

		Fin 626	Financial Investment Institutions (3 credits)
		Fin 627	International Finance (3 credits)
		Fin 631	Working Capital Management and Credit Analysis (3 credits)
		Fin 632	Financial Valuation of Technology-Based Companies (3 credits)
		Fin 634	Mergers, Acquisitions, and Restructuring (3 credits)

Marketing Concentration Courses - Choose Three Courses:

		Mrkt 631	Market Planning and Analysis (3 credits)
		Mrkt 637	Marketing Communications and Promotions (3 credits)
		MIS 625	Management Strategies for E-Commerce (3 credits)
		Mrkt 645	Internet Marketing Strategy (3 credits)
		Mrkt 630	Models of Consumer Behavior (3 credits)
		Mgmt 635	Data Mining and Analysis (3 credits)

e-Commerce Concentration Courses - Choose Three Courses :

		MIS 620	E-Commerce Technologies (3 credits)
		MIS 625	Management Strategies for E-Commerce (3 credits)
		MIS 635	Management of Telecommunications (3 credits)
		Mrkt 645	Internet Marketing Strategy (3 credits)
		Mgmt 676	Managing the Digital Firm (3 credits)

Operations Management Concentration Courses - Choose Three Courses:

		IE 674	Quality Maintenance and Support Systems (3 credits)
		Mgmt 630	Decision Analysis (3 credits)
		MnE 601	Manufacturing Systems (3 credits)
		MnE 602	Flexible and Computer Integrated Manufacturing (3 credits)
		MnE 603	Management of Manufacturing Systems (3 credits)

Transportation and Logistics Concentration Courses - Choose Three Courses:

		Mgmt 630	Decision Analysis (3 credits)
		Mgmt 710	Forecasting Methods for Business Decisions (3 credits)
		Tran 603	Introduction to Urban Transportation Planning (3 credits)
		Tran 740	Management of Transportation Carriers (3 credits)
		Tran 765	Multi-modal Freight Transportation Systems Analysis (3 credits)

Master of Science in Management (30 credits)

The Master of Science in Management is designed to allow students to build specialized knowledge in one of four concentration areas : Management Information Systems, e-Commerce, Organization Management or Management of Technology. Specialized knowledge is augmented with a 15 credit management core that provides the general knowledge needed to manage technical and specialized units.

Admission Requirements:

Applicants to the MSM must submit complete transcripts of all undergraduate work and scores on the Graduate Management Admissions Test (GMAT). The GMAT is required of all applicants except those holding master's or doctoral degrees from an accredited U.S. university. Up to nine credits of graduate work may be transferred from another school, provided that they are not counted towards a terminal degree at that school.

MSM Pre-Qualifying Requirements : Students are expected to demonstrate competency in the area of accounting, finance, quantitive methods, information systems and economics. Depending on the applicant's undergraduate degree program, all or part of the pre-qualifier requirements can be met with prior undergraduate course work. Applicants who do not meet pre-qualifying requirements will be required to complete up to 12 credits of course work.

Degree Requirements:

Pre-Qualifying Courses (Conditional Admits only) :

Mgmt 501	Management Foundations (3-0-3)
Mgmt 580	Managerial Science (3 credits)
MIS 246	Tools and Technologies for the Digital Firm (3-0-3)
Econ 565	Managerial Economics (3 credits)

Core Courses (All courses required. No substitutions) 15 Credits:

Acct 615	Management Accounting (3 credits)
Mrkt 620	Competing in Global Markets (3 credits)
Fin 600	Corporate Finance I (3 credits)
HRM 601	Organizational Behavior (3 credits)
Mgmt 680	Entrepreneurial Strategy (3 credits) ***or***
Mgmt 692	Strategic Management (3 credits)

Choose 5 Courses in one concentration for 15 Credits:
e-COMMERCE CONCENTRATION COURSES:

MIS 620	E-Commerce Technologies (3 credits)
MIS 625	Management Strategies for E-Commerce (3 credits)
IS 679	Management of Computer and Information Systems (3 credits)
CS 656	Internet and Higher-Layer Protocols (3 credits)
Mgmt 635	Data Mining and Analysis (3 credits)
CS 652	Computer Networks-Architectures, Protocols and Standards (3 Credits)
CS 688	Programming for Interactive Environments (3 credits)
Mrkt 645	Internet Marketing Strategy (3 credits)

MIS CONCENTRATION COURSES:

Mgmt 650	Knowledge Management (3 credits)
MIS 645	Information Systems Principles (3 credits)
CS 631	Data Management System Design (3 credits)
MIS 648	Decision Support Systems for Managers (3 credits)
CS 671	Knowledge-Based Systems (3 credits)
CS 632	Advanced Database System Design (3 credits)
EM 636	Project Management (3 credits)
IS 679	Management of Computer and Information Systems (3 credits)

ORGANIZATION MANAGEMENT CONCENTRATION COURSES:

		HRM 605	Managing High Performance Work Teams (3 credits)
		HRM 606	Human Resource Management (3 credits)
		HRM 640	Cultures in Organizations (3 credits)
		HRM 630	Managing Technological and Organizational Change (3 credits)
		HRM 685	Cross Cultural Management Studies (3 credits)
		HRM 610	Seminar on Leadership Skills (3 credits)
		Mgmt 650	Knowledge Management (3 credits)
		Mgmt 690	Electronic Communities in Organizations (3 credits)

MANAGEMENT OF TECHNOLOGY CONCENTRATION COURSES:

		Mgmt 620	Management of Technology (3 credits)
		HRM 630	Managing Technological and Organizational Change (3 credits)
		MIS 645	Information Systems Principles (3 credits)
		MIS 620	E-Commerce Technologies (3 credits)
		MIS 625	Management Strategies for E-Commerce (3 credits)
		MIS 648	Decision Support Systems for Managers (3 credits)
		Mgmt 676	Managing the Digital Firm (3 credits)
		Mgmt 650	Knowledge Management (3 credits)

Catalog and curricula information approved by the relevant academic department.

Chemical Engineering

Administered By: Otto H. York Department of Chemical, Biological and Pharmaceutical Engineering

Administration

Chairman [Interim]	Reginald P. Tomkins
Associate Chairman for Undergraduate Studies	Norman Loney
Associate Chairman for Graduate Studies and Industrial Relations	Reginald P. Tomkins
Director of Pharmaceutical Engineering Program	Piero M. Armenante

Faculty

Distinguished Professors	Piero M. Armenante, Kamalesh K. Sirkar, Rajesh N. Dave
Foundation Professor	Kamalesh K. Sirkar(Membrane Separations)
Professors	Basil C. Baltzis, Robert B. Barat, Teddy Greenstein, Deran Hanesian, Howard S. Kimmel, Dana E. Knox, Norman Loney, Angelo Perna, Donald H. Sebastian, Reginald P. Tomkins, Marino Xanthos
Associate Professor	Laurent Simon
Assistant Professors	Xianqin Wang
Distinguished Research Professors	Costas G. Gogos
Research Professors	Hyun J. Jun, Ming-wan Young
Joint Appointments	Joseph W. Bozzelli(Chemistry), Sergiu M. Gorun(Chemistry)

Advisors

Undergraudate Advisor	Norman Loney
Graduate Advisor	Reginald P. Tomkins

Degrees Offered: Master of Science in Chemical Engineering; Master of Science in Pharmaceutical Engineering and Doctor of Philosophy in Chemical Engineering

The graduate programs in Chemical Engineering offer opportunities for students to enhance their knowledge in the core areas of the discipline, learn about advanced topics in various established as well as emerging technologies through specialized courses, and engage in original research. Courses are taught by full-time faculty members that are also involved in cutting-edge research, and adjunct faculty with extensive industrial experience. The department enjoys close ties to the pharmaceutical and petrochemical industries, and plastics manufacturers through the Polymer Processing Institute (PPI). In addition to independent research, faculty members are associated with various research centers including the Center for Membrane Technology, the Particle Technology Center, and PPI. There are opportunities for interdisciplinary collaborative research with the Federated Department of Biological Sciences, the Department of Biomedical Engineering, the Department of Chemistry and Environmental Science, and the University of Medicine and Dentistry of New Jersey.

Master of Science in Chemical Engineering

This program is intended for those interested in advancing their understanding of chemical engineering. It may be taken on a part-time or full-time basis. There are two options, one of which includes a master's thesis.

Admission Requirements:

An undergraduate degree in chemical engineering is usually required. Students who do not have a degree in chemical engineering may be considered for admission through the bridge program. The bridge program is comprised of a sequence of two courses, ChE 501 and ChE 502 , that needs to be completed before beginning the graduate program. Bridge courses are not counted toward degree credit. The bridge program is primarily for individuals who have a degree in either chemistry or an engineering discipline other than chemical engineering.

A minimum undergraduate GPA of 3.0 on a 4.0 scale, or equivalent, is typically required for admission. Applicants must submit GRE scores unless they hold a B.S. degree in Chemical Engineering from an ABET-accredited program in the U.S.A. International students must achieve a minimum TOEFL score of 550 (pencil and paper) and 213 (computer-based).

Degree Requirements:

A minimum of 30 credits is required. Students must attain a minimum GPA of 3.0 in the core courses listed below, and a minimum overall GPA of 3.0. Students following option 1 (below) must also successfully complete a master's thesis.

Core Courses:

12 credits:

		ChE 611	Thermodynamics (3 credits)
		ChE 612	Kinetics of Reactions and Reactor Design (3 credits)
		ChE 624	Transport Phenomena I (3 credits)
		ChE 626	Mathematical Methods in Chemical Engineering (3 credits)

Option 1:

Required of those receiving partial or full departmental or research-based support. Students who do not receive financial support, may follow Option 1 without the Seminar and ChE 599 requirements listed below.

Thesis:

		ChE 701	Master's Thesis (6 credits)

Before deciding on a thesis topic and advisor, students must discuss thesis topics with at least three faculty members and get their signature on a form provided by the department. The signed form with the name of advisor selected and tentative title of thesis topic must be returned to the department for approval. Change of advisor requires consent of the previous advisor and departmental approval. The completed thesis must be examined and signed by three faculty members at least two of which must be on the department faculty. An oral presentation is also required. The MS thesis committee must be formed and submitted to the department for approval at least one semester before the expected graduation date. The department provides a form for the formation of the MS thesis committee.

Seminar:

In addition to the minimum 30 degree credits required, all students who receive departmental or research-based support must enroll each semester in ChE 791 Graduate Seminar.

ChE 599, Methods for Teaching Assistants and Graduate Assistants :

In addition to the minimum 30 degree credits, students receiving departmental support must enroll in ChE 599 at least once a year.

Elective Courses (12 credits):

A minimum of 3 credits of 600- or 700-level courses in chemical engineering. Of the remaining 9 credits, at least 3 credits must be in chemical engineering, pharmaceutical engineering, or chemistry. No more than 3 credits may be at the 500-level. 500-level courses offered in the department do not count towards degree requirements.

Option 2:

Available to students who do not receive any departmental or research-based support.

Elective Courses (18 credits):

A minimum of 9 credits of 600- and 700-level courses in chemical engineering. Of the remaining 9 credits, at least 3 credits must be in chemical engineering, pharmaceutical engineering, or chemistry. No more than 3 credits may be at the 500-level. 500-level courses offered in the department do not count towards degree requirements.

Doctor of Philosophy in Chemical Engineering

This is a research-oriented degree intended primarily for full-time students. Although courses may be taken on a part-time basis, a minimum of one year of full-time residency is typically required for completion of the doctoral dissertation.

Admission Requirements: A master's degree in chemical engineering and a GPA of at least 3.5 on a 4.0 scale, or equivalent, are usually required. All applicants must submit GRE scores. International students must also achieve a minimum TOEFL score of 213 (computer-based) or 550 (non-computer-based). Exceptional students with undergraduate degrees in chemical engineering may also apply directly for admission to the doctoral program. In addition to the GRE and TOEFL requirements mentioned above, a minimum undergraduate GPA of 3.5 on a 4.0 scale, or equivalent, is normally required. Students admitted to the program without a master's degree in chemical engineering must complete an additional 18 credits of course work as specified below. Admission of full-time doctoral students is on a competitive basis as the department admits only as many students as it can support through departmental and research-based funds.

Degree Requirements: To graduate, students must have an approved dissertation and attain an overall GPA of at least 3.0. In addition, students admitted to the program without a master's degree in chemical engineering must also attain a minimum GPA of 3.0 in the following four required courses: ChE 611, ChE 612, ChE 624 and ChE 626.

Course Work (24 credits): At least 24 credits of course work beyond the master's degree are required, of which at least 12 credits must be at the 700-level. For the required 700-level courses, at least 6 credits must be in chemical engineering or chemistry. No more than 6 credits may be in Independent Study (ChE 705 or Chem 705). No more than 3 credits in Independent Study may be taken with the same supervising faculty member. The supervising faculty member may never be the student's dissertation advisor. Students need always to get departmental approval for the courses they take for their degree requirements.

ChE 790, Doctoral Dissertation (36 credits): A minimum of 36 credits of ChE 790 , Doctoral Dissertation are required. Students cannot register for ChE 790 before they have officially selected a dissertation advisor and passed the doctoral qualifying examination. Should the required 36 credits of ChE 790 be completed before submission of the final dissertation document, students must register for a minimum of 3 credits of ChE 790 each semester until the dissertation has been submitted and accepted.

Seminar and ChE 599: In addition to the minimum 60-degree credits specified above, students must register every semester for ChE 791, Graduate Seminar. Part-time students may request that this requirement be waived for some semesters. In addition, students who receive support through teaching and/or graduate assistantships must register for ChE 599, Methods for Teaching Assistants and Graduate Assistants, at least every other semester they receive such assistantships.

Additional Requirements for Students Admitted without a Master's Degree in Chemical Engineering (18 credits):
In addition to the requirements specified above, students admitted to the program without a master's degree in chemical engineering must complete an additional 18 credits of course work as follows:

		ChE 611	Thermodynamics (3 credits)
		ChE 612	Kinetics of Reactions and Reactor Design (3 credits)
		ChE 624	Transport Phenomena I (3 credits)
		ChE 626	Mathematical Methods in Chemical Engineering (3 credits)

6 credits from 600- or 700-level courses in chemical engineering, pharmaceutical engineering, or chemistry.

Selection of Dissertation Advisor: Students must select a dissertation topic and advisor within 6 months of joining the program. Before making a decision, students should discuss research topics with at least five faculty members of the department and get their signature on a form provided by the department. The signed form with the names of advisors selected must be returned to the department for further processing. Advisors are assigned based on student preferences and availability of funding. Change of advisor requires consent of the previous advisor and departmental approval. In cases where more than one advisor is directing the dissertation, the primary advisor must be on the departmental faculty.

Qualifying Examination: All students are expected to pass a qualifying examination that tests general competence in chemical engineering at the master's level. Students with a master's degree in chemical engineering must take the exam during the first year of their studies. Students admitted to the program without a master's degree in chemical engineering must take the exam within the first three semesters of their studies. All students must pass the exam within the first two years of their studies. Students are allowed only two attempts to pass the examination.

The doctoral qualifying examination is offered in January and June of every year. It is an 8-hour written examination. Students are expected to solve/answer 6 problems as follows: 1 problem in Applied Mathematics for Chemical Engineers, 1 problem in Reaction Kinetics and Reactor Design, 1 problem in Chemical Engineering Thermodynamics, 1 problem in Transport Phenomena, and 2 problems from 2 different elective areas out of six elective areas offered on the exam. The 6 elective areas may vary, but they are announced to the students at least three months before an examination is held. There are two problems in each of the required and elective areas and students have to select one problem from each area. All problems are weighed equally and are graded on the 0 to 10 scale. A grade of at least 42 out 60 points (i.e., at least 70%) implies an automatic pass. A grade of no more than 30 out of 60 points (i.e., no more than 50%) implies that the student has failed the exam. Students receiving grades higher than 50% but less than 70% (i.e., more than 30 but less than 42 points out of 60) may pass, fail, or conditionally pass the exam based on the decision of the departmental committee on Graduate Studies.

Students are notified about an upcoming exam (date, elective areas) at least three months in advance and asked to respond in writing if they intend to take the exam.

Formation of Dissertation Committee: Within three months of passing the qualifying examination, doctoral students must form a dissertation committee. The department provides a special form. The signed form must be submitted for the approval of the Associate Chair for Graduate Studies in Chemical Engineering. The committee must consist of the doctoral student's dissertation advisor, three additional faculty members from the department, and one member from outside the department (preferably outside the university). The committee may consist of more than five persons, subject to the approval of the Associate Chair. Once formed, the committee cannot change unless there is a written explanation and request from the doctoral student and/or his/her advisor. The Associate Chair for Graduate Studies handles such requests.

Research Proposal: Within six months of forming the dissertation committee (i.e., no more than nine months after passing the qualifying examination), doctoral students must make an oral presentation to their dissertation committee and other interested persons on the scope of their proposed research. The committee must formally approve the proposal within a maximum of three additional months. This ensures meeting the requirements that doctoral students must have an approved dissertation committee and an approved dissertation proposal within a year of passing the qualifying examination. The approved and signed proposal must be submitted to the Associate Chair for Graduate Studies so that it is kept in the student's file.

Dissertation Defense: An oral defense of the dissertation is required after submission of the final document to the dissertation committee for approval. Signatures of all members of the dissertation committee must be received for final approval to be granted. The oral defense is open to the university community and general public and must be announced early.

Catalog and curricula information approved by the relevant academic department.

Chemistry

Administered By: Department Chemistry and Environmental Science

Administration

Chair	Somenath Mitra
Associate Chair	
Director of Freshman Chemistry	Robert J. Conley

Faculty

Distinguished Professors	Joseph W. Bozzelli, Carol A. Venanzi
Professors	Tamara Gund, Lev N. Krasnoperov, Somenath Mitra, Nancy L. Jackson
Associate Professors	Leonard Dauerman, Sergiu M. Gorun, Maurie Cohen
Assistant Professors	Edgardo T. Farinas, Zeyuan Qiu, Liping Wei
Research Professors	Zafar Iqbal
University Lecturers	William Skawinski, Frank B. Ellis, Michael P. Bonchonsky, Roumiana S. Petrova, Alexander D. Butherus
Director of Freshman Chemistry	Robert J. Conley
Professor Emeritus	Barbara B. Kebbekus, Donald Getzin

Advisors

Graduate Advisor	Lev N. Krasnoperov
Undergraduate Advisor	Roumiana S. Petrova

Degrees Offered: Master of Science in Chemistry

Master of Science in Chemistry

An undergraduate degree in chemistry or chemical engineering is usually required. Students with baccalaureate degrees in other areas of science and engineering may be considered for admission and required to take an individually designed program that includes undergraduate courses before beginning the graduate program. These courses are not counted toward degree credit.

A minimum undergraduate GPA of 3.0 on a 4.0 scale, or equivalent, is typically required for admission. General GRE scores must be submitted by those seeking financial support and those whose last prior degree was from outside the United States. Subject GRE is not required. International students must achieve a minimum TOEFL score of 550 (paper and pencil) and 213 (computer based).

Off-Campus Programs: At the National Starch and Chemical Corporation, NJIT offers sufficient courses to fulfill all degree requirements. NJIT faculty teach all courses. For locations, see Extension Programs in this catalog. In addition, a distance-based, 12-credit graduate certificate in Applied Chemistry is available as a step toward this degree for employees of the corporation. For further information about extension programs and Graduate Certificates, call the Associate Vice President for Continuing and Distance Education, Division of Continuing Professional Education, 1 (800) 624-9850 or (973) 596-3060; e-mail: cpe@njit.edu.

Degree Requirements:

A minimum of 30 degree credits is required. Students must attain a cumulative GPA of 3.0 or better in the core courses listed below, and a minimum overall GPA of 3.0.

Seminar: In addition to the minimum 30 degree credits required, all students who receive departmental or research-based awards must enroll each semester in CHE 791 Graduate Seminar.

Core:

3 credits from:

		Chem 602	Advanced Organic Chemistry II: Reactions (3 credits)
		Chem 605	Advanced Organic Chemistry I: Structure (3 credits)

3 credits from:

		Chem 661	Instrumental Analysis Laboratory (3 credits)
		Chem 664	Advanced Analytical Chemistry (3 credits)

3 credits from:

		Chem 610	Advanced Inorganic Chemistry (3 credits)
		Chem 673	Biochemistry (3 credits)

3 credits from:

		Chem 658	Advanced Physical Chemistry (3 credits)

Thesis:

Required of those receiving departmental or research-based support; others may choose 6 credits of 600- or 700-level courses in chemical engineering or chemistry instead of thesis.

		Chem 701	Master's Thesis (6 credits)

Elective:

12 credits for those completing a master's thesis

18 credits for those not completing a master's thesis

A maximum of 6 elective credits may be taken from outside chemistry or chemical engineering; a maximum of 3 credits may be at the 500 level.

Doctor of Philosophy in Chemistry

Doctoral candidates are expected to demonstrate creative thinking, self-motivation and a commitment to achieving quality in their research product. Departmental research includes a well-balanced mixture of experimental, computational, and theoretical projects in the areas of analytical, bio-, organic, inorganic, and physical chemistry. Chemistry doctoral students address real problems, have strong interactions with their advisors and are expected to solve pertinent chemical and environmental problems.

Qualified students may be accepted directly into the program with a bachelor's degree or after they have completed a master's degree in chemistry. A GPA in previous work of 3.5 or better is expected, and international students must submit a TOEFL score of at least 550 (214 on the computer based test). General GRE scores are also required for admission. GRE subject scores are not required. Although the program is intended for full-time students, courses many be taken on a part-time basis initially. A minimum of one year in full-time residency required for completion of the dissertation. Teaching assistantships (TAs) and Research Assistantships (RAs) are available on a competitive basis. In addition to tuition remission, assistantships include stipends for Ph.D. students.

Credits:

Students entering with bachelor's degrees are required to complete a minimum of 78 credits. This includes 42 credits of course work. The required core courses for the M.S. in Chemistry are mandatory; and no less than 24 credits in chemistry or related courses must be taken. At least 12 credits must be in courses at the 700 level (of which at least 6 should be in chemistry), and none may be at the 500 level. The qualifying examinations must be passed (see below). A minimum of 36 credits of research must be completed, and a dissertation must be submitted and defended.

For students who have completed a masters degree: The program requires a minimum of 24 credits of course work, at least 12 of which are at the 700 level. Of the 700 level courses, 6 credits must be in chemistry. Students must also take 36 credits of research work, followed by the submission and defense of a dissertation. While it is not required that the core courses be taken, students will have to pass qualifying examinations in these areas (see below). Therefore, it is recommended that they take these courses unless they already have a strong background in these areas.

Seminar:
Each semester, Ph.D. students must register for and attend departmental seminars. The credits awarded for this seminar are not applied to fulfillment of degree requirements.

Grades:
All students must maintain a grade point average of at least 3.0. Students entering without the MS degree must also attain a GPA of 3.0 in the core courses.

Qualifying Examination:
Within the first year after admission to the program, students must take a qualifying examination, which will include questions on the required core courses as well as recently offered elective courses. Students have two chances to pass all of the sections. If any section is failed or is not taken on the first trial, one more attempt is allowed. The examinations are given in January and June, and students should notify the Graduate Advisor for Chemistry of their intent to take the examinations at least a month before they are scheduled. After passing the qualifying examinations, students should select a research advisor and a doctoral research committee. The committee must meet the approval of the Departmental Graduate Advisor for Chemistry. It should consist of, at a minimum, the research advisor, three departmental faculty members and one person from outside the department. The graduate advisor should be notified of these selections. Forms are available from the departmental office to report the selections.

Dissertation:
Within six months of passing the qualifiers, the student must give an oral presentation to their research committee, detailing the background of the selected research project, and the student's plans for carrying out the research. The committee must formally approve the proposal. The committee may meet at other times to follow the student's progress, at the request of the student and the research advisor.

After the dissertation is completed, the student will present the research to the committee and the public, and defend it. It is expected that the committee will have been given copies of the document several weeks before the defense meeting to ensure that they have adequate time to review it. The date, time and place of the defense must be posted thoughout campus and e-mailed to the department at least two weeks ahead of time.

Obtaining a Ph.D. is expected to entail more than just fulfilling formal requirements. There are skills which students will develop while completing the formal program. We call these skills "The Informal Requirements".

Master of Science in Pharmaceutical Chemistry (30 credits)

OPTIONS:

1. 30 credits of course work,

2. 27 credits of course work, 3 credits research project,

3. 24 credits of course work, 6 credits of master’s thesis

(Note: All courses are 3-credits each)

REQUIRED CORE COURSES (15 credits):

		Chem 605	Advanced Organic Chemistry I: Structure (3 credits)
		Chem 673	Biochemistry (3 credits)
		Chem 777	Principles of Medicinal Chemistry (3)
		Chem 714	Pharmaceutical Analysis (3 credits)
		PhEn 601	Principles of Pharmaceutical Engineering (3 credits)

ELECTIVE COURSES (15 credits):

		Chem 661	Instrumental Analysis Laboratory (3 credits)
		Chem 664	Advanced Analytical Chemistry (3 credits)
		Chem 737	Applications of Computational Chemistry and Molecular Modeling (3-1-3)
		Chem 610	Advanced Inorganic Chemistry (3 credits)
		Chem 736	Inorganic Biological Chemistry (3-0-3)
		Chem 658	Advanced Physical Chemistry (3 credits)
		Chem 748	Nanomaterials (3)
		EvSc 616	Toxicology for Engineers and Scientists (3 credits)
		Math 663	Introduction to Biostatistics (3-0-3)
		Math 664	Methods for Statistical Consulting (3 credits)
		PhEn 500	Pharmaceutical Engineering Fundamentals I (3 credits)
		PhEn 604	Validation and Regulatory Issues in the Pharmaceutical Industry (3 credits)
		PhEn 618	Principles of Pharmacokinetics and Drug Delivery (3 credits)
{		PHEN635	***or***
		ME 635	Computer-Aided Design (3 credits)
		R120:572	(Concepts in Pharmaceutical Drug Development (Rutgers))
		R120:584	(Enzyme Kinetics & Mechanism (Rutgers))
		R160:515	(Chemical Structure Determination (Rutgers))
		PathN5209	(Business of Science: From Molecules to Medicine (UMD))
		GsndN5310	(Clinical Trials Overview: Methodology & Practices (UMD))
		PhpyN5021	(Principles of Pharmacology (UMD))
		CHEM700B	
		CHEM701C	

Civil Engineering

Administered By: Department of Civil and Environmental Engineering. Colton Hall, Room 200.

Administration

Chairperson	Taha F. Marhaba
Associate Chairperson for Graduate Studies	Janice R. Daniel
Associate Chairperson for Undergraduate Studies	Walter Konon

Faculty

Distinguished Professor	William R. Spillers, Sunil Saigal
Professors	Lisa B. Axe, Sima Bagheri, I J. Chien, Harold D. Deutschman, Robert Dresnack, Eugene B. Golub, Joshua S. Greenfeld, Hsin-neng Hsieh, Ct T. Hsu, Raj P. Khera, Walter Konon, Taha F. Marhaba, Jay N. Meegoda, Priscilla Nelson, Dorairaja Raghu, John R. Schuring, Methi Wecharatana, Lazar Spasovic
Associate Professors	Thomas J. Olenik, Janice R. Daniel, Yuan Ding, Fadi A. Karaa, Rongfang Liu, Taha F. Marhaba
Senior University Lecturer	Geraldine Milano

Advisors

Freshman Advisor	Harold D. Deutschman
Undergraduate Advisor	Walter Konon, Thomas J. Olenik
Graduate Advisor	Janice R. Daniel, (PhD Students), Hsin-neng Hsieh, (MS Students)

Degrees Offered: Master of Science in Civil Engineering; Doctor of Philosophy in Civil Engineering

In the information technology age, more resources are available for building new cities, repairing the infrastructure, cleaning up the environment: these are all tasks for the civil engineer. Major corporations, government agencies, private consulting and construction firms, and universities are just some of the organizations that employ civil engineers.

In-depth knowledge in one of the areas of civil engineering is essential for professional practice as well as for research. Courses are taught by full-time faculty members with a range of academic and professional experience as well as by adjunct instructors who are experts in their fields. Those students interested in research at the master's level or continuing their education at the doctoral level should consider working with faculty involved in one of the university's related research centers.

Master of Science in Civil Engineering

The M.S. in Civil Engineering is designed for those who want both specialized course work and the flexibility to tailor their program to their needs.

Admission Requirements:

Applicants are expected to have an undergraduate degree in civil engineering or its equivalent, and must have proficiency in basic sciences and mathematics. Students who lack an appropriate undergraduate background may be granted conditional admission in order to complete a bridge program or its equivalent. These courses are taken in addition to regular degree requirements; descriptions may be found in the undergraduate catalog.

Graduate Certificate Program: A 12-credit graduate certificate in Construction Management is available as a step toward this degree. Please see Graduate Certificates in this catalog for further information. For more information about continuing and distance education, please contact the Division of Continuing Professional Education, 1-800-624-9850 or 973-596-3060; email: cpe@njit.edu.

Bridge Program: Students who do not have a bachelor's degree in civil engineering, but who want to obtain a master's degree in civil engineering must complete a bridge program for their chosen area of specialization. These courses are not counted for degree credit. See the areas of specialization in this section for specific bridge programs. Please note that prerequisites for bridge courses also must be met. See the undergraduate catalog for descriptions of 100- to 400-level courses. Some of the bridge courses may be waived depending on the student's background.

Master of Architecture (M.Arch.) and M.S. in Civil Engineering Dual Degree Program: This program permits students to obtain a Master of Architecture with a Master of Science in Civil Engineering. There is no reduction in the degree requirements for the Master of Architecture program. This dual degree program permits students to obtain the M.S. in Civil Engineering in substantially less time; in some cases, in only one more semester of full-time study. This dual degree program is described in the "Architecture" degree program section in this catalog.

Degree Requirements:

The program as shown below offers numerous areas of specialization, each with its own list of required and elective courses and bridge program. Once the choice of specialization is made, the student consults his/her specialization advisor to plan and develop an individualized and cohesive sequence of courses that will meet the program requirements of at least 30 degree credits.

Seminar: In addition to the minimum 30 degree credits required, all students who receive departmental or research-based awards must enroll each semester in CE 791 Graduate Seminar.

Area of Specialization:

Construction Engineering and Management:

Bridge Program:

CE 200	Surveying (3-0-3)
CE 200A	Surveying Laboratory (0-3-1)
CE 210	Construction Materials and Procedures (3-0-3)
CE 341	Soil Mechanics (3-0-3)
CE 341A	Soil Mechanics Laboratory (0-3-1)
CEXXX	(Design Course)
CS 101	Computer Programming and Problem Solving (3-0-3)
Math 105	Elementary Probability and Statistics (3-0-3)
Math 112	Calculus II (4-1-4)
Mech 237	Strength of Materials (3-1-3)

One design course, approved by program advisor.

Requried:

12 credits:

CE 610	Construction Management (3 credits)
CE 611	Project Planning and Control (3 credits)
CE 616	Construction Cost Estimating (3 credits)
EM 632	Legal Aspects in Construction (3 credits)

Thesis:

Required of those receiving departmental awards; elective for all others.

CE 701	Master's Thesis (6 credits)

Elective:

Select 9 credits if completing a master's thesis; 15 credits if not completing a master's thesis, from:

Arch 675	Elements of Infrastructure Planning (3 credits)
CE 545	Rock Mechanics I (3 credits)
CE 553	Design and Construction of Asphalt Pavements (3 credits)
CE 614	Underground Construction (3 credits)
CE 615	Infrastructure and Facilities Remediation (3 credits)
CE 631	Advanced Reinforced Concrete Design (3 credits)
CE 637	Short Span Bridge Design (3 credits)
CE 642	Foundation Engineering (3 credits)
CE 659	Flexible and Rigid Pavements (3 credits)
CE 700	Civil Engineering Project (3 credits)
CE 702	Special Topics in Civil Engineering (3 credits)
CE 710	Systems in Building Construction (3 credits)
CE 711	Methods Improvement in Construction (3 credits)
EM 660	Financing an Industrial Enterprise (3 credits)
EM 693	Managerial Economics (3 credits)
EnE 662	Site Remediation (3 credits)
EnE 671	Environmental Impact Analysis (3 credits)
HRM 693	Employment Relationships and the Law (3 credits)
IE 603	Behavioral Science in Engineering Organization (3 credits)

3 credits from:

Arch 647	Special Topics in Computer Applications (3 credits)
CE 602	Geographic Information System (3 credits)
EM 602	Management Science (3 credits)
EM 655	Management Aspects of Information Systems (3 credits)
Math 611	Numerical Methods for Computation (3 credits)
MIS 645	Information Systems Principles (3 credits)

Other suitable electives may be taken subject to approval of program advisor.

Environmental Engineering

Bridge Program:

Bridge Courses for Water Quality Program

CE 320	Fluid Mechanics (4-0-4)
CE 321	Water Resources Engineering (3-0-3)
Chem 126	General Chemistry II (3-0-3)

Bridge Courses for Integrated Site Remediation

Chem 126	General Chemistry II (3-0-3)
CE 321	Water Resources Engineering (3-0-3)
CE 501	Introduction to Soil Behavior (3 credits)

Core Courses

6 credits as follows:

		EnE 663	Water Chemistry (3 credits)
		EnE 661	Microbiology for Environmental Engineers (3 credits) ***or***
		ERSC602	

Thesis

Required of those receiving departmental awards; electives for all others.

Specialty Electives
12 to 18 credits as follows:

Water Quality, Treatment and Infrastructure

		EnE 620	Environmental Chemodynamics (3 credits)
		EnE 664	Physical and Chemical Treatment (3 credits)
		EnE 665	Biological Treatment (3 credits)
		EnE 672	Stormwater Management (3 credits)
		CE 671	Performance and Risk Analysis of Infrastructure Systems (3 credits)

Integrated Site Remediation

		EnE 660	Introduction to Solid and Hazardous Waste Problems (3 credits)
		EnE 662	Site Remediation (3 credits)
		EnE 671	Environmental Impact Analysis (3 credits)
		CE 602	Geographic Information System (3 credits)

Multidisciplinary

This offers the flexibility of a program. The curriculum is customized in consultation with the graduate advisor.

General Electives
0 to 6 credits as follows:

See List of Department General Electives.

Management/Leadership Electives
3 to 6 credits as follows:

		CE 610	Construction Management (3 credits)
		CE 711	Methods Improvement in Construction (3 credits)
		EM 631	Legal Aspects in Environmental Engineering (3 credits)
		HRM 601	Organizational Behavior (3 credits)

Construction/Facilities Engineering and Management
Bridge Program

		CE 210	Construction Materials and Procedures (3-0-3)
		CE 501	Introduction to Soil Behavior (3 credits)
		Mech 320	Statics and Strength of Materials (3-0-3)
		CS 101	Computer Programming and Problem Solving (3-0-3)
		Math 225	Survey of Probability and Statistics (1-0-1)
		Math 112	Calculus II (4-1-4)

Core Courses

6 credits as follows:

		CE 610	Construction Management (3 credits)
		CE 611	Project Planning and Control (3 credits)

Thesis

Required of those receiving departmental awards; elective for all others.

Specialty Electives

12-18 credits as follows:

		CE 614	Underground Construction (3 credits)
		CE 615	Infrastructure and Facilities Remediation (3 credits)
		CE 616	Construction Cost Estimating (3 credits)
		CE617	
		CE 644	Geology in Engineering (3 credits)
		CE 700	Civil Engineering Project (3 credits)
		CE 671	Performance and Risk Analysis of Infrastructure Systems (3 credits)
		CE 701	Master's Thesis (6 credits)

General Electives

0 to 6 credits as follows:

See List of Department General Electives.

Management/Leadership Electives

3 to 6 credits as follows:

		CE 711	Methods Improvement in Construction (3 credits)
		EM 632	Legal Aspects in Construction (3 credits)
		HRM 601	Organizational Behavior (3 credits)

Civil Engineering

Administered By: Department of Civil and Environmental Engineering

Geotechnical Engineering:

Bridge Program:

		CE 320	Fluid Mechanics (4-0-4)
		CE 332	Structural Analysis (3-0-3)
		CE 333	Reinforced Concrete Design (3-0-3)
		CE 341	Soil Mechanics (3-0-3)
		CE 341A	Soil Mechanics Laboratory (0-3-1)
		CE 443	Foundation Design (3-0-3)
		CS 101	Computer Programming and Problem Solving (3-0-3)
		Math 222	Differential Equations (4-0-4)

Core Courses:

6 credits as follows:

		CE 641	Engineering Properties of Soils (3 credits)
		CE 642	Foundation Engineering (3 credits)

Thesis:
Required of those receiving departmental awards; elective for all others.

Specialty Electives:
12 to 18 credits as follows:

		CE 545	Rock Mechanics I (3 credits)
		CE 602	Geographic Information System (3 credits)
		CE 643	Advanced Foundation Engineering (3 credits)
		CE 644	Geology in Engineering (3 credits)
		CE 645	Rock Mechanics II (3 credits)
		CE 606	Geospatial Data Applications (3 credits)
		CE 647	Geotechnical Aspects of Solid Waste (3 credits)
		CE 648	Flow Through Soils (3 credits)
		CE 700	Civil Engineering Project (3 credits)
		CE 701	Master's Thesis (6 credits)
		CE 742	Geotechnology of Earthquake Engineering (3 credits)

General Electives:
0 to 6 credits as follows:

See List of Department General Electives.

Management/Leadership Electives
3 to 6 credits as follows:

		CE 610	Construction Management (3 credits)
		CE 711	Methods Improvement in Construction (3 credits)
		EM 632	Legal Aspects in Construction (3 credits)
		HRM 601	Organizational Behavior (3 credits)

Structural Engineering:
Bridge Program:

		CE 333	Reinforced Concrete Design (3-0-3)
		CE 341	Soil Mechanics (3-0-3)
		CE 341A	Soil Mechanics Laboratory (0-3-1)
		CE 432	Steel Design (3-0-3)
		CIS 101	Computer Programming and Problem Solving (2-1-2)
		Math 222	Differential Equations (4-0-4)
		Mech 236	Dynamics (2-0-2)

Core Courses:
6 credits as follows:

		CE 639	Applied Finite Element Methods (3 credits)
		CE 636	Stability of Structures (3 credits)

Thesis:
Required of those receiving departmental awards; elective for all others.

Specialty Electives:
12 to 18 credits as follows:

		CE 531	Design of Masonry and Timber Structures (3 credits)
		CE 631	Advanced Reinforced Concrete Design (3 credits)
		CE 632	Prestressed Concrete Design (3 credits)
		CE 634	Structural Dynamics (3 credits)
		CE 635	Fracture Mechanics of Engineering Materials (3 credits)
		CE 637	Short Span Bridge Design (3 credits)
		CE 638	Nondestructive Testing Methods in Civil Engineering (3 credits)
		CE 700	Civil Engineering Project (3 credits)
		CE 701	Master's Thesis (6 credits)
		CE 702	Special Topics in Civil Engineering (3 credits)
		CE 730	Plastic Analysis and Design (3 credits)
		CE 733	Design of Metal Structures (3 credits)
		CE 734	Design of Tall Buildings and Space Structures (3 credits)
		CE 736	Finite Element Methods in Structural and Continuum Mechanics (3 credits)
		CE 737	Earthquake Engineering (3 credits)
		CE 739	Structural Optimization (3 credits)
		Mech 630	Theory of Elasticity (3 credits)

General Electives
0 to 6 credits as follows:

See List of Department General Electives.

Management/Leadership Electives
3 to 6 credits as follows:

		CE 610	Construction Management (3 credits)
		CE 711	Methods Improvement in Construction (3 credits)
		EM 632	Legal Aspects in Construction (3 credits)
		HRM 601	Organizational Behavior (3 credits)

Transportation Engineering:
Bridge Program

		CE 350	Transportation Engineering (3-0-3)
		CS 101	Computer Programming and Problem Solving (3-0-3)
		Econ 265	Microeconomics (3-0-3)
		Math 105	Elementary Probability and Statistics (3-0-3)
		Math 309	Mathematical Analysis for Technology (4-0-4)

Core Courses
6 credits as follows:

{		CE 650	Urban Systems Engineering (3 credits) ***or***
		Tran 650	Urban Systems Engineering (3 credits)
{		CE 660	Traffic Studies and Capacity (3 credits) ***or***
		Tran 615	Traffic Studies and Capacity (3 credits)

Thesis
Required of those receiving departmental awards; elective for all others.

Specialty Electives
12 to 18 credits as follows:

		CE 659	Flexible and Rigid Pavements (3 credits)
{		CE 552	Geometric Design of Transportation Facilities (3 credits) ***or***
		Tran 552	Geometric Design of Transportation Facilities (3 credits)
{		CE 603	Introduction to Urban Transportation Planning (3 credits) ***or***
		Tran 603	Introduction to Urban Transportation Planning (3 credits)
{		CE 625	Public Transportation Operations and Technology (3 credits) ***or***
		Tran 625	Public Transportation Operations and Technology (3 credits)
{		CE 653	Traffic Safety (3 credits) ***or***
		Tran 653	Traffic Safety (3 credits)
{		CE 655	Land Use Planning (3 credits) ***or***
		Tran 655	Land Use Planning (3 credits)
		CE 700	Civil Engineering Project (3 credits)
		CE 701	Master's Thesis (6 credits)
{		CE 752	Traffic Control (3 credits) ***or***
		Tran 752	Traffic Control (3 credits)

Civil Engineering

Administered By: Department of Civil and Environmental Engineering

Civil Engineering - Online
Bridge Program:

		CE 320	Fluid Mechanics (4-0-4)
		CE 321	Water Resources Engineering (3-0-3)
		CE 332	Structural Analysis (3-0-3)
		CE 333	Reinforced Concrete Design (3-0-3)
		CE 501	Introduction to Soil Behavior (3 credits)
		Chem 126	General Chemistry II (3-0-3)

Core Courses
21 credits as follows:

		CE 610	Construction Management (3 credits)
		CE 621	Hydrology (3 credits)
		CE 632	Prestressed Concrete Design (3 credits)
		CE 611	Project Planning and Control (3 credits)
		EnE 702	Special Topics in Environmental Engineering (3 credits)
		CE 620	Open Channel Flow (3 credits)
		Tran 752	Traffic Control (3 credits)

Thesis
Required of those receiving departmental awards; elective for all others.

Management/Leadership Electives
9 credits as follows:

		EM 602	Management Science (3 credits)
		HRM 601	Organizational Behavior (3 credits)
		EM 631	Legal Aspects in Environmental Engineering (3 credits)

PhD in Civil Engineering
This is a program for superior students with master's degrees in civil engineering or allied fields who wish to do advanced research in an area of civil engineering. In exceptional circumstances, highly qualified students with bachelor's degrees in civil engineering may be accepted directly into the doctoral program.

Admission Requirements:
A minimum master's GPA of 3.5 on a 4.0 scale, or equivalent, is normally required for admission. The GRE (general section) is required of all applicants. All international students must also achieve a minimum TOEFL score of 550.

Degree Requirements:
The department approves specific degree requirements and dissertation topics on an individual basis. Students must attain a minimum overall GPA of 3.0. Students must conduct independent original research in a specific area of civil engineering. Students must select an advisor willing to supervise dissertation work.

36 credits minimum of CE 790 Doctoral Dissertation is generally required. These 36 credits should be completed before submission of the final dissertation document. Students must register for a minimum of 3 credits of CE 790? until the dissertation has been submitted and accepted.

24 credits minimum of course work beyond the master's degree are required, of which at least 12 credits must be at the 700 level; the remaining credits may be at the 600 level.

Seminar: CE 791 Graduate Seminar is required of all doctoral students every semester.

Preliminary Qualifying Examination: Full-time students must take the preliminary qualifying exam for the first time within one year of beginning active study and must pass it completely by the next time the examination is offered. Part-time students must take the preliminary qualifying exam for the first time within three years of the beginning of active study and must pass it completely by the next time the examination is offered. Exceptional students having only bachelor's degrees who are admitted directly into the doctoral program must take the preliminary qualifying examination within one and one-half years of admission and must pass it within two years. All students are permitted to take the examination only twice.

Dissertation Committee: After passing the preliminary qualifying examination, each student in consultation with the major faculty member develops a list of five faculty members who have agreed to serve on an advisory committee as follows: two or three members of the graduate faculty in the student's major area of interest; a member of the graduate faculty in the student's major area appointed by the department chairperson; a member of the graduate faculty of the Department of Civil and Environmental Engineering from another field of interest; a member of the graduate faculty from the area of the student's minor field of interest.

Research Proposal : Doctoral students must prepare a written research proposal and make an oral presentation for approval by their dissertation committee. The proposal must be presented after formation of the committee but within six months after passing the qualifying examination. Research is expected to investigate or develop a unique contribution to science and technology.

Dissertation Defense : An oral defense of the dissertation is required after submission of the final document to the department for approval. Signatures of all members of the dissertation committee must be received for final approval to be granted.

Catalog and curricula information approved by the relevant academic department.

Computational Biology

Administered By: Department of Mathematical Sciences

Administration

Chair	Daljit S. Ahluwalia
Associate Chair	Demetrius Papageorgiou
Program Director	Demetrius Papageorgiou

Faculty

Distinguished Professors	Gene M. Jonakait, Gregory A. Kriegsmann
Professors	Daljit S. Ahluwalia, Roman I. Andrushkiw, Manish Bhattacharjee, Denis L. Blackmore, Amitabha K. Bose, Fadi Deek, H M. Lacker, Dorothy Levy, Jonathan H. Luke, Petronije Milojevic, Robert M. Miura, Demetrius Papageorgiou, Manuel Perez, Michael S. Siegel, David Stickler, John Tavantzis, Farzan Nadim
Associate Professors	John K. Bechtold, John K. Bechtold, Bruce G. Bukiet, Hamilton A. Chase, Wooyoung Choi, Sunil K. Dhar, Rose Dios, Jorge P. Golowasch, Jay M. Kappraff, Martin Katzen, Lou Kondic, Murray I. Lieb, Zoi-heleni Michalopoulou, Peter G. Petropoulos, Roy A. Plastock, Kewal S. Sran, Sheldon Wang, Cyrill B. Muratov
Assistant Professors	Roy H. Goodman, Peter Gordon, David J. Horntrop, Shidong Jiang, Victor V. Matveev, Richard O. Moore, Gareth J. Russell, Louis Tao, Yuan-nan Young, Kaushik Ghosh
Special Lecturers	Aridaman K. Jain, Karen D. Rappaport, Jeyakumaran Ratnaswamy

Advisors

Advisor	Lou Kondic

Degrees Offered: Master of Science in Computational Biology

The Master of Science in Computational Biology seeks to train students at the interface of biology, computational science, and mathematical science. The program will train students to pose biological problems in mathematical terms using techniques of mathematical modeling. It will teach students how to use computational, numerical and analytic tools to aid in the analysis of mathematical models. Furthermore, it will show students how to interpret their mathematical results in biological terms. This program will be of interest to any student who is interested in a truly inter-disciplinary learning experience.

Master of Science in Computational Biology

Master of Science in Computational Biology

This masters program is designed to provide computational biology skills for students with a background in biology, mathematics, computer science, physical science, or engineering.

Admission Requirements:

1. B.S. in a natural science, mathematics, computer science, or an engineering discipline.
2. Math 222 and 337 or their equivalents.
3. One year of physics.
4. One semester of chemistry.
5. Biology – R120:301 or its equivalent.
6. Computer Science - CS 113 or 115, or their equivalents.

If the prerequisites are not fulfilled, completion of specific bridge courses will be required as a condition of admission.

Degree Requirements: A minimum of 30 credits is required for the degree, excluding bridge courses. The graduate curriculum consists of seven core courses and additional elective courses, with an optional thesis (six credits) or research project (three credits).

Required Courses (21 Credits):

		BIOL601	
		BNFO601	
		Math 611	Numerical Methods for Computation (3 credits)
		Math 630	Linear Algebra and Applications (3 credits)
		Math 635	Analytical Computational Neuroscience (3 credits)
		Math 663	Introduction to Biostatistics (3-0-3)
		Biol 638	Computational Ecology (3-0-3)

Electives: (Choose 3 courses from below; 9 credits)

		Math 637	Foundations of Mathematical Biology (3 credits)
		Math 644	Regression Analysis Methods (3 credits)
		Math 699	Design and Analysis of Experiments (3 credits)
		Chem 658	Advanced Physical Chemistry (3 credits)
		R120:512	Mammalian Physiology (3 credits)
		R120:516	Microbial Ecology (3)
		R120:524	
		R120:530	Biophysical Membrane Physiology (4 credits)

***Masters Project/Thesis (Optional):**

		BIOL700	
		BIOL701	

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* Masters Project or a Master's Thesis is optional. (Advisor's permission is required).

Computer Engineering

Administered By: Department of Electrical and Computer Engineering

Administration

Chair	Atam P. Dhawan
Associate Chair (Undergraduate)	Sui-hoi E. Hou
Associate Chair (Graduate)	Sotirios G. Ziavras

Faculty

Distinguished Professors	Yeheskel Bar-Ness, Bernard Friedland, Jacob Savir
Professors	Ali N. Akansu, Ansarin, changtn, Roy H. Cornely, Atam P. Dhawan, Haim Grebel, Richard A. Haddad, Alexander M. Haimovich, Jacob Klapper, Durgamadhab Misra, Edip Niver, Yun-qing Shi, Kenneth S. Sohn, Marek Sosnowski, Leonid Tsybeskov, Gerald Whitman, Mengchu Zhou, Sotirios G. Ziavras
Associate Professors	Ali Abdi, John D. Carpinelli, Hongya Ge, Sui-hoi E. Hou, Walid Hubbi, Constantine N. Manikopoulos, Sirin Tekinay, Roberto Rojas-Cessa
Assistant Professors	Jie Hu, Swades K. De, Yanchao Zhang
Special Lecturer	Arthur B. Glaser

Advisors

Undergraduate Advisor	Shivon S. Boodhoo
Undergraduate Advisor	Sui-hoi E. Hou
MS Computer Engineering Advisor	Mengchu Zhou
PHD Computer Engineering Advisor	Sotirios G. Ziavras
MS Electrical Engineering Advisor	Durgamadhab Misra
PHD Electrical Engineering Advisor	Sotirios G. Ziavras
MS Telecommunications Advisor	Nirwan Ansari
MS Internet Engineering Advisor	Nirwan Ansari

Degrees Offered: Master of Science in Computer Engineering; Doctor of Philosophy in Computer Engineering
Focus on interdisciplinary course work and research provides students enrolled in the M.S. and Ph.D. in Computer Engineering programs with an advanced background in both the hardware and software aspects of computing.

The master's program prepares computer engineers to successfully make the hardware-software design trade-offs inherent to computing today. The rapid development of computer hardware and software in the last decade has created a demand for engineers who are not only knowledgeable in both these areas, but who also understand their interaction. The fields of embedded computer system design and computer networks are based squarely on this knowledge.

The doctoral program is designed for superior students with a master's degree in computer engineering, computer science, electrical engineering, or other related fields, who wish to pursue advanced research in the area of computer engineering. The master's and doctoral programs emphasize computer architecture and systems, computer networking, intelligent systems, microprocessor-based systems, and VLSI system design.

Master of Science in Computer Engineering

This program prepares its graduates to successfully handle problems requiring in-depth knowledge of both computer hardware and software, and more important, their interaction. Students may concentrate in microprocessor-based systems, parallel computing systems, computer networking, VLSI system design, or machine vision systems. All applicants must submit GRE scores. International students must achieve a minimum TOEFL score of 550 (pencil and paper) and (213 computer-based).

Admission Requirements:

Applicants are expected to have an undergraduate education in engineering or computer science. Applicants with baccalaureate degrees in areas other than computer engineering may be admitted and required to complete a bridge program. Those with undergraduate degrees in other fields should consult the MSCOE Program Advisor for bridge requirements. Bridge courses do not count toward degree requirements.

Bridge Program: Students with undergraduate degrees in computer science take courses from:

ECE 353	Computer Organization and Architecture (3-0-3)
ECE 395	Microprocessor Laboratory (0-4-2)
ECE 231	Circuits and Systems I (3-1-3)
ECE 684	Advanced Microprocessor Systems (3 credits)

Students with undergraduate degrees in electrical engineering take courses from:

CIS 505	Programming, Data Structures, and Algorithms (3 credits)
ECE 353	Computer Organization and Architecture (3-0-3)
ECE 395	Microprocessor Laboratory (0-4-2)
ECE 684	Advanced Microprocessor Systems (3 credits)

Graduate Certificate Program: A 12-credit graduate certificate in Information Assurance is available as a step toward this degree. Please see Graduate Certificates in this catalog for further information. For more information about continuing and distance education, please contact the Division of Continuing Professional Education, 1-800-624-9850 or 973-596-3060; email: cpe@njit.edu.

Degree Requirements:

Students must complete 30 credits; 21 or more credits must be from ECE courses. They include two required computer engineering core courses, two more required courses for one of the five areas of specialization, and a master's project or thesis. As a requirement for graduation, students must achieve a 3.0 cumulative GPA, not including the master's thesis or project. The master's thesis or project grade must be B or higher.

All M.S. students are required to fulfill? two semesters of ECE 791 (Graduate Seminar).

Core:

Required for all specializations

6 credits:

CS 610	Data Structures and Algorithms (3 credits)
ECE 690	Computer Systems Architecture (3 credits)

Project or Thesis (required):

	ECE 700	Master's Project (3 credits) ***or***
*	ECE 701	Master's Thesis (3 credits)

Areas of Specialization:

Electives:
15 credits if completing master's thesis or 18 credits if completing master's project:

A list of suggested complementary elective courses is available for each area of concentration/specialization. Consult the Graduate Advisor of Computer Engineering for a current list of these courses. Other courses may be used as electives with the permission of the graduate advisor.

Computer Architecture and Systems:
Required:
6 credits:

		ECE 658	VLSI Design I (3 credits)
		ECE 692	Embedded Computing Systems (3)

Microprocessor-Based Systems:
Required:
6 credits:

		ECE 686	Instrumentation Systems and Microprocessors (3 credits)
		ECE 688	Microcontrollers in Instrumentation (3 credits)

Intelligent Systems:
Required:
6 credits:

		ECE 605	Discrete Event Dynamic Systems (3 credits)
		ECE 609	Artificial Neural Networks (3 credits)

VLSI System Design:
Required:
6 credits

		ECE 658	VLSI Design I (3 credits)
		ECE 758	VLSI Design II (3 credits)

Computer Networking:
Required:
6 credits:

		ECE 683	Computer Network Design and Analysis (3 credits)
		ECE 637	Internet and Higher-Layer Protocols (3 credits)

Doctor of Philosophy in Computer Engineering

This program is intended for superior students with a master's degree in computer engineering, computer science, electrical engineering, or other related fields, who wish to pursue advanced research in computer engineering. The program emphasizes the following areas: computer architecture and systems, computer networking, intelligent systems, microprocessor-based systems, and VLSI systems design.

Admission Requirements:
Applicants are expected to have a master's degree in computer engineering, computer science, electrical engineering, or other related fields. Students who lack an appropriate background may be admitted and required to take bridge courses that cannot be applied as degree credits.

Students must demonstrate superior academic background in engineering, mathematics, and physical science; skills in programming; and proficiency in major areas of computer engineering and science. A minimum master's GPA of 3.5 on a 4.0 scale, or equivalent, is required for admission. GRE scores must be submitted. International students must also achieve a minimum TOEFL score of 550 (213 computer-based).

Superior undergraduate students may apply to be admitted directly into the Ph.D. program. Such an accelerated program requires a minimum entrance GPA of 3.5 and an interview with the Electrical and Computer Engineering Department Graduate Affairs Committee.

Degree Requirements:

A minimum of 60 degree credits beyond the master's degree is required; 24 credits of course work beyond the master's degree, with at least 12 at the 700 level; and 36 credits of doctoral dissertation. Doctoral students must register for six semesters of ECE 791 Graduate Seminar. Students must attain a minimum overall GPA of 3.0. Students admitted into the program at the baccalaureate level must complete a total of 87 credits, consisting of 51 course credits and 36 dissertation credits. At least 12 course credits must be at the 700 level. Courses will be selected in consultation with the graduate advisor. Dissertations should demonstrate original research that contributes to the knowledge in the field and should result in the submission of at least one paper for publication in a peer-reviewed journal. Students must provide the department with a written proposal showing that facilities are available and that there is a faculty member willing to supervise dissertation work. Students who complete 36 credits of ECE 790 before research is finished must register for a minimum of 3 credits of ECE 790 each semester thereafter until the dissertation is accepted.

Residence: Degree-seeking students must spend at least one academic year in full-time residence.

Qualifying Examination: Contains material related to the student's intended area of specialization. See department for more details.

Dissertation Defense: An oral defense of the dissertation is required after submission of the final document to the department for approval.

Pre-Doctoral Research: With department approval, well-qualified students may register for up to a maximum of 9 credits of ECE 792 Pre-Doctoral Research before passing the qualifying examination. A maximum of 6 credits of ECE 792 may be applied toward ECE 790. For further information, see Academic Policies and Procedures in this catalog and the department Handbook for Graduate Students.

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* ECE 701 (6 credits)

Computer Science

Administered By: Department of Computer Science, Guttenberg Information Technologies Center, Room 4400.

Administration

Chairperson	Michael A. Baltrush
Associate Chairperson	James M. Calvin
PhD Director	David Nassimi

Faculty

Distinguished Professor	Joseph Y. Leung
Professors	Narain Gehani, James Geller, James McHugh, Ali Mili, Yehoshua Perl, Frank Y. Shih, verkhovs, Jason T. Wang
Associate Professors	Michael A. Baltrush, James M. Calvin, Alexandros Gerbessiotis, Daochuan Hung, Marvin K. Nakayama, Chengjun Liu, John W. Ryon, Andrew Sohn, Dimitrios Theodoratos
Assistant Professors	Cristian M. Borcea, Barry Cohen, Usman W. Roshan, Guiling Wang
Special Lecturers	George Blank, Osama Eljabiri, Jonathan J. Kapleau, Dionissios Karvelas, Morty D. Kwestel, Theodore L. Nicholson, Wallace Rutkowski

Advisors

Undergraduate Advisor	Sarah Vandermark
MSCS Advisor	Kathleen Price
First Year PhD Advisor	David Nassimi

Degrees Offered: Master of Science in Computer Science; Doctor of Philosophy in Computer Science.
The Department of Computer Science is distinguished by prominent researchers who are actively investigating new applications in parallel processing and advanced computer architecture, systems integration, real-time computing, neuroscience and robotics, medical imaging, combinatorial computing, bioinformatics, computer vision and image processing, and software engineering.

The department provides an environment that gives students the background and skills necessary for entry into today's workplace. This is achieved through team research in state-of-the-art facilities; a faculty that works steadily in the forefront of many research areas; interaction with industry and experts; and an administration focused on research and student services. As a result, the department attracts the largest student population for computer and information science in the greater New York/New Jersey area.

The computer and information science department maintains and offers computing facilities for its students, faculty, and staff. The computing facilities include research laboratories housing research in areas of computer science such as: networking, real-time systems, hypermedia, parallel processing, and collaborative systems. Users have access to the state-of-the-art software and hardware including Oracle database, UNIX-based workstations and Microsoft Windows PCs supported by several file and compute servers. Internet access, departmental intranets, and conferencing systems provide an integrated infrastructure for supporting teaching and research.

Master of Computer Science

The Master of Science (MS) in Computer Science (CS) is intended for students who are interested in pursuing advanced studies in computer science.

Admission Requirements:

- GPA
  - 3.0 out of 4.0 required for students with a computer science background.
  - 3.0 out of 4.0 required for students without a computer science background who may be required to enroll in bridge courses.
- International students TOEFL score: the Institute requires a minimum score of 213.
- International students: GRE required.
- Students with a US or Canadian degree in computer science or engineering: GRE recommended but not required.
- Students with a US or Canadian degree not in computer science or engineering: GRE required.

Students who lack a comprehensive computer science background will be required to take appropriate bridge courses and attain a minimum cumulative GPA of 3.0 in the bridge courses.

Students are expected to have good programming skills, and a grasp of the fundamentals of computer science (students should have acquired this knowledge in the undergraduate degree Bachelor of Science in Computer Science or equivalent degree). To ensure that students have the background to do well and succeed in doing the MS in Computer Science at NJIT, they will be required to take a short answer exam to demonstrate that they have good programming skills (in C++ or Java) and that they know the basic concepts of operating systems, networking, and databases. Students who do not pass the programming part of this exam will be required to take a programming bridge course, CS 505 Programming and Data Structures and Algorithms. Students who do not pass the basic concepts part of the exam will be required to take a concepts course, CS 507 Principles of Computer Science.

Note that credits earned in the bridge program cannot count towards the MS program. However, grades of 500-level bridge courses contribute towards the graduate GPA. Students must maintain a cumulative graduate GPA of 3.0 or better.

If a student satisfies a bridge requirement before matriculation, the student can request a bridge course waiver which must be filed no later than the end of the first semester of studies and accompanied by all relevant documentation as required by University regulations. See Academic Policies and Procedures in the NJIT Graduate Catalog at catalog.njit.edu/graduate/frontmatter/AcademicPolicy.php.

PASS/FAIL courses, professional development courses, work experience, or a course with a grade less than B (or equivalent) cannot be used to satisfy a bridge course requirement. Grades in the bridge program (500-level courses or higher) contribute to the cumulative graduate GPA. However, these courses do not count toward the MS program credit requirements. The undergraduate catalog, catalog.njit.edu/courses/cs.php, contains descriptions of undergraduate courses included in the bridge program.

Application Processing:

The Computer Science Department reviews only completed applications submitted to the Office of Graduate Admissions. Applicants are advised to request status information on their application directly from the Graduate Admissions Office, not the Computer Science Department. Graduate Admissions can be reached at admissions@njit.edu or www.njit.edu/gadmission or by mail at NJIT, Graduate Admissions Office, University Heights, Newark NJ 07102.

Degree Options:

Students can pick from one of three options for the MS degree:

1. Course only (with optional specialization - 33 credits.
2. Project - 30 credits
3. Thesis (specialization required) - 30 credits.

Students will be assigned a graduate advisor to assist them in formulating a program of study and selecting a specialization or degree option.

1. Course Only Option (33 credits)

The courses required for this option are:

a) Four courses:
- Either CS 610 Data Structures and Algorithms or CS 667 Design Techniques for Algorithms.

- Three of the following four course choices:
  - CS 631 Database Systems Design.
  - CS 656 Internet and Higher Layer Protocols.
  - CS 650 Computer Architecture.
  - CS 630 Operating Systems.

b) 5 courses from the Computer Science graduate catalog. Two of these five must be from an approved list of advanced courses.

c) Two (2) courses either from the Computer Science graduate catalog or from another department's graduate catalog. Courses from outside the Computer Science Department must be relevant to the Computer Science program and require prior approval.

Total number of credits required for graduation is 33.

Specializations:

Students can optionally specialize in a specific area (see below) by taking a minimum of four (4) courses listed in the specialization in accordance with requirements (b) and (c). Note that some specialization courses have prerequisites that must be fulfilled before enrolling in these courses.

Computer Networking and Security

Choose three (3) courses from the following table:

		CS 604	Client/Server Computing (3 credits)
		CS 608	Cryptography and Security (3-1-3)
		CS 656	Internet and Higher-Layer Protocols (3 credits)
		CS 696	Network Management and Security (3 credits)
		IS 681	Computer Security Auditing (3 credits)

Databases and Data Mining

Choose three (3) courses from the following table:

		CS 632	Advanced Database System Design (3 credits)
		CS 731	Applications of Database Systems (3 credits)
		CS 734	Data Mining (3 credits)
		CS 744	Data Mining and Management in Bioinformatics (3 credits)

Note: Taking CS 700 level courses require permission of the graduate advisor.

Image Processing and Pattern Recognition

Choose three (3) courses from the following table:

		CS 659	Image Processing and Analysis (3 credits)
		CS 759	Advanced Image Processing and Analysis (3 credits)
		CS 780	Computer Vision (3 credits)
		CS 782	Pattern Recognition and Applications (3 credits)

Note: Taking CS 700 level courses require permission of the graduate advisor.

Software Engineering

Choose three (3) courses from the following table:

		CS 673	Software Design and Production Methodology (3 credits)
		IS 676	Requirements Engineering (3 credits)
		CS677	

Computer Algorithms

Choose three (3) courses from the following table:

		CS 611	Introduction to Computability and Complexity (3 credits)
		CS 665	Algorithmic Graph Theory (3 credits)
		CS 667	Design Techniques for Algorithms (3 credits)
		CS 668	Parallel Algorithms (3 credits)
		CS 669	Computational Geometry (3 credits)

Bioinformatics

Choose three (3) courses from the following table:

		BNFO601	
		BNFO602	
		CS 744	Data Mining and Management in Bioinformatics (3 credits)
		Math 661	Applied Statistics (3 credits)

Note: Taking CS 700 level courses require permission of the graduate advisor.

2. Project Option (30 credits)

Students must

- Enroll in the Masters Project course CS 700B.

In the semester prior to enrolling in CS 700B, the student must prepare and submit a project proposal to the Department no later than the last weekday class day of the 8th week of the

- Fall semester for a spring project, or
- Spring semester for a summer or fall project.

The student must have an advisor in the Computer Science Department who is a tenure- track faculty member or who holds a joint appointment in the department.

With the exception of the project, the Project Option is similar to the Course Only Option with a specialization. The 3-credit project is considered equivalent to two (2) courses of requirement (1.b).

Project Requirements

- Before a student pursues a Master's Project, the following requirements must be fully satisfied:
  - All bridge courses must be completed.
  - In the semester prior to the project, a student prepares and submits a project proposal to the Department no later than the last weekday class day of the 8th week of the Fall semester for a spring project and no later than the last weekday class day of the 8th week of the Spring semester for a summer or fall project. The preparatory work for the proposal may be accomplished within the framework of a required course or an independent study course offered by the prospective advisor. Therefore, such a course must be taken in the semester prior to the project.
- A CS Department tenure-track faculty member or a faculty member who holds a joint appointment in the computer science department can advise an MS project.
- Proposal preparation must adhere to the existing departmental guidelines; the information and templates are available online.

Thesis Option (30 credits)

Students must

- select a specialization, and
- enroll in the Thesis CS 701 course for two (2) semesters (Thesis must match specialization).

A student can enroll in CS 701 during the second semester of full time study.

Normally the student enrolls for two semesters of CS 701 to prepare the thesis proposal, perform the research, and prepare the thesis. The thesis must be orally defended and follow the style set forth by the Graduate School at NJIT. The thesis committee is composed of a Computer Science tenure-track committee chair and two other tenure-track members of the Computer Science Department or Faculty holding a joint appointment to the department.

With the exception of the thesis, the thesis option is similar to the Course Only Option with a specialization. The six (6) credit thesis is considered equivalent to three (3) courses of requirement (1.b).

Thesis Requirements

- Before a student pursues a Master's Thesis, the following requirements must be fully satisfied:
  - All bridge courses must be completed.
  - In the semester prior to the thesis, a student prepares and submits a thesis proposal to the department no later than week 8 of the Fall semester for a spring thesis and week 8 of the Spring semester for a summer of fall thesis. The preparatory work for the proposal may be accomplished within the framework of a required course or an independent study course offered by the prospective advisor. Therefore, such a course must be taken in the semester prior to the thesis.
- A CS department tenure-track faculty member or a faculty member who holds a joint appointment in the Computer Science Department can advise an MS thesis.
- A thesis must adhere to the style requirements set forth by the Graduate School: www.njit.edu/v2/Directory/Admin/Graduate_Studies/thesis.php.
- An oral defense is required. The defense must take place between one week prior to the Reading Day of the semester and the last day of the Examination period. A committee of at least three tenure-track faculty members from the CS Department, including the thesis advisor, collectively determines the grade for CS 701 at the conclusion of the oral defense.

Other Policies

- Transfer: Transfer of computer science courses from other US/Canada institutions is allowed as per university regulations provided that these courses are related to the program. Graduate Advisor and Graduate Studies Office approvals are required.
- MS/MS Program: Under the University MS/MS program, up to six credits of courses taken in other departments can be used for graduate credits toward the degree as long as these courses are related to computer science. Graduate advisor and Graduate Studies Office approvals are required.
- Co-op Program: Before a student applies for CS 590/591/592 registration, the successful completion of the bridge program, all ESL requirements, and at least four graduate courses is required.
- The same course cannot satisfy two or more requirements.

CS Advanced Courses

		CS 611	Introduction to Computability and Complexity (3 credits)
		CS 632	Advanced Database System Design (3 credits)
		CS 659	Image Processing and Analysis (3 credits)
		CS 661	Systems Simulation (3 credits)
		CS 665	Algorithmic Graph Theory (3 credits)
		CS 667	Design Techniques for Algorithms (3 credits)
		CS 668	Parallel Algorithms (3 credits)
		CS 673	Software Design and Production Methodology (3 credits)
		CS 696	Network Management and Security (3 credits)
		CS 704	Sequencing and Scheduling (3-0-3)
		CS 730	Seminar in Database Management Topics (3 credits)

		CS 731	Applications of Database Systems (3 credits)
		CS 734	Data Mining (3 credits)
		CS 744	Data Mining and Management in Bioinformatics (3 credits)
		CS 750	High Performance Computing (3 credits)
		CS 752	Communication Protocol Synthesis and Analysis (3 credits)
		CS 759	Advanced Image Processing and Analysis (3 credits)
		CS 775	Seminar in Software Engineering (3 credits)
		CS 780	Computer Vision (3 credits)
		CS 782	Pattern Recognition and Applications (3 credits)

Bridge Courses

Students who intend to pursue an MS degree in Computer Science are expected to have a certain background in Computer Science and Mathematics. A student who does not have this background will be expected to take bridge courses in the beginning before taking graduate level Computer Science courses. These students will be notified in their acceptance letter that bridge courses are a condition of their acceptance into the Master's Program. If a student's acceptance letter indicates bridge courses are required, they must contact the Graduate Advisor. If the acceptance letter does not indicate bridge courses, none are required and the student may immediately begin taking graduate courses. A student must maintain a cumulative GPA of 3.0 in bridge courses. Bridge courses do not count towards MS degree requirements; however, they count toward the cumulative graduate GPA

		CS 252	Computer Organization and Architecture (3-0-3)
		CS 332	Principles of Operating Systems (3-0-3)
		CS 505	Programming, Data Structures, and Algorithms (3 credits)
		CS 506	Foundations of Computer Science (3 credits)
		Math 111	Calculus I (4-1-4)
		Math 112	Calculus II (4-1-4)
		Math 211	Calculus III A (3-0-3)
		Math 333	Probability and Statistics (3-0-3)

Note: CS 505 requires prior knowledge of higher level programming language. For students with no prior programming experiences, CS 113 and CS 114 are recommended for replacement.

PhD in Computer Science

Bridge Program:

Applicants are expected to have backgrounds in computer science and mathematics equivalent to the bridge program courses listed below. Students who lack this background may be admitted and required to take these courses and attain a cumulative GPA of 3.0.

		CS 251	Computer Organization (3-0-3)
		CS 332	Principles of Operating Systems (3-0-3)
		CS 333	Introduction to UNIX Operating Systems (3-0-3)
		CS 505	Programming, Data Structures, and Algorithms (3 credits)
		CS 510	Assembly Language Programming and Principles (3 credits)
		Math 111	Calculus I (4-1-4)
		Math 112	Calculus II (4-1-4)
		Math 211	Calculus III A (3-0-3)
		Math 226	Discrete Analysis (4-0-4)
		Math 333	Probability and Statistics (3-0-3)

Core Requirements:

All PhD students are required to take qualifying examinations in the following areas:

		CS 610	Data Structures and Algorithms (3 credits)
		CS 611	Introduction to Computability and Complexity (3 credits)
		CS 665	Algorithmic Graph Theory (3 credits)

Concentration Areas:

A PhD. student within the program is required to pick an area of concentration. While the areas of concentrations change according to faculty research interests, here are examples of possible concentrations with possible courses taken within those concentrations..

		CS 631	Data Management System Design (3 credits)
		CS 632	Advanced Database System Design (3 credits)
		IS 634	Information Retrieval (3 credits)
		CS 665	Algorithmic Graph Theory (3 credits)
		CS 667	Design Techniques for Algorithms (3 credits)
		CS 670	Artificial Intelligence (3 credits)
		CS 734	Data Mining (3 credits)
		BIOL601	

Computer Algorithms and Theory of Computing:

		CS 610	Data Structures and Algorithms (3 credits)
		CS 611	Introduction to Computability and Complexity (3 credits)
		CS 665	Algorithmic Graph Theory (3 credits)
		CS 667	Design Techniques for Algorithms (3 credits)
		CS 668	Parallel Algorithms (3 credits)
		CS 669	Computational Geometry (3 credits)
		IE 704	Sequencing and Scheduling (3 credits)

Computer Systems, and Parallel and Distributed Processing:

		CS 630	Operating System Design (3 credits)
		CS 633	Distributed Systems (3 credits)
		CS 636	Compiling System Design (3 credits)
		CS 637	Real-Time Systems (3 credits)
		CS 650	Computer Architecture (3 credits)
		CS 668	Parallel Algorithms (3 credits)
		CS 750	High Performance Computing (3 credits)
		ECE 658	VLSI Design I (3 credits)
		ECE 758	VLSI Design II (3 credits)
		ECE 689	Digital System Design for Machine Arithmetic (3 credits)
		ECE 785	Parallel Processing Systems (3 credits)

Databases, Data Mining, and Knowledge-Based Engineering:

		CS 630	Operating System Design (3 credits)
		CS 631	Data Management System Design (3 credits)
		CS 632	Advanced Database System Design (3 credits)
		IS 634	Information Retrieval (3 credits)
		IS 658	Multimedia Systems (3 credits)
		CS 665	Algorithmic Graph Theory (3 credits)
		CS 667	Design Techniques for Algorithms (3 credits)
		CS 670	Artificial Intelligence (3 credits)
		CS 671	Knowledge-Based Systems (3 credits)
		CS 731	Applications of Database Systems (3 credits)
		CS 734	Data Mining (3 credits)

Image Processing and Computer Graphics:

		CS 630	Operating System Design (3 credits)
		CS 632	Advanced Database System Design (3 credits)
		CS 657	Principles of Interactive Computer Graphics (3 credits)
		CS 659	Image Processing and Analysis (3 credits)
		CS 665	Algorithmic Graph Theory (3 credits)
		CS 667	Design Techniques for Algorithms (3 credits)
		CS 682	Geometric Modeling (3 credits)
		CS 759	Advanced Image Processing and Analysis (3 credits)
		CS 780	Computer Vision (3 credits)
		CS 782	Pattern Recognition and Applications (3 credits)
		ECE 601	Linear Systems (3 credits)
		ECE 643	Digital Image Processing I (3 credits)
		ME 635	Computer-Aided Design (3 credits)

Other 600/700-level courses as approved by advisor.

Networking and Security:

		CS 604	Client/Server Computing (3 credits)
		CS 630	Operating System Design (3 credits)
		CS 651	Data Communications (3 credits)
		CS 652	Computer Networks-Architectures, Protocols and Standards (3 Credits)
		CS 654	Telecommunication Networks Performance Analysis (3 credits)
		CS 656	Internet and Higher Layer Protocols (3 credits)
		CS 696	Network Management and Security (3 credits)
		CS 697	Principles of Broadband ISDN and ATM (3 credits)
		CS 741	Communication Network Design (3 credits)
		CS 752	Communication Protocol Synthesis and Analysis (3 credits)

Software Engineering:

		CS 601	Object-Oriented Programming (3 credits)
		CS 610	Data Structures and Algorithms (3 credits)
		CS 611	Introduction to Computability and Complexity (3 credits)
		CS 630	Operating System Design (3 credits)
		CS 635	Computer Programming Languages (3 credits)
		CS 636	Compiling System Design (3 credits)
		CS 641	Formal Languages and Automata (3 credits)
		CS 667	Design Techniques for Algorithms (3 credits)
		CS 673	Software Design and Production Methodology (3 credits)
		IS 676	Requirements Engineering (3 credits)
		IS 683	Object-Oriented Software Development (3 credits)
		CS 688	Programming for Interactive Environments (3 credits)

Systems Analysis, Simulation and Modeling:

		CS 605	Discrete Event Dynamic Systems (3 credits)
		CS 621	Numerical Analysis I (3 credits)
		CS 622	Numerical Analysis II (3 credits)
		CS 630	Operating System Design (3 credits)
		CS 631	Data Management System Design (3 credits)
		CS 637	Real-Time Systems (3 credits)
		CS 651	Data Communications (3 credits)
		CS 654	Telecommunication Networks Performance Analysis (3 credits)
		CS 661	Systems Simulation (3 credits)
		CS 662	Model Analysis and Simulation (3 credits)
		CS 741	Communication Network Design (3 credits)

Electrical Engineering

Administered By: Department of Electrical and Computer Engineering

Administration

Interim Chair	Timothy N. Chang
Associate Chair (Undergraduate)	Sui-hoi E. Hou
Associate Chair (Graduate)	Durgamadhab Misra

Faculty

Distinguished Professors	Yeheskel Bar-Ness, Bernard Friedland, Jacob Savir
Professors	Ali N. Akansu, Nirwan Ansari, William N. Carr, changtn, Roy H. Cornely, Atam P. Dhawan, Haim Grebel, Richard A. Haddad, Alexander M. Haimovich, Jacob Klapper, Durgamadhab Misra, Yun-qing Shi, Kenneth S. Sohn, Marek Sosnowski, Gerald Whitman, Mengchu Zhou, Sotirios G. Ziavras
Associate Professors	John D. Carpinelli, Hongya Ge, Sui-hoi E. Hou, Walid Hubbi, Edip Niver, Leonid Tsybeskov
Assistant Professors	Ali Abdi, Jie Hu, Swades K. De, Roberto Rojas-Cessa, Yanchao Zhang
Special Lecturer	Arthur B. Glaser

Advisors

Undergraduate Advisor	Shivon S. Boodhoo
Undergraduate Advisor	Sui-hoi E. Hou
MS Electrical Engineering Advisor	Durgamadhab Misra
PHD Electrical Engineering Advisor	Durgamadhab Misra
MS Computer Engineering Advisor	Mengchu Zhou
PHD Computer Engineering Advisor	Durgamadhab Misra
MS Telecommunications Advisor	Roberto Rojas-Cessa

Degrees Offered: Master of Science in Electrical Engineering; Doctor of Philosophy in Electrical Engineering

The Department of Electrical and Computer Engineering serves the community, the state and the nation by educating engineers, expanding knowledge and developing new tools for solving complex technological problems. The department's graduate programs offer students with backgrounds in electrical engineering or related areas unusual opportunities to specialize in advanced phases of electrical engineering. In addition to more than 30 full-time faculty members devoted to teaching and research, students are taught by adjunct professors from industry who offer specialty courses in their area of expertise and serve on thesis and dissertation committees.

The master's degree programs provide state-of-the-art training at advanced levels in areas of technical specialization, including faculty-supervised research. Students in the doctoral program conduct significant original research in areas of interest to department members. Students also have opportunities to conduct thesis research at industrial sites, hospitals, biomedical engineering facilities, and university centers and departments.

Master of Science in Electrical Engineering

A program for students with an undergraduate degree in engineering who wish either to specialize in an advanced phase of electrical engineering or prepare for a more advanced degree.

Admission Requirements:

Applicants are expected to have undergraduate backgrounds in physics, mathematics (through differential equations and vector analysis), electrical networks and devices, electronics, analysis and design methods, transients, electromagnetic fields, and appropriate laboratory work in some of these areas. GRE scores must be submitted. International students must also achieve a minimum TOEFL score of 550 (213 computer-based). For further information, see the Admissions section in this catalog.

Bridge Program: Students who have earned a Bachelor of Science in Engineering Technology (B.S.E.T.) degree, or who lack an appropriate background may be admitted and be required to take selected courses such as the ones listed below in addition to the degree requirements in order to make up deficiencies. They must attain a grade of B or better in each course. At the discretion of the department, students who have taken courses equivalent to these may have their bridge programs reduced accordingly.

		ECE 321	Random Signals and Noise (3-0-3)
		ECE 232	Circuits and Systems II (3-1-3)
		ECE 333	Signals and Systems (3-0-3)
		ECE 361	Electromagnetic Fields I (3-0-3)
		ECE 362	Electromagnetic Fields II (3-0-3)
		ECE 372	Electronic Circuits II (3-0-3)
		ECE 373	Electronic Circuits III (3-0-3)

Graduate Certificate Program: A 12-credit graduate certificate in Telecommunications Networking is available as a step toward this degree. See Graduate Certificates in the Degree Programs section of this catalog. For further information, call the Associate Vice President of Continuing and Distance Education, Division of Continuing Professional Education, 1 (800) 624-9850 or (973) 596-3060; e-mail cpe@njit.edu

Degree Requirements:

Upon entering the program, students select an area of specialization supervised by the MSEE Program Advisor. The master's program consists of 30 credits. Students who enter the program but who do not receive departmental or research-based awards have three program options: 24 course credits and 6 credits of master's thesis; or 27 course credits and 3 credits of master's project; or 30 course credits not to include either a master's project or thesis. Students should consult with the Program Advisor or designee before registering for courses to make sure they are meeting department requirements. As a requirement for graduation, students must achieve a 3.0 cumulative GPA in graduate-level courses, not including the master's thesis or project. The project grade must be B or better.

ECE courses at the 500 level are not acceptable for credit toward a graduate degree in electrical engineering. Only one 500 level course outside the department may be applied for credit toward a graduate degree in electrical engineering.

All students are required to fulfill two semesters of ECE 791 Graduate Seminar.

Project, Thesis:

Thesis is required for all those receiving departmental or research-based support. For all others, a project or thesis is optional.

		ECE 700	Master's Project (3 credits)
	*	ECE 701	Master's Thesis (3 credits)

Areas of Specialization:

Entering students must select an area of specialization during their first semester. Special topics courses and electives are chosen with the approval of the MSEE Program Advisor or designee. Two non-ECE graduate courses may be chosen. Students should contact the MSEE Program Advisor for guidance.

Electrical Engineering Core:

Applies to all areas of specialization in Electrical Engineering

6 credits:

		ECE 601	Linear Systems (3 credits)
		ECE 673	Random Signal Analysis I (3 credits) ***or***
		ECE 620	Electromagnetic Field Theory (3 credits)

Focus Area: Communications, Signal Processing and Microwave:

Area requirements (Choose at least two)

		ECE 640	Digital Signal Processing (3 credits)
		ECE 642	Communication Systems I (3 credits)
		ECE 742	Communication Systems II (3 credits)
		ECE 740	Advanced Digital Signal Processing (3 credits)
		ECE 630	Microwave Engineering (3 credits)
		ECE 632	Antenna Theory (3 credits)

Suggested Electrical Engineering Electives:

		ECE 609	Artificial Neural Networks (3 credits)
		ECE 622	Wave Propagation (3 credits)
		ECE 623	Fourier Optics (3 credits)
		ECE 625	Fiber and Integrated Optics (3 credits)
		ECE 626	Optoelectronics (3 credits)
		ECE 642	Communication Systems I (3 credits)
		ECE 644	Introduction to Wireless and Personal Communications Systems (3 credits)
		ECE 684	Advanced Microprocessor Systems (3 credits)
		ECE 746	Adaptive Array Processing and Interference Cancellation (3 credits)
		ECE 747	Signal Decomposition Techniques: Transforms, Sub-bands, and Wavelets (3 credits)
		ECE 755	Advanced Topics in Digital Communications (3 credits)
		ECE 757	Advanced Wireless Communications (3 credits)
		ECE 776	Information Theory (3 credits)
		ECE 777	Statistical Decision Theory in Communications (3 credits)
		ECE 778	Algebraic Coding for Information Transmission (3 credits)

Focus Area : Computer Netwoking:

Area requirements

		ECE 683	Computer Network Design and Analysis (3 credits)
		ECE 783	Computer Communication Networks (3 credits)

Suggested Electrical Engineering Electives:

		ECE 605	Discrete Event Dynamic Systems (3 credits)
		ECE 637	Internet and Higher-Layer Protocols (3 credits)
		ECE 638	Network Management and Security (3 credits)
		ECE 639	Principles of Broadband Networks (3 credits)
		ECE 642	Communication Systems I (3 credits)
		ECE 644	Introduction to Wireless and Personal Communications Systems (3 credits)
		ECE 645	Wireless Networks (3 credits)
		ECE 658	VLSI Design I (3 credits)
		ECE 677	Optimization Techniques (3 credits)
		ECE 681	High Performance Routers and Switches (3 credits)
		ECE 690	Computer Systems Architecture (3 credits)

		ECE 742	Communication Systems II (3 credits)
		ECE 745	Advanced Wireless Networks (3 credits)
		ECE 785	Parallel Processing Systems (3 credits)
		ECE 685	Network Interface Design (3 credits)
		CS 610	Data Structures and Algorithms (3 credits)
		CS 665	Algorithmic Graph Theory (3 credits)
		Math 661	Applied Statistics (3 credits)
		Mgmt 685	Operations Research and Decision Making (3 credits)

Area requirements

		ECE 689	Digital System Design for Machine Arithmetic (3 credits)
		ECE 690	Computer Systems Architecture (3 credits)

Suggested Electrical Engineering Electives:

		ECE 605	Discrete Event Dynamic Systems (3 credits)
		ECE 612	Computer Methods Applied to Power Systems (3 credits)
		ECE 640	Digital Signal Processing (3 credits)
		ECE 643	Digital Image Processing I (3 credits)
		ECE 650	Electronic Circuits (3 credits)
		ECE 660	Control Systems I (3 credits)
		ECE 664	Real-time Computer Control Systems (3 credits)
		ECE 684	Advanced Microprocessor Systems (3 credits)
		ECE 686	Instrumentation Systems and Microprocessors (3 credits)
		ECE 687	Design of Medical Instrumentation (3 credits)
		ECE 688	Microcontrollers in Instrumentation (3 credits)
		ECE 785	Parallel Processing Systems (3 credits)

Focus Area : Solid State, VLSI and Electro-optics Systems:

Area requirements (Choose at least two)

		ECE 622	Wave Propagation (3 credits)
		ECE 626	Optoelectronics (3 credits)
		ECE 650	Electronic Circuits (3 credits)
		ECE 657	Semiconductor Devices (3 credits)
		ECE 658	VLSI Design I (3 credits)
		ECE 758	VLSI Design II (3 credits)

Suggested Electrical Engineering Electives:

		ECE 605	Discrete Event Dynamic Systems (3 credits)
		ECE 623	Fourier Optics (3 credits)
		ECE 624	Optical Engineering (3 credits)
		ECE 625	Fiber and Integrated Optics (3 credits)
		ECE 630	Microwave Engineering (3 credits)
		ECE 648	Digital Microelectronics (3 credits)
		ECE 659	Fabrication Principles of Electronic and Optoelectronic Devices (3 credits)
		ECE 660	Control Systems I (3 credits)
		ECE 677	Optimization Techniques (3 credits)
		ECE 684	Advanced Microprocessor Systems (3 credits)
		ECE 690	Computer Systems Architecture (3 credits)

		ECE 730	Theory of Guided Waves (3 credits)
		ECE 739	Laser Systems (3 credits)
		ECE 756	Advanced Topics in Semiconductor Devices (3 credits)
		ECE 785	Parallel Processing Systems (3 credits)
		ECE 789	Selected Topics in Electrical and Computer Engineering II (3 credits)
		ECE 677	Optimization Techniques (3 credits)
		ECE 768	Optimal Control Theory (3 credits)
		MtSE 702	Characterization of Solids (3 credits)
		MtSE 650	Physical Metallurgy (3 credits)
		MtSE 765	Science and Technology of Thin Films (3 credits)

Focus Area : Intelligent Systems:

Area requirements (choose at least two)

		ECE 605	Discrete Event Dynamic Systems (3 credits)
		ECE 609	Artificial Neural Networks (3 credits)
		ECE 610	Power System Steady-State Analysis (3 credits)
		ECE 660	Control Systems I (3 credits)

Suggested Electrical Engineering Eectives:

		ECE 611	Transients in Power Systems (3 credits)
		ECE 612	Computer Methods Applied to Power Systems (3 credits)
		ECE 613	Protection of Power Systems (3 credits)
		ECE 614	Dynamics of Electromechanical Energy Conversion (3 credits)
		ECE 615	Advanced Electromechanical Energy Conversion I (3 credits)
		ECE 616	Power Electronics (3 credits)
		ECE 640	Digital Signal Processing (3 credits)
		ECE 664	Real-time Computer Control Systems (3 credits)
		ECE 666	Control Systems II (3 credits)
		ECE 661	Control System Components (3 credits)
		ECE 677	Optimization Techniques (3 credits)
		ECE 684	Advanced Microprocessor Systems (3 credits)
		ECE 766	Stability Theory of Nonlinear Systems (3 credits)
		ECE 768	Optimal Control Theory (3 credits)
		ECE 769	Stochastic Estimation and Control (3 credits)

Doctor of Philosophy in Electrical Engineering

This is a program for superior students with master's degrees in electrical engineering or allied fields who wish to conduct advanced research in an area of electrical engineering.

Exceptional Candidates with a Bachelor of Science in Electrical Engineering

Highly qualified students with bachelor's degrees in electrical engineering may be accepted directly into the doctoral program. Contact the doctoral program coordinator for further information.

Admission Requirements:

Applicants are expected to have a broad background in engineering, mathematics, physics, and computer science. At least half of undergraduate course work should have been in the physical sciences or similar fields. Doctoral students should have majored in electrical engineering or related field, with course work at the master's level in mathematics, physics and/or computer science. In addition, students are expected to be proficient in computer programming. GRE scores must be submitted. International students must also achieve a minimum TOEFL score of 550 (213 computer-based).

Students who lack an appropriate background will be required to take additional courses that cannot be applied as degree credits.

Degree Requirements:

Course selection is determined in consultation with the area faculty.

24 credits minimum of course work beyond the master's degree.

12 credits of 700-level courses (normally associated with the area of specialization as listed in the master's degree description). For details, see the department "Handbook for Graduate Students."

36 credits of ECE790 Doctoral Dissertation.

Registrations for six semesters of ECE 791Graduate Seminar are required of all doctoral students.

Dissertation and Defense: The dissertation should demonstrate original research that contributes to the knowledge in the field and should result in the submission of at least one paper for publication in a peer-reviewed journal. Students must provide the department a written proposal showing that facilities are available and that there is a faculty member willing to supervise dissertation work. Students who complete 36 credits of ECE 790 before their research is finished, must register for a minimum of 3 credits of ECE 790 every semester thereafter until the dissertation has been accepted. An oral defense of the dissertation is required after submission of the final document to the dissertation committee for approval.

Residency: Degree-seeking students must spend at least one academic year in full-time residence.

Qualifying Examination: The examination contains material related to the student's fundamental knowledge, which includes the area of specialization. Contact the doctoral programs coordinator for more information.

Pre-Doctoral Research: With department approval, well-qualified students may register for up to a maximum of 9 credits of ECE 792 Pre-Doctoral Research prior to passing the qualifying examination. A maximum of 6 credits of ECE 792 may be applied toward the ECE 790 requirement.

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* ECE 701 (6 credits)

Engineering Management

Administered By: Department of Industrial and Manufacturing Engineering

Administration

Chairperson	Athanassios Bladikas
Associate Chairperson	George Abdou
Program Director	Carl Wolf

Faculty

Professors	Layek Abdel-Malek, Reggie J. Caudill, Sanchoy K. Das, Paul G. Ranky, Donald H. Sebastian, Stephen J. Tricamo, Carl Wolf
Associate Professors	George Abdou, Golgen Bengu, Athanassios Bladikas, Kevin J. Mcdermott*
Assistant Professors	Arijit Sengupta, Jian Yang
Distinguished Professor	Alok K. Chakrabarti**

* Joint appointment with Department of Engineering Technology.

** Joint appointment with School of Management.

Degrees Offered: Master of Science in Engineering Management

By drawing on the diverse resources available through the university and surrounding industry, the M.S. in Engineering Management program develops engineers and other technically trained individuals for leadership roles in a technologically-based, project-oriented enterprise.

Focus on interdisciplinary course work and research provides students with an advanced background in both the theoretical and practical aspects of managing technical/engineering projects and programs via case studies, role playing, and course work. The engineering management program faculty bring to the classroom a critical blend of practical and academic experience.

Master of Science in Engineering Management

The program is particularly valuable to individuals who have a number of years of experience in industry, government, and service organizations, or those who have been entrepreneurs. It provides these professionals with broad-based knowledge and skills to succeed as organizational managers and project managers, from conceptualization through implementation.

Admission Requirements:

Eligibility for admission requires completion of an undergraduate degree in engineering, the sciences or a closely related area. Students are expected to have achieved an undergraduate GPA of at least 2.8 on a 4.0 scale. Students not satisfying the above requirement will be considered for conditional admission on a case-by-case basis. In some cases, a bridge program will be required to qualify for matriculation.

Bridge Program: Students who lack appropriate academic preparation may be required to take one or more of the following courses before being admitted to the program. These courses are taken in addition to degree requirements:

		EM 501	Industrial Management (3 credits)
		EM 502	Engineering Cost Analysis (3 credits)
		EM 503	Methods and Applications of Industrial Statistics and Probability (3 credits)

Graduate Certificate Program: A 12-credit graduate certificate in Construction Management, Operations Productivity, Pharmaceutical Management or Project Management is available as a step toward this degree. Please see Graduate Certificates in this catalog for further information. For more information about continuing and distance education, please contact the Division of Continuing Professional Education, 1-800-624-9850 or 973-596-3060; email: cpe@njit.edu.

Off-Campus Programs: At extension and corporate sites, NJIT offers sufficient courses to fulfill all degree requirements. NJIT faculty teach all courses. For locations, see Extension Programs in this catalog. The university's distance learning arm, ACCESS/NJIT, offers this program (as well as part of the bridge program described above) to qualified students who have access to the Internet and a VCR. In addition, distance-based, 12-credit graduate certificates in Construction Management, Operations Productivity, Pharmaceutical Management or Project Management, are available as a step toward this degree. See Graduate Certificates in this catalog. For further information about extension programs, ACCESS/NJIT programs, and graduate certificates, call the associate vice president of continuing and distance education, Division of Continuing Professional Education, 1 (800) 624-9850 or (973) 596-3060; email cpe@njit.edu.

Degree Requirements:

The program requires 30 credits, 18 of which are taken in a required core. A purpose of the core is to provide knowledge in the functional areas that are the cornerstones of the discipline: organization and people management, cost management, and systems management. The remaining 12 credits are elective courses, which may be within an area of specialization to meet the individual's specific professional and personal objectives. A 3-credit project or a 6-credit thesis is optional. In some cases, students may select courses to enhance their technical competency. In other cases, individuals may select courses to prepare for a change in responsibilities or job function. At least half of the elective courses must be selected from those offered by the Department of Industrial and Manufacturing Engineering.

Seminar : In addition to the minimum 30 degree credits required, all students who receive departmental or research-based awards must enroll each semester in IE 791 Graduate Seminar.

Core:
18 credits:

		Acct 615	Management Accounting (3 credits)
		EM 602	Management Science (3 credits)
		EM 636	Project Management (3 credits)
		HRM 601	Organizational Behavior (3 credits)
		IE 673	Total Quality Management (3 credits)
		MIS 648	Decision Support Systems for Managers (3 credits)

Project or Thesis (optional):

{		IE700	***or***
		IE 701	Master's Thesis (6 credits)

Areas of Specialization:

For all areas of specialization, select 6 credits if completing a master's thesis; 9 credits if completing a master's project; 12 credits if not completing either a master's project or thesis.

Project Management:

		EM 634	Legal, Ethical and Intellectual Property Issues for Engineering Managers (3 credits)
		EM 637	Project Control (3 credits)
		EM 691	Cost Estimating for Capital Projects (3 credits)
		IE 651	Industrial Simulation (3 credits)

Cost Engineering:

		EM 632	Legal Aspects in Construction (3 credits)
		EM 637	Project Control (3 credits) ***or***
		IE 618	Engineering Cost and Production Economics (3 credits)
		EM 691	Cost Estimating for Capital Projects (3 credits)
		Fin 624	Corporate Finance II (3 credits)

Technical Marketing:

		EM 640	Distribution Logistics (3 credits)
		EM 641	Engineering Procurement and Materials Management (3 credits)
		Mrkt 631	Market Planning and Analysis (3 credits)
		Mrkt 636	Design and Development of High Technology Products (3 credits)

Technological Entrepreneurship:

		EM 634	Legal, Ethical and Intellectual Property Issues for Engineering Managers (3 credits)
		Mgmt 620	Management of Technology (3 credits)
		MnE 655	Concurrent Engineering (3 credits)
		Mrkt 636	Design and Development of High Technology Products (3 credits)

Quality:

		EM 674	Benchmarking and Quality Function Deployment (3 credits)
		IE 605	Engineering Reliability (3 credits)
		IE 672	Industrial Quality Control (3 credits)
		MnE 654	Design for Manufacturability (3 credits)

Facility Management:

		Arch 650	Economy of Building (3 credits)
		EM 632	Legal Aspects in Construction (3 credits)
		Fin 624	Corporate Finance II (3 credits)
		IE 653	Facility Maintenance (3 credits)

Manufacturing Systems Management:

		MnE 601	Manufacturing Systems (3 credits)
		MnE 602	Flexible and Computer Integrated Manufacturing (3 credits)
		MnE 603	Management of Manufacturing Systems (3 credits)
		MnE 655	Concurrent Engineering (3 credits)

Management Information Systems:

		EM 655	Management Aspects of Information Systems (3 credits)
		IE 651	Industrial Simulation (3 credits)
		IE 661	Man-Machine Systems (3 credits)
		MIS 690	Executive Information Systems (3 credits)

Engineering Management:

		EM 635	Management of Engineering Research and Development (3 credits)
		EM 714	Multicriteria Decision Making (3 credits)
		HRM 606	Human Resource Management (3 credits)
		IE 618	Engineering Cost and Production Economics (3 credits)
		MIS 645	Information Systems Principles (3 credits)
		MnE 655	Concurrent Engineering (3 credits)

Engineering Science

Administered By: Office of the Dean, Newark College of Engineering

Administration

Program Director	William C. Van Buskirk

Faculty

Professors from Newark College of Engineering and College of Science and Liberal Arts, as appropriate

Degrees Offered: Master of Science in Engineering Science

The M.S. in Engineering Science allows students to study areas not covered by traditional engineering or science discipline graduate programs. For those already in the work force, the program provides the opportunity to develop expertise relevant to their work.

Master of Science in Engineering Science

This is a very flexible program that permits advanced study from numerous disciplines in engineering and the sciences.

Admission Requirements:

Applicants are expected to have an accredited undergraduate degree in science or engineering. Candidates with other appropriate backgrounds may be considered.

Bridge Program: To ensure academic success in their graduate studies, students may be required to take additional undergraduate or graduate courses before beginning graduate curricula. This program of courses will be individually-designed in consultation with the student's graduate advisor. Such courses are not counted toward degree requirements.

Degree Requirements:

A minimum of 30 credits is required. A thesis or project may be included.

Seminar : In addition to the minimum 30 degree credits, all students who receive departmental or research-based awards must enroll each semester in a graduate seminar. The seminar is selected in consultation with the graduate advisor.

Required:

15 credits, selected in consultation with graduate advisor: 6 credits of 600-level mathematics 3 credits of 600-level physics, chemistry, or biology 6 credits of 600-level engineering courses

PROJECT OR THESIS (optional):

3 or 6 credits: selected in consultation with graduate advisor

Elective:

15 credits selected in consultation with graduate advisor

The elective credits must form a meaningful and coherent program integrated with the specialization in science or engineering.

Environmental Engineering

Administered By: Department of Civil and Environmental Engineering

Degrees Offered: Master of Science in Environmental Engineering; Doctor of Philosophy in Environmental Engineering
Environmental engineers are essential participants in the planning, design and construction of waste water and potable water treatment plants, solid waste disposal systems, site remediation and emission control measures, and other similar projects. Major corporations, government agencies, private consulting and construction firms, and universities are just some of the organizations that employ environmental engineers.

In-depth knowledge in environmental engineering is essential for professional practice as well as for research. Full-time faculty members with a range of academic and professional practice experience as well as by adjunct instructors who are experts in their field teach the courses. Those students interested in research at the master's level or continuing their education at the doctoral level should consider working with faculty involved in one of the university's related major research centers.

Master of Science in Environmental Engineering

The M.S. in Environmental Engineering is designed for those who want both specialized course work and the flexibility to tailor their program to their needs.

Admission Requirements:

Applicants are expected to have an undergraduate degree in engineering or its equivalent. Students who lack an appropriate undergraduate background may be granted conditional admission in order to complete a bridge program or its equivalent. These courses are taken in addition to regular degree requirements; descriptions may be found in the undergraduate catalog.

Bridge Program: Students who lack appropriate background are asked to make up deficiencies by taking a program of courses, including any prerequisites, that is designed in consultation with graduate advisors. See the undergraduate catalog for description of bridge courses. These courses are taken in addition to the degree requirements:

		CE 320	Fluid Mechanics (4-0-4)
		CE 321	Water Resources Engineering (3-0-3)
		CE 322	Hydraulic Engineering (3-0-3)
		CE 501	Introduction to Soil Behavior (3 credits)
		Chem 126	General Chemistry II (3-0-3)
		CIS 101	Computer Programming and Problem Solving (2-1-2)
		Math 222	Differential Equations (4-0-4)
		Mech 234	Engineering Mechanics (2-0-2)
		Mech 236	Dynamics (2-0-2)

Degree Requirements:

The program comprises 30 credits of required and elective courses. The student consults the graduate advisor to plan and maintain an individualized and cohesive sequence of courses.

Seminar: In addition to the minimum 30 degree credits required, all students who receive departmental or research-based awards must enroll each semester in EnE 791 Graduate Seminar.

Required:

12 credits as follows:

		EnE 663	Water Chemistry (3 credits)
		EnE 660	Introduction to Solid and Hazardous Waste Problems (3 credits)
		EnE 661	Microbiology for Environmental Engineers (3 credits)
		Math	(Graduate mathematics or computer science course approved by graduate advisor)

Thesis:

Required of those receiving departmental awards; elective for all others.

		EnE 701	Master's Thesis (6 credits)

Elective:

Select 12 credits if completing a master�s thesis; 18 credits if not completing a master�s thesis, from:

		CE 601	Advanced Remote Sensing (3 credits)
		CE 602	Geographic Information System (3 credits)
		CE 604	Environmental Modeling in Remote Sensing (3 credits)
		CE 605	Research Methods in Remote Sensing (3 credits)
		CE 618	Applied Hydrogeology (3 credits)
		CE 620	Open Channel Flow (3 credits)
		CE 621	Hydrology (3 credits)
		CE 623	Groundwater Hydrology (3 credits)
		CE 647	Geotechnical Aspects of Solid Waste (3 credits)
		CE 702	Special Topics in Civil Engineering (3 credits)
		EnE 610	Hazardous Site Operations (3 credits)
		EnE 662	Site Remediation (3 credits)
		EnE 664	Physical and Chemical Treatment (3 credits)
		EnE 665	Biological Treatment (3 credits)
		EnE 666	Analysis of Receiving Waters (3 credits)
		EnE 668	Air Pollution Control (3 credits)
		EnE 669	Water and Wastewater Analysis (3 credits)
		EnE 670	Advanced Processes in Water Pollution Control (3 credits)
		EnE 671	Environmental Impact Analysis (3 credits)
		EnE 672	Stormwater Management (3 credits)
		EnE 700	Environmental Engineering Project (3 credits)
		EnE 702	Special Topics in Environmental Engineering (3 credits)
		EnE 720	Environmental Chemodynamics (3)
		EnE 760	Applied Environmental Soil Chemistry (3 credits)

Doctor of Philosophy in Environmental Engineering

This is a program for superior students with master's degrees in environmental engineering, civil engineering, or allied fields who wish to conduct advanced research in an area of environmental engineering. In exceptional circumstances, highly qualified students with bachelor's degrees in civil engineering or environmental engineering may be accepted directly into the doctoral program.

Admission Requirements:

A minimum master's GPA of 3.5 on a 4.0 scale, or equivalent, is normally required for admission. The GRE (general section) is required of all applicants. All international students must also achieve a minimum TOEFL score of 550 (pencil and paper) and 213 (computer-based).

Degree Requirements:

The department approves specific degree requirements and dissertation topics on an individual basis. Students must attain a minimum overall GPA of 3.0. Students must conduct independent original research in a specific area of environmental engineering. Students must select an advisor willing to supervise dissertation work.

36 credits minimum of EnE 790 Doctoral Dissertation is generally required. These 36 credits should be completed before submission of the final dissertation document. Students must register for a minimum of 3 credits of EnE 790 until the dissertation has been submitted and accepted.

24 credits minimum of course work beyond the master's degree is required, of which at least 12 credits must be at the 700 level; the remaining credits may be at the 600 level.

Seminar: EnE 791 Graduate Seminar is required for all doctoral students every semester.

Preliminary Qualifying Examination: Full-time students must take the preliminary qualifying examination for the first time within one year of beginning active study and must pass it completely by the next time the examination is offered. Part-time students must take the preliminary qualifying examination for the first time within three years of the beginning of active study and must pass it completely by the next time it is offered. Exceptional students having only bachelor's degrees who are admitted directly into the doctoral program must take the preliminary qualifying examination within one and one-half years of admission and must pass it within two years. All students are permitted to take the examination only twice.

Dissertation Committee: After passing the preliminary qualifying examination, each student in consultation with the major faculty member develops a list of five faculty members who have agreed to serve on an advisory committee as follows: two or three members of the graduate faculty in the student's major area of interest; a member of the graduate faculty in the student's major area appointed by the department chairperson; a member of the graduate faculty of the Department of Civil and Environmental Engineering from another field of interest; a member of the graduate faculty from the area of the student's minor field of interest.

Research Proposal: Doctoral students must prepare a written research proposal and make an oral presentation for approval by their dissertation committee. The proposal must be presented after formation of the committee but within six months after passing the qualifying examination. Research is expected to investigate or develop a unique contribution to science and technology.

Dissertation Defense: An oral defense of the dissertation is required after submission of the final document to the department for approval. Signatures of all members of the dissertation committee must be received for final approval to be granted.

Catalog and curricula information approved by the relevant academic department.

Environmental Policy Studies

Administered By: Department of Chemistry and Environmental Science

Administration

Program Director	Maurie Cohen

Faculty

Professor	Nancy L. Jackson
Associate Professors	Maurie Cohen, Zeyuan Qiu
Lecturer	Michael P. Bonchonsky
Affiliated Faculty	Joseph W. Bozzelli, Somenath Mitra

Degrees Offered: Master of Science in Environmental Policy Studies, Ph.D. Environmental Science. (Policy Concentration)

The Master of Science in Environmental Policy Studies focuses on the role of the social sciences in the development, implementation and evaluation of environmental policy. Building on the strengths of a technological university, students take foundation courses in geography, economics, and policy. Application courses on economic modeling and geospatial analysis enable students to acquire skills in the tools and methods used in environmental problem solving and policy analysis. The core faculty is multidisciplinary with strengths in geography, economics and planning. Affiliated faculty have backgrounds in chemistry, engineering, and history. Graduates of the program have secured employment in both the public and private sectors including the: United States, The New Jersey Department of Environmental Protection, regional planning commissions, local community development programs, private engineering and planning firms, and software development corporations. Graduates have also entered doctoral level programs in environmental science, history and law.

The Ph.D. in Environmental Science (Policy Concentration) is offered by the Department of Chemistry and Environmental Science of which the Graduate Program in Environmental Policy is a part. Successful environmental policies must rest on the development of reliable models for assessing change to the biophysical environment in the presence of human action. The Department of Chemistry and Environmental Science offers a research-oriented doctoral degree in Environmental Science with a concentration in Environmental Policy. The program emphasis is on the integration of environmental and social sciences to develop more effective responses to resource problems. For more information about degree requirements, please visit the Department of Chemistry and Environmental Science website.

Master of Science in Environmental Policy Studies

The program is designed to provide students with the opportunity to acquire skills in the tools and methods used in environmental problem solving and policy analysis. The program may be completed on a part-time or full-time basis.

Admission Requirements:

The following criteria are applied when considering an applicant for admission to the program:

- An undergraduate degree in earth sciences (e.g. physical geography, geology, meteorology, ecology), social sciences (e.g. human geography, economics, sociology), engineering (e.g. environmental, civil, chemical) or another related discipline.
- An undergraduate GPA of at least 3.0 and at least 3.5 in major field (on a scale of 4.0).
- A minimum of one semester of statistics at the undergraduate level; an advanced statistics course at the undergraduate level is highly desirable.
- A combined GRE score (verbal and quantitative) of at least 1100

The following materials must be submitted to be considered for admission:

- Application for Admission to Graduate Study form
- MS-EPS Supplemental Materials form
- Official transcripts of all prior work and certificate of graduation
- Personal statement (two to three pages)
- Three letters of recommendation
- Graduate Record Examination (GRE) scores
- International students are required to pass the TOEFL at 550 (pencil and paper), 213 (computer based) or above.

Degree Requirements

Students are required to complete a total of 30 graduate course credits: 18 credits of required core courses and 12 credits of elective application courses.

ELECTIVE APPLICATION COURSES (12 credits)

The Graduate Program in Environmental Policy Studies offers a regular series of special topics courses and students may also enroll in courses offered by other departments. The website Green@NJIT offers a comprehensive list of options. The selection of elective application courses is made in consultation with the Program Director.

Students may select to write a 6-credit thesis in lieu of two elective application courses and this work is normally completed over two sequential semesters. Preparation of the thesis is conducted under the supervision of an advisor and presented to a three-member committee. Subject to approval by the Program Director, students also have the option to substitute up to two sections (6 credits) of independent study under faculty direction in place of elective application courses.

Various - Four Electives (12 Credits)

		EPS 701	Master's Thesis (6 credits)
		EPS 725	Independent Study I (3 credits)
		EPS 726	Independent Study II (3 credits)

Catalog and curricula information approved by the relevant academic department.

Environmental Science

Administered By: Department of Chemistry and Environmental Science

Adminstration

Chair	Somenath Mitra

Faculty

Distinguished Professors	Carol A. Venanzi, Joseph W. Bozzelli
Professors	Tamara Gund, Lev N. Krasnoperov, Somenath Mitra, Nancy L. Jackson
Associate Professor	mcohen gorun, Leonard Dauerman
Assistant Professors	Edgardo T. Farinas, Zeyuan Qiu, Liping Wei
University Lecturers	William Skawinski, Frank B. Ellis, Roumiana S. Petrova, Alexander D. Butherus, Michael P. Bonchonsky
Research Professor	Zafar Iqbal

Rutgers-Newark Faculty

Professors	Kafkewitz, Weis
Associate Professor	Gates
Assistant Professors	Slater, Nathan Yee

Advisors

Graduate Advisors	Somenath Mitra

Degrees Offered: Master of Science in Environmental Science; Doctor of Philosophy in Environmental Science. Both degrees are offered jointly by NJIT and Rutgers-Newark.

The environmental science graduate programs are offered through several departments at New Jersey Institute of Technology and at Rutgers Newark, collaborating in an interdisciplinary program of research and teaching. These are the departments of Chemistry and Environmental Science, and Environmental Policy at NJIT, the Federated Department of Biological Sciences, and the Rutgers-Newark Department of Earth & Environmental Sciences. The strong research program is supported by major grants from federal and state agencies, and industry. Environmental science plays a major role in several NJIT research centers, including the Hazardous Substance Management Research Center, the Northeast Hazardous Substance Research Center, the Particle Technology Center, and the Center for Membrane Technologies. Research grants involve collaborations with other universities including MIT, Princeton, Rutgers, UMDNJ, Utah, Karlsruhle (Germany), Bordeaux and Lille (France).

Master of Science in Environmental Science

This is an interdisciplinary program intended for individuals with backgrounds in science or engineering who want advanced education in the identification, management, treatment and effects of hazardous and toxic materials in the environment. It may be taken on a part-time or full-time basis.

Admission Requirements:

Applicants should have undergraduate degrees in chemistry, biology, chemical engineering, environmental engineering, environmental science, or related fields who have taken a minimum of one year of college chemistry and mathematics through calculus. Students who lack an appropriate background may be considered for admission and required to take a program of courses that is designed in consultation with the graduate advisor. These may include undergraduate courses which are not counted toward degree credit.

A minimum undergraduate GPA of 3.0 on a 4.0 scale, or equivalent, is typically required for admission. Those applying for financial support and those whose last prior degree was from outside the United States must submit GRE scores. International students must achieve a minimum TOEFL score of 550 (pencil and paper) and 213 (computer-based).

Degree Requirements:

A minimum of 30 degree credits is required. Candidates must consult with the graduate advisor (not thesis advisor) in designing appropriate programs of study.

Students must attain a minimum GPA of 3.0 in the core courses listed below, and a minimum overall GPA of 3.0.

Seminar: In addition to the minimum 30 degree credits required, all students who receive departmental or research-based awards must enroll each semester in EvSc 600 Environmental Science Seminar.

Core:

15 credits:

		EM 631	Legal Aspects in Environmental Engineering (3 credits)
		EvSc 610	Environmental Chemical Science (3 credits)
		EvSc 612	Environmental Analysis (3 credits)
		EvSc 616	Toxicology for Engineers and Scientists (3 credits)

R120:604 Microbiology: Principles and Applications

Thesis:

Required of those receiving departmental or research-based support; others may choose 6 credits of course work instead of thesis.

6 credits:

		EvSc 701	Master's Thesis (3 credits)

Elective:

Courses are offered at NJIT and Rutgers-Newark and selected with the graduate advisor�s (not thesis advisor�s) approval.

9 credits if completing a master�s thesis; 15 credits if not completing a master�s thesis from:

		EvSc 602	Special Topics in Environmental Science I (3 credits)
		EvSc 611	Hazardous Waste Management (3 credits)
		EvSc 613	Environmental Problem Solving (3 credits)
		EvSc 614	Quantitative Environmental Risk Assessment (3 credits)
		EvSc 615	Global Environmental Problems (3 credits)
		EvSc 700	Master's Project (3 credits)
		EvSc 702	Special Topics in Environmental Science II (3 credits)
		EvSc 711	Advanced Environmental Analysis (3 credits)
		EvSc 725	Independent Study I (3 credits)

		EvSc 726	Independent Study II (3 credits)
		EPS671	
		EPS 613	Environmental History and Policy (3 credits)
		EPS 614	Environmental Economics (3 credits)
		EPS 660	Ethics and Environmental Policy (3 credits)
		EnE 660	Introduction to Solid and Hazardous Waste Problems (3 credits)
		EnE 662	Site Remediation (3 credits)
		EnE 664	Physical and Chemical Treatment (3 credits)
		EnE 665	Biological Treatment (3 credits)
		EnE 668	Air Pollution Control (3 credits)
		ChE 685	Industrial Waste Control I (3 credits)
		ChE 686	Industrial Waste Control II (3 credits)
		ChE 687	Industrial Gas Cleaning (3 credits)
		ChE 740	Biological Treatment of Hazardous Chemical Wastes (3 credits)
		Chem 662	Air Pollution Analysis (3 credits)
		Chem 664	Advanced Analytical Chemistry (3 credits)
		R120:551	Biology of Pollution (3 credits)
		R120:536	Multivariate Biostatistics (3 credits)
		R120:616	Topics in Biology (1 to 3 credits by arrangement)
		R460:577	Seminar in Environmental Geology (3 credits)
		IE 615	Industrial Hygiene and Occupational Health (3 credits)
		ME 660	Noise Control (3 credits)
		EPS 612	Introduction to Environmental Policy Studies (3 credits)
		EPS 622	Sustainable Development (3 credits)

Doctor of Philosophy in Environmental Science

This is a research-oriented degree intended for full-time students. Although courses may be taken on a part-time basis, a minimum of one year of full-time residency is typically required for completion of the doctoral dissertation.

Admission and Degree Requirements for Students Entering with a Master's Degree

A master's degree in chemistry, biology, chemical engineering, environmental engineering, environmental science, or related fields is usually required. Highly qualified students with bachelor's degrees in these fields may also be accepted directly into the doctoral program.

A minimum master's GPA of 3.5 on a 4.0 scale, or equivalent, is typically required for admission. GRE scores must be submitted. International students must achieve a minimum TOEFL score of 550.

Specific degree requirements and dissertation topics are approved by the department on an individual basis. Students must attain a minimum overall GPA of 3.0. A minimum of 36 credits of EvSc 790 Doctoral Dissertation, and registration every semester for EvSc 600 Environmental Science Seminar, are required. Should the 36 credits of EvSc 790 be completed before submission of the final dissertation document, students must register for a minimum of 3 credits of EvSc 790 per semester until it has been submitted and accepted. In addition, at least 24 credits of course work beyond the master's degree are required, of which 12 credits must be at the 700-level and chosen in consultation with the graduate advisor. No more than 6 credits may be in Independent Study (EvSc 725 or EvSc 726).

Qualifying Examination: All applicants are expected to pass a qualifying examination that tests general competence in environmental sciences at the master's level. It must be taken within the first year following admission to the program, and passed within two years. A student will be allowed only two attempts to pass the examination.

Formation of Dissertation Committee: Within three months of passing the qualifying examination, doctoral students must form a dissertation committee that meets the approval of the graduate advisor (not the dissertation advisor) in environmental science. As a minimum, the committee must consist of the doctoral student's dissertation advisor, three additional faculty members from the program, and one member from outside the program and the Department of Chemical Engineering, Chemistry and Environmental Science.

Research Proposal: Within six months of forming the dissertation committee, doctoral students must make a formal oral presentation to their dissertation committee and other interested persons on the scope of their proposed research. The committee must formally approve the proposal within a maximum of three additional months. This ensures meeting the requirements that doctoral students must have an approved dissertation committee and an approved dissertation proposal within a year of passing the qualifying examination.

Dissertation Defense: An oral defense of the dissertation is required after submission of the final document to the dissertation committee for approval. Signatures of all members of the dissertation committee must be received for final approval to be granted.

Students must attain a minimum GPA of 3.0 in the required courses (EvSc 610, EvSc 612, EvSc 616, EM 631, and R120:604), and a minimum overall GPA of 3.0.

Admission and Degree Requirements for Students Entering with a Bachelor's Degree

Exceptional students with appropriate undergraduate degrees may apply directly for admission to the doctoral program. Applicants are evaluated on a case-by-case basis. A minimum undergraduate GPA of 3.5 on a 4.0 scale, or equivalent, is typically required for admission. GRE scores must be submitted. International students must achieve a minimum TOEFL score of 550.

Students must attain a minimum GPA of 3.0 in the required courses (EvSc 610, EvSc 612, EvSc 616, EM 631, and R120:604), and a minimum overall GPA of 3.0.

Required:
51 credits as follows:

		R120:604	Microbiology: Principles and Applications (3 credits)
		EM 631	Legal Aspects in Environmental Engineering (3 credits)
		EvSc 610	Environmental Chemical Science (3 credits)
		EvSc 612	Environmental Analysis (3 credits)
		EvSc 616	Toxicology for Engineers and Scientists (3 credits)

In addition, a minimum of 36 credits of EvSc 790 Doctoral Dissertation, and registration every semester for EvSc 600 Environmental Science Seminar, are required. Should the 36 credits of EvSc 790 be completed before submission of the final dissertation document, students must register for a minimum of 3 credits of EvSc 790 per semester until it has been submitted and accepted.

Elective:
27 credits as follows :

12 credits from 700-level courses chosen in consultation with the graduate advisor. No more than 6 credits may be in Independent Study(EvSc 725 or EvSc 726).

15 credits from any 600- or 700-level courses (may be from outside the department)

Qualifying Examination - A qualifying examination must be taken within three semesters of admission to the program, and passed within two years. A student will only be allowed two attempts to pass the examination.

Formation of Dissertation Committee - Within three months of passing the qualifying examination, doctoral students must form a dissertation committee that meets the approval of the graduate advisor (not the dissertation advisor) in environmental science. As a minimum, the committee must consist of the doctoral student's dissertation advisor, three additional faculty members from the program, and one member from outside the program and the Department of Chemical Engineering, Chemistry and Environmental Science.

Research Proposal - Within six months of forming the dissertation committee, doctoral students must make an oral presentation to their dissertation committee and other interested persons on the scope of their proposed research. The committee must formally approve the proposal within a maximum of three additional months. This ensures meeting requirements that doctoral students must have an approved dissertation committee and an approved dissertation proposal within a year of passing the qualifying examination.

Dissertation Defense - An oral defense of the dissertation is required after submission of the final document to the dissertation committee for approval. Signatures of all members of the dissertation committee must be received for final approval to be granted.

History

Administered By: Federated History Department of Rutgers-Newark and NJIT

Administration

Chairperson	Neil M. Maher
Director, Graduate Programs	Susan Carruthers
NJIT Graduate Coordinator	
Deputy Chair (Rutgers-Newark)	Jon Cowans

Faculty

Distingushed Professors	Richard B. Sher
Professors	Karl W. Schweizer
Associate Professor	Neil M. Maher
Assistant Professors	Stephen G. Pemberton
University Lecturer	Lisa Nocks

Rutgers-Newark Faculty

Board of Governors Distinguished Service Professor	Clement Price
Professors	Peter Golden, Annette Gordon-Reed, Jan Lewis, Jonathan Lurie, Said Samatar, Odoric Wou
Associate Professors	Susan Carruthers, Jon Cowans, Ruth Feldstein, James Goodman, Frederic Russell, Beryl Satter
Assistant Professors	Karen Caplan, Gary Farney, Eva Giloi

Degrees Offered: Master of Arts in History, Master of Arts in Teaching (History). Both degrees are offered jointly by NJIT and Rutgers-Newark.

The Federated History Department offers the master of arts for generalists and for students interested in preparing for further graduate study in history, and the Master of Arts in Teaching for current and prospective secondary school teachers of history and social studies. The objective of the graduate history program is to furnish a broad yet rigorous course of study in preparation for careers in teaching, business, law, government, administration, and other fields related to history, as well as to enhance the professional experience and increase the opportunities for advancement of students who are already working as professionals in these fields.

Program administration and teaching are shared by faculty from both campuses, and the full resources of both universities are available to all history graduate students and faculty. Resources include access to the Rutgers University library system of more than three million volumes, to the outstanding collection in the history of medicine at UMDNJ, and to excellent history collections in the region. The program emphasizes hands-on learning and archival research in association with local institutions, such as the Thomas Edison National Historic Site in nearby West Orange and the Newark Museum and the New Jersey Historical Society in Newark.

The joint Rutgers-Newark/NJIT graduate history program is the largest and most diverse master's-level history program in New Jersey. Many of the graduate faculty have national or international reputations as scholars, representing a wide variety of time periods and fields of study. The program is particularly noted for its strengths in environmental history and the history of technology and medicine; the history of communication, cultural and intellectual history; diplomatic history; history of women; pre-Civil War and contemporary America; African and African-American history; legal history; and global and comparative history.

Master of Arts in History

The M.A. in History furnishes a broad yet rigorous training in history in preparation for a wide variety of careers in education, law, business, medicine, and administration.

Admission Requirements:
Applicants must have an undergraduate degree from an accredited institution and favorable letters of recommendation from professors familiar with their work. An undergraduate GPA of at least 3.0 is normally required. Students must provide GRE scores.

Application:
Students interested in the program should contact the graduate programs director and apply to Rutgers-Newark.

Degree Requirements
A minimum of 30 credits is required, including 18 in a major field and 6 in a minor field chosen in consultation with a faculty advisor. The remaining 6 credits may be completed through a Master's Thesis or a combination of a Master's Essay and an additional course.

Major Fields:

American History See the Federated History Department website for more information.

World History See the Federated History Department website for more information.

History of Technology, Environment, and Medicine/Health
Based at NJIT, this concentration is a unique integration of three relatively new and increasingly important historical sub-disciplines. Students concentrating in the History of Technology, Environment, and Medicine/Health explore not only the interrelationships between environmental transformations, technology in society, and health and medicine, but also their social meanings, their cultural relations, their political, social, and gender histories, and their local, national, and global contexts. NJIT has a distinguished concentration of faculty in these areas, with particular strengths in American environmental and urban environmental history; the social and cultural history of medicine; and the history of technology and communication.

Students interested in pursuing this major field of concentration should contact the NJIT graduate coordinator for more information.

The following is a sample curriculum for a student completing a major field of study (18 credits) in the History of Technology, Environment and Medicine/Health.

		Hist 622	Culture and Science in the History of American Medicine (3 credits)
		Hist 628	Gender, Science and Technology in the Modern World (3 credits)
		Hist 632	Technology, Culture and History (3 credits)
		Hist 634	Environmental History of North America (3 credits)
		Hist 635	History of Technology, Environment and Medicine: Theory and Method (3 credits)
		Hist 638	Social History of Communication (3 credits)

Minor Field:
6 credits of course work in a minor field, selected in consultation with a faculty advisor.

Master s Thesis/Master s Essay:
Students must complete either (1) a Master s Thesis (6 credits) or (2) a Master s Essay (3 credits) and an additional 3 credits of course work.? For additional information on the Master s Thesis and Master s Essay, see the Federated History Department website.

Master of Arts in Teaching (History)

The Master of Arts in Teaching is a terminal degree for students who are preparing for, or are already engaged in, careers in secondary school teaching in history and social studies. See the Rutgers Graduate School-Newark catalog for more information.

Catalog and curricula information approved by the relevant academic department.

Industrial Engineering

Administered By: Department of Industrial and Manufacturing Engineering

Administration

Chairperson	Athanassios Bladikas
Associate Chairperson	George Abdou
Program Director	George Abdou

Faculty

Professors	Layek Abdel-Malek, Reggie J. Caudill, Sanchoy K. Das, Paul G. Ranky, Stephen J. Tricamo, Carl Wolf
Associate Professors	George Abdou, Golgen Bengu, Athanassios Bladikas, Kevin J. Mcdermott, Arijit Sengupta*
Assistant Professors	Jian Yang

Advisors

Graduate Advisor	Sanchoy K. Das

* Joint appointment with Department of Engineering Technology

Degrees Offered: Master of Science in Industrial Engineering; Doctor of Philosophy in Industrial Engineering

The field of industrial engineering brings together the various sciences concerned with technology, the production of goods, performance of services and the way in which people work. Industrial engineers address the efficient utilization of resources to produce quality, as well as cost competitive goods and services in a healthy and efficient work environment. Industrial engineering covers a broad spectrum including production planning and control, manufacturing systems and processes, facilities design, human factors, occupational safety, quality control, systems reliability, and systems analysis and design with a strong emphasis on advanced computing.

Master of Science in Industrial Engineering

A program for individuals who seek professional advancement in the industrial engineering field.

Admission Requirements:

Applicants are expected to have an accredited undergraduate degree in industrial engineering or related fields. For further information, see Admissions in this catalog.

Bridge Program: Students who do not have a bachelor of science degree in industrial engineering may be admitted and required to complete the following bridge program. These courses do not count toward degree requirements:

		EM 502	Engineering Cost Analysis (3 credits)
		EM 602	Management Science (3 credits)
		IE 501	Fundamentals of Industrial Engineering (3 credits)

Graduate Certificate Program: A 12-credit graduate certificate in Operations Productivity is available as a step toward this degree. Please see Graduate Certificates in this catalog for further information. For more information about continuing and distance education, please contact the Division of Continuing Professional Education, 1-800-624-9850 or 973-596-3060; email: cpe@njit.edu.

Degree Requirements:

A minimum of 30 credits beyond a baccalaureate degree is required. A master's thesis or independent research is optional. Students select an area of specialization and individually design their programs in consultation with the graduate advisor. Faculty advisor approval must be obtained by students before they are permitted to register for IE 701 Master's Thesis.

Seminar: In addition to the minimum 30 degree credits required, all students who receive departmental or research-based awards must enroll each semester in IE 791 Graduate Seminar.

Core:

12 credits:

		IE 604	Advanced Engineering Statistics (3 credits)
		IE 618	Engineering Cost and Production Economics (3 credits)
		IE 621	Systems Analysis and Simulation (3 credits)
		IE 650	Advanced Topics in Operations Research (3 credits)

Thesis or Independent Research (optional):

The following optional courses are appropriate for all areas of specialization:

{		IE 701	Master's Thesis (6 credits) ***or***
		IE 725	Independent Research (3 credits)

Areas of Specialization:

The range of possible specializations is broad. Students should consult the graduate advisor in designing specializations and related degree requirements. The following is a list of possible specializations and suggested electives.

Courses are selected from an area of specialization with the approval of the graduate advisor as follows: 12 credits if completing a master's thesis, 15 credits if completing independent research, or 18 credits if not completing either a master's thesis or independent research.

Quality and Reliability Engineering:

		EM 635	Management of Engineering Research and Development (3 credits)
		EM 640	Distribution Logistics (3 credits)
		IE 605	Engineering Reliability (3 credits)
		IE 606	Maintainability Engineering (3 credits)
		IE 608	Product Liability Control (3 credits)
		IE 672	Industrial Quality Control (3 credits)
		IE 674	Quality Maintenance and Support Systems (3 credits)
		MnE 655	Concurrent Engineering (3 credits)

Cost Engineering:

		EM 636	Project Management (3 credits)
		EM 691	Cost Estimating for Capital Projects (3 credits)
		EM 693	Managerial Economics (3 credits)
		EM 771	Operations Cost and Management Control (3 credits)
		IE 605	Engineering Reliability (3 credits)
		IE 606	Maintainability Engineering (3 credits)
		IE 618	Engineering Cost and Production Economics (3 credits)
		IE 641	Operations Analysis (3 credits)
		IE 651	Industrial Simulation (3 credits)
		IE 653	Facility Maintenance (3 credits)
		IE 672	Industrial Quality Control (3 credits)

Operations Research and Decision Sciences:

		EM 714	Multicriteria Decision Making (3 credits)
		IE 605	Engineering Reliability (3 credits)
		IE 623	Linear Programming (3 credits)
		IE 624	Heuristic Methods (3 credits)
		IE 651	Industrial Simulation (3 credits)
		IE 652	Facilities Location and Plant Layout (3 credits)
		IE 672	Industrial Quality Control (3 credits)
		IE 704	Sequencing and Scheduling (3 credits)
		IE 705	Mathematical Programming in Management Science (3 credits)
		IE 706	A Queueing Approach to Performance Analysis (3 credits)

Human Factors/Ergonomics:

		IE 605	Engineering Reliability (3 credits)
		IE 614	Safety Engineering Methods (3 credits)
		IE 615	Industrial Hygiene and Occupational Health (3 credits)
		IE 665	Applied Industrial Ergonomics (3 credits)
		IE 670	Industrial Work Physiology (3 credits)
		IE 672	Industrial Quality Control (3 credits)
		IE 675	Safety in Facility and Product Design (3 credits)
		IE 760	Quantitative Methods in Human Factors (3 credits)
		ME 660	Noise Control (3 credits)
		ME 670	Introduction to Biomechanical Engineering (3 credits)
		ME 671	Biomechanics of Human Structure and Motion (3 credits)
		MnE 601	Manufacturing Systems (3 credits)
		MNE612	

Production and Manufacturing Systems:

		CS 610	Data Structures and Algorithms (3 credits)
		CS 651	Data Communications (3 credits)
		EM 655	Management Aspects of Information Systems (3 credits)
		IE 618	Engineering Cost and Production Economics (3 credits)
		IE654	
		IE655	
		ME 635	Computer-Aided Design (3 credits)
		MnE 601	Manufacturing Systems (3 credits)
		MnE 602	Flexible and Computer Integrated Manufacturing (3 credits)
		MnE 603	Management of Manufacturing Systems (3 credits)
		MNE612	

Service Systems:

		CS 632	Advanced Database System Design (3 credits)
		EM 636	Project Management (3 credits)
		HRM 606	Human Resource Management (3 credits)
		IE 622	Simulation and Risk Analysis in Operations Management (3 credits)
		IE 624	Heuristic Methods (3 credits)
		IE 641	Operations Analysis (3 credits)
		IE 651	Industrial Simulation (3 credits)
		IE 652	Facilities Location and Plant Layout (3 credits)
		IE 673	Total Quality Management (3 credits)
		IE 674	Quality Maintenance and Support Systems (3 credits)
		MIS 545	Management Information Systems (3 credits)

Systems Analysis:

		CS 505	Programming, Data Structures, and Algorithms (3 credits)
		CS 631	Data Management System Design (3 credits)
		CS 673	Software Design and Production Methodology (3 credits)
		IS 676	Requirements Engineering (3 credits)
		EM 636	Project Management (3 credits)
		EM 691	Cost Estimating for Capital Projects (3 credits)
		IE 622	Simulation and Risk Analysis in Operations Management (3 credits)
		IE 624	Heuristic Methods (3 credits)
		IE 651	Industrial Simulation (3 credits)
		IE 673	Total Quality Management (3 credits)
		MnE 655	Concurrent Engineering (3 credits)

Doctor of Philosophy in Industrial Engineering

The objectives of the Ph.D. in Industrial Engineering program are to provide the knowledge and develop the skills that students need to become leaders of research in academia, industry and government.

This program is intended for highly qualified students who wish to pursue advanced research in industrial engineering and related areas. The program emphasizes two areas: manufacturing systems and assurance sciences, and human factors and occupational safety.

Admission Requirements:

Applicants should have a master's degree in industrial engineering or a related field. In certain circumstances, a qualified student with a bachelor's degree in industrial engineering or related field may be admitted into the program.

Degree Requirements:

For students entering with an appropriate master's degree, a minimum of 60 degree credits is required as follows: 36 credits of dissertation and 24 credits of course work beyond the master's degree in an area of specialization, 12 credits of which must be at the 700 level and none at the 500 level. Of the 24 credits of course work, 12 credits are core courses and the other 12 credits are technical electives.

Registration for IE 791 Graduate Seminar is required each semester for all students.

If the 36 credits of dissertation are completed before the dissertation is finished, students must register each semester for at least 3 credits of dissertation until the dissertation is accepted.

For students entering with bachelor's degrees, a minimum of 42 credits of course work and at least 36 credits of dissertation research is required.

Specific degree requirements and dissertation topics are approved by the department on an individual basis. Before being permitted to register for dissertation, students must complete course requirements, pass qualifying examinations, both written and oral, and demonstrate that there are facilities and a faculty member available to supervise the research.

Qualifying Examinations: All doctoral students are expected to pass both a written and oral qualifying examination. Passing the written qualifying examination is a prerequisite for the oral examination. Students are urged to take these examinations as soon as possible after being admitted into the program.

Students must take a two-part written examination within the first year following admission to the program, and pass within two years. The examination is offered every October. A student will be allowed only two attempts to pass the examination. Both parts must be taken at the same time. It consists of two sections:

Section I General competence in mathematics including calculus, probability and statistics, differential equations, and linear algebra.

Section II Proficiency in fundamentals of industrial engineering including: operations research (deterministic and probabilistic), quality control, reliability, engineering economy, production planning and control, and human factors.

The oral examination should be taken and passed in the semester after the written examination is passed. The dissertation committee assigns a topic for the oral examination from the student's area of specialization. The examination is offered by the dissertation committee. Thorough study and understanding of theoretical, technical and practical aspects of the assigned topic should be demonstrated in the oral examination.

Formation of a Dissertation Committee: With the approval of the graduate advisor, within two months after passing the written examination, students must form a dissertation committee. The committee should consist of at least four faculty members from the department including the student's advisor. In addition, one member of the committee must be chosen from outside the department.

Dissertation Proposal: Within three months of passing the oral examination, students must submit, for the approval of their dissertation committee, both in writing and orally, a doctoral proposal on the scope of their proposed research.

The dissertation must represent original research leading to meaningful advances in the industrial engineering profession. The work must be worthy of publication in refereed journals on industrial engineering or related fields. Doctoral students must complete the dissertation in the five years subsequent to passing their written and oral qualifying examinations.

Dissertation Defense: Each doctoral student must submit to their committee a written dissertation for their approval. After the dissertation committee approves the document, the student must successfully defend the dissertation in front of the committee and other interested faculty and students.

Areas of Specialization:

Manufacturing Systems and Assurance Sciences:
Core:
12 credits:

		IE 704	Sequencing and Scheduling (3 credits)
		IE 705	Mathematical Programming in Management Science (3 credits)
		IE 706	A Queueing Approach to Performance Analysis (3 credits)
		MnE 654	Design for Manufacturability (3 credits)

Elective:
12 credits, 3 credits of which must be at the 700 level and none at the 500 level

Courses selected from IE, ME, MnE, CS, and Math.

Human Factors and Occupational Safety:
Core:
12 credits:

		IE 604	Advanced Engineering Statistics (3 credits)
		IE 760	Quantitative Methods in Human Factors (3 credits)
		IE 761	Advanced Studies in Human Factors (3 credits)
		IE 762	Psychophysical Methods in Human Factors (3 credits)

Elective:
12 credits, 3 credits of which must be at the 700 level and none at the 500 level
Courses selected from IE, ME, MnE, CS, and Math.

Information Systems

Administered By: Department of Information Systems

Administration

Dean, College of Computing Sciences	Narain Gehani
Acting Associate Dean, College of Computing Sciences	Barry Cohen
Assistant to the Dean, College of Computing Sciences	Serena Branson
Acting Chair, Information Systems Department	Michael P. Bieber
Assistant to the Chair, Information Systems	Michelle D. Craddock
Associate Chair.	George R. Widmeyer
Director of Undergraduate HCI Program	Quentin Jones
Director of Undergraduate IS Program	Michael P. Bieber
Director of Master's Program	George R. Widmeyer
Director of Emergency Management & Business Continuity	Michael J. Chumer
Director of PhD Program	Yi-fang Wu
Secretary	vacant

Faculty

Professors Emerita	S R. Hiltz, Murray Turoff, Marilyn Tremaine
Professors	Michael P. Bieber, Fadi Deek
Associate Professors	Quentin Jones, David Mendonca, Michael L. Recce, Julian M. Scher, George R. Widmeyer, Yi-fang Wu
Assistant Professors	Min Song
Senior University Lecturers	Elizabeth A. Gomez, Richard W. Egan
Research Professor	Michael J. Chumer

Advisors

Advisor B.A./ B.S.	Sarah Vandermark, Megan T. Summers
Advisor M.S.	George W. Olsen
Advisor Ph.D.	Min Song

Degrees Offered: Master of Science in Information Systems; Doctor of Philosophy in Information Systems.

The field of Information Systems (IS) addresses the application software lifecycle, including the design, creation, management, evaluation and analysis of the wide variety of computing systems applications that are directly used by individuals, groups and organizations to support their work and social lives. Students in this program will master both the technology and the human behavior in the computing environment.

The study of Information Systems is based upon the concept that there is a growing body of knowledge on the relationships between people and computers that is independent of any specific application. Understanding of the total system involves both the human and the computing environment as an integrated whole. Students will master both the technology and the understanding of human behavior in the computing environment.

The MSIS program provides solid grounding in three principal areas, all of which are applicable to the areas described above:

Systems analysis and software engineering
Information and communication technologies
Management of information system

The program emphasizes the planning, investigation, design, development, application, management and evaluation of Information Systems. The program trains students to be integral members of application design and development teams.

The program also provides exposure to the state-of-the-art in IS research, so that students will be prepared to work with both emerging concepts and technologies.For students wishing to become directly involved in research, there are ample opportunities to participate in ongoing projects, as well as to write a master's thesis under faculty supervision. A number of master's level courses are also included in the Ph.D.curriculum.The MSIS program is designed as a subset of the PH.D program in IS.The description here includes several notes for students considering continuing on with the Ph.D. program.

The program is offered both face-to-face and in a distance learning mode employing collaborative learning methods including team and project activities.

Masters in Information Systems

Admission Requirements

The field of IS is broadly interdisciplinary. Applicants with degrees in any field are therefore welcome to apply for the MS IS program. A series of "bridge courses" are used to develop the required skills of incoming students who may not have been exposed to some parts of the IS curriculum.

Applicants with undergraduate degrees in Information Systems, Management Information Systems, Information Technology, Computer Science, Computer Engineering and similar areas usually are sufficiently prepared for entry. Requirements for entry include a working knowledge of an object-oriented programming language, at least one year of calculus, one course in calculus-based probability and statistics, and finally an additional advanced mathematics course such as discrete analysis.

Applicants must have a GPA of 2.8 or higher in their prior academic work. (Applicants not meeting this requirement, but who have significant work experience since their last degree may be considered on an individual basis.)

Applicants without a prior undergraduate or master's degree from the United States must submit GRE, GMAT or MCAT scores for admission.

Bridge Program:

Computer and Information Systems Technology:

		CS 505	Programming, Data Structures, and Algorithms (3 credits)
		IS 245	Information Technology Systems: Hardware/Software (3-0-3)

Mathematics:

		Math 111	Calculus I (4-1-4)
		Math 112	Calculus II (4-1-4)
		Math 333	Probability and Statistics (3-0-3)

Management:

		Acct 115	Principles of Accounting I (3-0-3)

Students may substitute Math 226, Discrete Analysis, for Math 112, Calculus II. Students must get a B in all IS bridge courses, and no grade lower than a C in the others. Students without an excellent command of English may be required to take specific written and spoken English courses. Final determination of bridge requirements can only be made from the examination of a completed formal application folder. Applicants with prior coursework covering the bridge topics should attach a note to their application clearly showing which courses correspond to these bridge requirements, if possible.

Off-Campus Programs: At extension and corporate sites, NJIT offers sufficient courses to fulfill all degree requirements. NJIT faculty teach all courses. For locations, see Extension Programs in this catalog. The university's distance learning arm, ACCESS/NJIT, offers this program (as well as part of the bridge program described above) to qualified students who have access to the Internet and a VCR. In addition, distance-based, 12-credit graduate certificates in Information Assurance, Internet Applications Development or Telecommunications Networking are available as a step toward this degree. See Graduate Certificates in this catalog. For further information about extension programs, ACCESS/NJIT programs, and graduate certificates, call the associate vice president of continuing and distance education, Division of Continuing Professional Education, 1 (800) 624-9850 or (973) 596-3060; e-mail cpe@njit.edu.

Important Note: Students assigned to bridge courses or English courses must take these courses before taking before taking 600- and 700-level graduate courses. It is possible, however, to sign up for graduate courses (i) in the final semester in which bridge courses are taken and (ii) when prerequisites delay taking of a particular bridge course.

Degree Requirements:

The student is required to take 30 credits (10 courses).

The course planning form, posted on the MSIS Web site, lays out much of the information in this program description. Students should use it to plan out their courses for the MS IS degree. They should bring this (or email it) to the Program Director whenever they wish to discuss their progress.

The required courses are:
IS Core Courses (6 courses/18 credits)

All six IS core courses are required:

		IS 677	Information System Principles (3 credits)
		IS 663	Advanced System Analysis and Design (3 credits)
		IS 631	Enterprise Database Management (3 credits)
		IS 679	Management of Computer and Information Systems (3 credits)
		CS 652	Computer Networks-Architectures, Protocols and Standards (3 Credits)
		HRM 601	Organizational Behavior (3 credits)

We recommend that students start taking the core courses immediately. Note that one must take IS 677 before IS 679.

Electives (4 courses/12 credits):

The remaining four courses are electives chosen from the list below. Students will normally choose a specialization track that includes two to four courses. Students may also customize a track with approval from the Director of the MSIS Program.

We encourage Masters students doing well in the program to take electives at the 700-level.

Students planning to continue with the IS Ph.D. program may take up to four non-IS courses after gaining written approval from their MS IS Advisor. They also should check the Ph.D. program requirements and consider taking specific required courses as MS IS elective. They are advised to take as many 700-level courses as possible.

Masters Project and Masters Thesis

We strongly encourage students to consider a one-semester Masters Project (IS 700) or two-semester masters Thesis (IS 701). The masters project provides the opportunity to apply knowledge and skills to develop an application system or solve a complex problem. The thesis option extends the project by conducting publishable research in the project area. Both courses count as IS electives, and are not mandatory for graduation.

While we encourage people to partake in NJIT's Cooperative Program, it does not count as IS elective credit.

For further details, please see http://is.njit.edu/msis/

ELECTIVE TRACK:

Select one of the following tracks and choose two to four of the courses listed in that area. The student is responsible for checking with the program director to determine if the necessary course prerequisites have been met. All other electives must be chosen from the list below.

Research Methods:

		IS 675	Information System Evaluation (3 credits)
		IS 735	Computer Mediated Communication Systems (3 credits)
		IS 763	Qualitative Methods in IS Research (3)
		Math 661	Applied Statistics (3 credits)

Data Managment:

		CS 602	Java Programming (3 credits)
		CS 632	Advanced Database System Design (3 credits)
		IS 634	Information Retrieval (3 credits)
		CS 731	Applications of Database Systems (3 credits)
		CS 734	Data Mining (3 credits)
		Mgmt 635	Data Mining and Analysis (3 credits)

Decision Making and Knowledge Management:

		MIS 648	Decision Support Systems for Managers (3 credits)
		CS 661	Systems Simulation (3 credits)
		IS 767	Decision Support Systems (3 credits)
		Mgmt 630	Decision Analysis (3 credits)
		Mgmt 650	Knowledge Management (3 credits)

Business Informatics:

		IS 684	Business Process Innovation (3 credits)
		MIS 625	Management Strategies for E-Commerce (3 credits)
		Mgmt 690	Electronic Communities in Organizations (3 credits)
		Mgmt 676	Managing the Digital Firm (3 credits)
		Mrkt 645	Internet Marketing Strategy (3 credits)
		Fin 600	Corporate Finance I (3 credits)
		Acct 615	Management Accounting (3 credits)

Interaction Design:

		IS 658	Multimedia Systems (3 credits)
		IS 675	Information System Evaluation (3 credits)
		IS 735	Computer Mediated Communication Systems (3 credits)
		IS 686	Pervasive Computing: An HCI Perspective (3 credits)
		IS 613	Design of Emergency Management Information Systems (3)
		PTC 601	Advanced Professional and Technical Communication (3 credits)
		PTC 605	Elements of Visual Design (3 credits)
		PTC 610	Usability: User and Task Analysis (3 credits)
		PTC 632	Content Management and Information Architecture (3 credits)

Security:

		CS 608	Cryptography and Security (3-1-3)
		IS 681	Computer Security Auditing (3 credits)
		CS 696	Network Management and Security (3 credits)
		IS 680	Information Systems Auditing (3)
		ECE 698	Selected Topics in Electrical and Computer Engineering (3 credits)
		IS 687	Transaction Mining and Fraud Detection (3 credits)

Network Management:

		CS 633	Distributed Systems (3 credits)
		CS 651	Data Communications (3 credits)
		CS 656	Internet and Higher-Layer Protocols (3 credits)
		CS 696	Network Management and Security (3 credits)
		CS 697	Principles of Broadband ISDN and ATM (3 credits)
		ECE 644	Introduction to Wireless and Personal Communications Systems (3 credits)
		MIS 635	Management of Telecommunications (3 credits)

Systems Analysis and Design:

		IS 683	Object-Oriented Software Development (3 credits)
		IS 684	Business Process Innovation (3 credits)
		IS 698	Special topics in Information Systems (3)
		IS 676	Requirements Engineering (3 credits)
		EM 636	Project Management (3 credits)
		EM 637	Project Control (3 credits)
		Mgmt 644	Communication in Technology Transfer and Innovation (3 credits)

Software Systems:

		CS 602	Java Programming (3 credits)
		CS 610	Data Structures and Algorithms (3 credits)
		CS 630	Operating System Design (3 credits)
		CS 635	Computer Programming Languages (3 credits)
		CS 650	Computer Architecture (3 credits)

Emergency Management:

		IS 613	Design of Emergency Management Information Systems (3)
		IS 615	Improvisation in Emergency Management (3)
		MIP 675	Elements of Infrastructure Planning (3 credits)
		IS 614	Command and Control Systems (3)
		EvSc 603	Hazardous Waste Operations and Emergency Response (3 credits)
		EvSc 616	Toxicology for Engineers and Scientists (3 credits)

Ph.D. in Information Systems

Contents

Ph.D. PROGRAM REQUIREMENTS

Program Goal and Focus

IS Ph.D. Program Goal

To educate future scholars to conduct cutting-edge and high-impact research at leading universities and research labs.

Program Focus

The field of Information Systems builds upon fundamental knowledge concerning the design, use and evaluation of interconnected human, computing and organizational systems. Information Systems support and can be studied within many domains, including business, science, engineering, community, social and education activities, in the private, public and non-profit sectors. Across all these areas, Information Systems is broadly concerned with the effective use and integration of computing technologies into human endeavors.

The Ph.D. program in Information Systems is designed to produce scholars who possess a commanding knowledge of the nature of Information Systems. The program seeks to develop individuals who can expand both the theory and practice of information systems for complex applications and environments. The program is designed to attract scholars from different disciplinary backgrounds and encourages an interdisciplinary approach to the exploration of information and human-centered system requirements, analysis, design, implementation, user acceptance, deployment, management and the evaluation of their effectiveness and consequences.

Currently the IS Department supports two research tracks: Human-Centered Computing (HCC) and Information Integration and Informatics (III). IS Ph. D. dissertations must produce a substantial scientific contribution to their particular area.

> *Human-Centered Computing* (HCC) research centers on people (individuals, teams, organizations or societies) in all stages of information and communication technology development and use. The HCC faculty's current projects include studies on collaboration and technology design in areas such as social networking through web and pervasive (mobile) applications, game design, cognitive-based decision support, emergency management, and educational innovation.
>
> *Information Integration and Informatics* (III) is centered on the science of information or automatic information processing. It focuses on the exploitation and utilization of digital content, including the relevant processes, technologies, and human involvement in creation, storage, querying, representation, presentation, organization, integration, management, analysis, security, privacy, interaction and preservation at each stage of the information life-cycle. The III faculty's current projects include text mining, search engines and recommender systems, security and pattern matching analysis, knowledge engineering, and digital library integration.

While the current focus of the IS Ph.D. program is on HCC and III, we do allow a limited number of students to pursue dissertations in the areas of Business Informatics/Management Information Systems (MIS). The dissertation committee for students with this focus must include an appropriate chair or co-chair from NJIT's School of Management.

The design of the IS Ph.D. program has the following aims to ensure proper preparation of students to become top-quality researchers and teachers:

- The qualifying exam and research proposition ensure ability and readiness to conduct research.

- The Ph.D. program immerses its students in all types of research activities throughout their doctoral study.
- The Ph.D. program mentors its students to be capable teachers.

The design of the Ph.D. program has the following aims to ensure a high-quality mentoring process:

- Ensure all aspects of the program can be managed adequately.
- Ensure steady, satisfactory progress of students, from admission to graduation.
- Ensure high quality mentoring and advising of students.
- Ensure that students research in areas where they have adequate faculty guidance and oversight.

Part-Time and Distance Students:

The IS Ph.D. program welcomes both part-time and distance students with the following caveats. All students (full-time on-campus, part-time and distance) must satisfy the same admissions criteria. Part-time students will be given more time to complete the degree requirements. However, they must realize that the Ph.D. requirements are rigorous and time consuming, and that it is often more difficult to complete them when one's attention is divided because of full-time work responsibilities.

Part-time students are strongly encouraged to obtain a leave from work obligations in order to focus on their dissertation research on a full-time basis for at least one year. Distance students must make arrangements to meet regularly with their advisor, either in-person or through phone or online meetings, and complete all coursework. They are also encouraged to arrange their work schedule to participate in research group meetings and other research activities as often as possible.

Entrance Requirements:

Our entrance requirements are standard for all applicants, regardless of whether their prior degrees are from NJIT or elsewhere. Applicants must have at least a baccalaureate degree and preferably a master's degree with a demonstrated record of academic achievement, and show promise of completing a rigorous Ph.D. program and the capacity to undertake high quality research. We welcome applications from well-qualified individuals who have varying academic backgrounds and who will contribute to the richness and diversity of our Information Systems community. It should be noted that applicants without sufficient computing or mathematics/statistics background will be assigned additional foundation coursework ("bridge courses") which must be completed in consultation with the Ph.D. director. Students should be aware that these courses may take additional time.

To ensure that each applicant, once admitted, will likely be able to find a dissertation advisor and committee in our program with proper expertise, we require that all perspective applicants seek a faculty advocate prior to application. Applicants can also consult with the Ph.D. director regarding research interests and contacting faculty. To identify a faculty advocate, applicants should browse faculty web sites (http://is.njit.edu) to learn their research interests and decide which faculty might have proper expertise to assess and foster their research interests. Then, applicants should contact their potential faculty advocates to discuss their research interests. Once a faculty member agrees to advocate his or her application, the applicant then prepares a research statement which clearly explains the applicant's motivation, research interests, plans for Ph.D. study and how the chosen faculty advocate's interests as well as those of other faculty in the program fit into these plans. While it is presumed that the advocate will serve as the applicant's faculty mentor, applicants may change faculty mentors and advisors as their research interests evolve. The purpose of advocation is to ensure a good fit with our program, if your application is approved.

Application materials for the IS Ph.D. program include several items in addition to the standard requirements listed at the NJIT Admissions Office web site:

- GRE, including analytical writing
- TOEFL, including TWE, if your native language is not English
- Transcripts from all prior undergraduate, certificate and graduating degrees. GPA should be 3.5 or better on a 4.0 scale.
- Curriculum Vitae
- Three letters of reference
- Research Statement (or Statement of Purpose)
- Copies of the published versions of all papers listed in your curriculum vitae, regardless of whether or not they are written in English.
- Copies of award letters or certificates listed in your curriculum vitae.

Applicants seeking financial support must submit all application materials by January 15 for the Fall admission, and by September 15 for the Spring admission.

Overall Course Requirements

Students must maintain a grade average of 3.5 (B+) or better in the core courses. A grade of B or better in each core course is required in order to take the qualifying exam. Furthermore, no graduate course may have a grade of less than B and count toward candidacy. This includes potential courses for transfer credit.

Students also must choose a research specialty that will be the focus of the Ph.D. dissertation. At least 24 credits must be related to doctoral coursework which includes core courses and specialty courses (see Table 1); up to two may be Independent Study. At least 5 courses must be at the 700 level.

Total Required Credits

The Ph.D. program requires students to enroll for 78 credits, or 90 credits if they want to also obtain a master's degree. Most course or research units are 3 credits each. (Applicants usually already have a master's degree. If the student already has a master's degree, up to 30 credits of coursework can be credited as described in the next section.) The master's degree is not automatically granted, rather the student must consult with the Office of Graduate Studies regarding its timing and approval. Also, students who wish to earn a master's degree during their doctoral study must enroll in the appropriate courses to satisfy degree requirements of both degrees. This may require taking additional credits not specifically required for the Ph. D. program. Funded students might only receive funding for the 78 Ph.D. required credits.

Table 1. Total Required Credits

	Ph.D. only	Master's and Ph.D.
Foundation Coursework	18 credits	30 credits
Doctoral Coursework	24 credits	24 credits
Doctoral Dissertation	36 credits	36 credits
Total Credits	78 credits	90 credits

Foundation Coursework: 18-30 credits

The following courses are expected to have been completed as part of a master's degree. For students entering only with a bachelor's degree, and for students with a prior master's who have not taken them, these courses must be completed, along with the core courses specified in the Core Knowledge Stage below before other courses are taken. For other courses taken in a prior master's degree to count for credit, they must be relevant to the student's research field, and approved by the Ph.D. director, upon the recommendation of his or her faculty mentor. Existing master's degrees may be credited for up to 10 courses (30 credits) as long as they follow the criteria in this paragraph.

IS Foundation Courses (6 credits):

IS 663	Advanced System Analysis and Design (3 credits)
IS 677	Information System Principles (3 credits)

Computing Sciences Tools and Methodologies Foundation Courses (6+ credits):

To ensure a strong technical foundation, Ph.D. students should choose at least one course from the Programming area and at least one from the Database area. It is recommended that students take at least one course in networking area as well. Suggested courses include:

Programming Languages and Methodologies:

CS 602	Java Programming (3 credits)

Database Design:

IS 631	Enterprise Database Management (3 credits)
CS 632	Advanced Database System Design (3 credits)

Networking and Security:

		CS 652	Computer Networks-Architectures, Protocols and Standards (3 Credits)
		CS 656	Internet and Higher-Layer Protocols (3 credits)
		CS 696	Network Management and Security (3 credits)

Additional Foundation Courses:

Additional courses necessary to fulfill the 18 or 30 credit Foundation Coursework requirement should be chosen in consultation with the faculty mentor or Ph.D. director.

Stages of the Ph.D. Program

1. Core Knowledge Stage
2. Research and Teaching Apprenticeship Stage
3. Dissertation Stage

1. Core Knowledge Stage

The Core Knowledge stage comprises the first year of required core courses and the qualifying exam. (With the explicit approval of the Ph.D. Program Director, an equivalent course may be substituted for a core course.)

Core Courses

	*	Math 661	Applied Statistics (3 credits)
		IS753	(Evaluation of User Experience)
		IS755	(Philosophy of Science)
		IS764	(Quantitative Methods in IS Research)

Participation in Research Activities:

		IS 791	Graduate Seminar (Non-credit)

IS research group meetings present an important opportunity for community members (faculty and Ph.D. students) to immerse themselves in IS research paradigms, to learn about the research that other members of same research interests are doing, to present their own ideas, and to find collaborators.

Full-time funded students (through the department or grants) must attend research group meetings and other research talks sponsored by the program every semester during the Core Knowledge stage and register for IS 791. Full-time funded students must actively participate in every semester they are on-campus during the Research and Teaching Apprenticeship stage. They are encouraged to continue participating during their Dissertation stage. Other students must register and actively participate for at least 2 semesters during the Ph.D. program (in person or remotely), and are strongly encouraged to attend as often as they can. Exit requirements for IS 791 include presentations in research group meetings.

Qualifying Exam

The qualifying exam is given on a pre-announced date during the month of May. The exam has three sections: quantitative research methods, qualitative research methods, and article review. To be admitted to degree candidacy, a student must pass all three sections of the exam, subject to the following conditions:

- If a student fails one section the first time and wishes to remain in the program, the student must re-take that section of the exam the following May. If the student fails the re-take, of the section, the student is dismissed from the program.

- If the student fails two or more sections the first time taking the exam, the student is dismissed from the program.

Timing

All timing in this document refers to consecutive calendar time, and does not permit leaves of absence or other gaps in studies except for truly extraordinary circumstances, which must be justified to, and approved by both the IS Ph.D. program committee and NJIT's Graduate Studies

Office. Unapproved leaves will result in dismissal from the program.

Full-time students without other conditions (see below) must take the qualifying exam at the end of their first academic year of studies (i.e., in May after 9 months since starting the program).

Timing for Students who are part-time, International, without a Master's Degree or Starting in the Spring

Part-time students may take up to 2 academic years (i.e., 4 consecutive Fall and Spring semesters) to complete the core courses and take the qualifier for the first time. Part-time students who require bridge courses prerequisite to the core courses may take up to an additional 2 semesters with the permission of the Ph.D. program director. International students who need to take English courses and full-time students without a master's degree who need to take bridge courses prerequisite to the core courses may take up to 2 academic years to complete the core courses and take the qualifier for the first time. Full-time non-international students entering the program in the spring semester will have one additional semester, as they need to wait until May of the following year to take the qualifying exam.

2. Research and Teaching Apprenticeship Stage

The Research and Teaching Apprenticeship stage comprises the program phase between first taking the qualifying exam and before developing a dissertation proposal. It includes finding a faculty mentor, submitting papers, reviewing papers, teaching, and successfully completing a research proposition. As will be described, the research proposition is meant to demonstrate "research readiness" and precedes the dissertation proposal, which is prepared during the Dissertation stage.

A student planning form, which includes all the elements described here, must be approved by both the faculty mentor and the Ph.D. Director by the end of every semester.

Several of the elements have very specific timing and other criteria, which if unmet will result in dismissal from the program unless explicitly stated otherwise. We encourage students to maintain close contact with both their faculty mentor and the Ph.D. Director, especially if they are facing or anticipating any problems that will prevent them from meeting the criteria stated.

Timing

Full-time students must complete the Research and Teaching Apprenticeship stage within two calendar years of entering this stage. (i.e., 24 consecutive months), as well as the other timing requirements included in the description that follows, or be dismissed from the program. Part-time students must complete this stage within three calendar years.

Requirements for the Research and Apprenticeship Stage

During this stage, students are required to fulfill the following requirements:

1. Faculty Mentor

Both full-time and part-time students should strive to select a faculty mentor by the start of the Research and Teaching Apprenticeship stage, and must select a faculty mentor by the end of the first year of entering this stage. (Therefore, it is recommended to identify a probable mentor prior to applying to the program.) The faculty mentor presumably will become the student's dissertation advisor, though this is a period for students to explore one or more areas of research as part of finding an exciting dissertation topic. Students may switch faculty mentors as their research interests evolve.

The criteria for a faculty mentor follow those of a dissertation advisor, which must adhere to the guidelines from NJIT's Office of Graduate Studies. Students can work with two co-mentors, as long as both follow the guidelines for dissertation co-advisors. Students requiring a co-mentor under these criteria must find the second co-mentor within six months of finding the first.

Student's Chosen Specialty:

As a corollary, the student's chosen specialty and eventual dissertation topic must be such that the student can be guided by an available faculty mentor and it is feasible to form a fully-functioning dissertation committee.

2. Coursework

Students must complete their coursework by the end of this stage, except for pre-doctoral dissertation and doctoral dissertation credits. If a student quickly completes all other requirements in this stage, he or she may show how the remaining courses are planned to be completed within the first of the Dissertation stage. The faculty mentor (or co-mentors) must be consulted in choosing these courses and must approve them before the student takes them.

General Knowledge for Teaching:

If necessary, students and their advisors are responsible for choosing a set of other courses that will give the student enough knowledge to teach general undergraduate courses in Information Systems and/or in their chosen specialty.

Specific Knowledge for Research and Dissertation:

Students and their advisors are responsible for choosing courses or independent study that will provide them with the appropriate knowledge to complete the student's dissertation, and be considered knowledgeable in the student's chosen field. The advisor can recommend courses in excess of the official number of credits required for graduation if the additional knowledge is critical. The Information Systems Department currently supports two specialty areas: Human-Centered Computing, and Information Integration and Informatics, for which courses are specified. Students must declare a track once they enter the Research Apprenticeship Stage and discuss with their faculty mentor (or co-mentors) which specialty courses to take from the following list, or others as appropriate.

Selected specialty courses in Human-Centered Computing:

		IS 658	Multimedia Systems (3 credits)
		IS 686	Pervasive Computing: An HCI Perspective (3 credits)
		IS 735	Computer Mediated Communication Systems (3 credits)
		IS 786	Special Topics (3 credits)
		IS 767	Decision Support Systems (3 credits)

Selected specialty courses in Information Integration and Informatics:

		IS 634	Information Retrieval (3 credits)
		IS6XX	(Web Mining)
		IS6XX	(Web Services Authentication)
		CS 731	Applications of Database Systems (3 credits)
		CS 734	Data Mining (3 credits)
		CS 744	Data Mining and Management in Bioinformatics (3 credits)

It is possible for a student with a different interest to propose and receive permission from the Ph.D. program committee to create an individually tailored specialty area, instead. They must be in Information Systems or a related discipline and include a specialty area of at least four courses that constitutes� a coherent body of knowledge in support of the student's expected area of specialization and research. The set of courses for the specialty area should include at least one at the 700 (advanced graduate) level. Students considering this must discuss this option with the Ph. D. director before entering the Ph.D. program to ensure that the program has the expertise and resources to support the specialty area.

3. Research Proposition

Once a student has sufficient knowledge in a research area, the student will prepare a research proposition. During this time, the student will register for IS 776 under his or her Faculty mentor's advising section. The proposal should follow the NSF grant proposal format, including length (but without the budget and external commitments, etc., of an actual grant proposal). The topic does not have to become the student's dissertation, but the ideal case it will and could yield an actual proposal that gains funding for the student's research. Students are encouraged to consult their faculty mentor in preparing the research proposition.

The proposal will be due on November 15th in the Fall semester and April 15th in the Spring semester. The Ph.D. Director will form a review panel consisting of 3 faculty members and 2-4 Ph.D. students for each proposal. The student's faculty mentor(s) may not serve on the panel. The panel will meet during the first week of December in the Fall and the first week in May in the Spring. Students will have 20 minutes to present an overview of their project in a public forum, followed by time for the panel to ask questions. The panel will then meet in a closed-door session to determine the results. The panel will release a written panel summary with specific reviewing comments as part of its judgment to the Ph.D. director. The reviewing decision is either Pass or Fail. A proposal must receive a majority of faculty panelist votes to pass. (Student panelist input is highly-valued but not counted in the formal vote.) If a candidate fails the first time, he or she will be given a second chance to pass in the following semester. Registration for IS 776 is still required during the second attempt.

4. Regular Publishing Activity

Students must present evidence of one conference or journal paper submission a year, every year following the successful passing of the qualifying exam. Students are strongly encouraged to co-author papers with faculty and other doctoral students. They also are strongly encouraged to revise and resubmit any rejected papers. All publishing activities should be documented in the student planning form, including submissions, notification of receiving submissions, and reviewer comments.

5. Regular Reviewing Activity

Students are required to actively participate in reviewing activities. They can either review internal papers by faculty or students prior to submissions, or review external papers by request of journal editors or conference program chairs. They also must participate in reviewing their peers' research propositions during the Research and Teaching Apprenticeship stage. All reviewing activities should be documented with original papers and review comments, and made available for department records at the time of presenting the student planning form every semester. Students must review at least 5 papers or proposals/research propositions during this stage.

6. Teaching apprenticeship and Practicum

Students are required to apprentice with a faculty member for a semester in preparation for a teaching practicum. During the apprenticeship, students typically will serve as a teaching assistant or grader on the course for which they subsequently will do the practicum. During the practicum, the student will teach at least one course under the direct supervision of the course coordinator, preferably an on-campus (face-to-face) course or a hybrid course. Students are required to meet with the course coordinator in advance of and regularly throughout the semester to ensure that their section of the course is being taught well, consistent with the approved course curriculum, and conform to current IS Department grading standards. Students must receive a satisfactory rating to pass this requirement, which typically equates to a 2.8 teaching rating or better through the standard NJIT instructor evaluation. (A student not receiving this rating must coordinate with his or her advisor, the course coordinator, Ph.D. director and department chair to determine a course of action to develop into a good instructor and pass the practicum before graduation.) International students and domestic students who are supported with a teaching assistantship must take ENG 599 for TA's. With permission of the Ph. D. Director, this teaching can be postponed to the last year of the Dissertation stage.

3. Dissertation Stage:

A student can enter the dissertation stage only after all the requirements in the previous two stages are met. In this stage, students write and defend their dissertation proposal, conduct their main study , and write and defend their full dissertation thesis. Students also must actively submit publications based on this research.

Dissertation Proposal

The dissertation proposal is a binding contract between the dissertation committee and the student. If a student successfully defends a proposal, the research plan in the dissertation proposal is to be followed. The student then carries out all research activities� detailed in the proposal.

A dissertation proposal must show motivation, appropriate coverage of literature, a sound research framework, a prototype system (where appropriate), a pilot study (where appropriate), data analysis, and the detailed steps for completing the full dissertation.

Paper Submission based on Dissertation Proposal

Before defending the proposal, a student must provide evidence of a paper submission based upon some aspect of the dissertation proposal.

Dissertation

The dissertation must contain all of the aforementioned items in the dissertation proposal, except that a pilot study would be replaced with a formal study. The dissertation must also include contributions and limitations.

Paper Submission based on Final Dissertation

Before defending the final dissertation, a student must provide evidence of a paper submission based on the results from the formal study in the dissertation (not just the pilot study in the proposal).

Dissertation Advisor and Committee Criteria

A dissertation committee must be formed once a dissertation topic and initial scope is defined. The faculty mentor or co-mentors presumably will continue on to become the dissertation advisor or co-advisors. All dissertation advisors, committees and committee members must adhere to the guidelines from NJIT's Office of Graduate Studies. Similarly, changes to advisors or committees must gain formal approval from the Ph.D. Director and Office of Graduate Studies, and adhere to timing requirements. Students are obligated to present their progress regularly to the entire dissertation committee. All committee members must agree to participate fully in evaluating the dissertation proposal and thesis, and attend the defenses either in person or remotely.

Timing

For all students (part-time and full-time), the dissertation proposal must be successfully defended within 2 calendar years (24 consecutive months) of entering the Dissertation stage, and the dissertation must be successfully defended within 2 calendar years following the proposal acceptance. If the student experiences a major topic change or other major unforeseen event, he or she may petition the Ph.D. Committee for a possible, appropriate extension. Such an extension is not guaranteed. Full-time students entering with a master's degree are expected to complete their Ph. D. degree within 4 calendar years, while those entering with only a bachelor's degree are expected to completer within 5 calendar years. Per NJIT policy, the statue of limitation for doctoral study is 7 years.

Appendix:

Defense Procedures (for both proposal and dissertation)

A Ph.D. candidate must obtain his or her advisor's permission to defend a proposal or final dissertation with adequate lead time prior to the defense. Once permitted to defend, the student must meet with the Ph.D. program director to review these procedures and criteria.

Pre-Defense Checklist:

1. Evidence of a paper submission based on research conducted for the dissertation or proposal.
2. The proposal or final thesis document must be received by committee members at least 6 weeks prior to the intended defense date.
3. The candidate makes appointments to meet with each committee member separately (in person or remotely) to review his or her comments on the proposal or thesis. Then the student incorporates these comments into the final draft for distribution at the defense.
4. Once the entire committee agrees that the proposal or dissertation is ready to be defended, then the student schedules a date for the defense at least 2 weeks in advance, so that the community can be notified to attend.
5. The date and time for the defense must be scheduled when every dissertation committee member can participate, either in person, by phone, or via video conferencing. We strongly encourage defenses to be arranged at dates and times conducive to attendance by the rest of the IS community, which normally would exclude the summer.
6. The candidate notifies the Ph.D. program director with the date, time, title, abstract and dissertation committee members and their affiliations, as soon as possible and at least 2 weeks before the defense. The director makes the announcement and helps arrange for the room, presentation equipment, and, if necessary, coordination of distance participants.
7. The candidate practices his or her presentation with the dissertation advisor or at least one co-advisor several days in advance of the defense.
8. The candidate makes sufficient copies of slides and defense documents for the committee during the defense.
9. Student prints a copy of the defense report available on the Office of Graduate Studies web site.
10. All other Graduate Studies policies concerning the dissertation or proposal defense must also be followed.

Post Defense Checklist:

1. The advisor (or co-advisors) e-mails all committee members, the candidate, and the Ph.D. program director, informing them of the results of the defense (pass without revisions/with minor revisions/major revisions/fail). After discussion with dissertation committee, and with its consensus, the advisor will notify the student and the Ph.D. Program Director in a timely manner with a detailed set of agreed-upon revisions. These revisions serve as a contract between the committee and the student.
2. The advisor (or co-advisors) then completes and forwards the defense report, including the set of required revisions if any, to the Ph.D. program director.
3. Once the student completes all required revisions for the proposal or dissertation, the revised document is then sent to the advisor for approval. Once approved, the document is then forwarded to all committee members.
4. Committee members are required to decide whether to leave the final approval to the dissertation advisor(s), or to themselves. Once final approval is given, the defense report will be co-signed by the department chair and Ph.D. program director, and then forwarded to the Office of Graduate Studies. In the latter case, the Ph.D. program director will hold onto the defense report until he or she hears from all committee members.

* Fall

** Fall; course to be taught starting Fall 2008

*** Spring; course to be taught starting Spring 2009

**** Spring; course to be renumbered

Catalog and curricula information approved by the relevant academic department.

Infrastructure Planning

Administered By: College of Architecture and Design

Administration

Program Director	Darius T. Sollohub
Associate Program Director	Georgeen Theodore
Graduate Program and Admissions Coordinator	Frederick A. Little

Faculty

Distinguished Professor	G M. Mostoller, Zeynep Celik
Professors	Sima Bagheri, Robert Dresnack, Karen A. Franck, Urs P. Gauchat, Glenn Goldman, David L. Hawk, Peter C. Papademetriou, Antonio P. De Sousa Santos, Lazar Spasovic
Associate Professors	Janice R. Daniel, David H. Elwell, Joshua S. Greenfeld, Anthony W. Schuman, Donald R. Wall
Assistant Professors	Maurie Cohen, Gabrielle Esperdy, Richard J. Garber, Wassim Jabi, Darius T. Sollohub, Georgeen Theodore
Research Professors	Ervin Bales, Richard V. Olsen

Degrees Offered: Master in Infrastructure Planning

Through interdisciplinary teaching, research and practice made possible by NJIT's resources in architecture, civil and environmental engineering, transportation, management, and environmental policy studies, the program addresses the global need to train planning and design professionals capable of acting across the spectrum of disciplines involved in infrastructure development.

Infrastructure is defined as the whole built fabric of public spaces, institutions, facilities and services that shapes and sustains daily life. Collaboration between the disciplines concerned with different infrastructure components is necessary to develop holistic strategies for building more livable and efficient urban environments. The goal of the M.I.P. program is to gain a coherent understanding of the interrelationships between those components and to develop the potential of integrally planned and designed infrastructure systems to deal more effectively with the critical problems confronting our cities.

Using a variety of project settings, the program focuses on the natural environment and on public space, roads, transportation, services and utilities as interacting physical and spatial systems, as well as on parks, schools, housing and civic institutions. The purpose is to develop operational strategies that integrate the broadest possible range of planning and design policies, methods and actions for improving human settlements; and to resolve in environmental terms the larger social and political issues that affect the quality of life in our communities.

Capitalizing on NJIT 's multidisciplinary resources and location at the center of the nation's greatest regional concentration of urban infrastructure, the M.I.P. program incorporates applied research and realistic problem solving in its curriculum and also offers internships and research assistantships. M.I.P. faculty, drawn from the university's four academic divisions, is supplemented by eminent infrastructure planning practitioners. Collaborative relationships have been established with complementary academic programs at Rutgers University and with regional, national and international institutions concerned with infrastructure. At NJIT, a number of notable research facilities are engaged in specialized work related to infrastructure planning and design.

Master in Infrastructure Planning

A unique interdisciplinary program in infrastructure planning and design directed at students with previous degrees in architecture, landscape architecture, urban planning or civil engineering.

Dual Degree Programs: Dual M.Arch./M.I.P. or M.S. in Civil Engineering/M.I.P. degree options that reduce the number of credits required to obtain the two degrees separately are available to students with superior academic records who hold bachelor's degrees in architecture or engineering from NJIT or equivalent degrees from other universities; or who are prospective graduates of the professional M.Arch. program at NJIT. See "Architecture" for the M.Arch./M.I.P dual degree program description. See the graduate advisor for the M.S. in Civil Engineering/M.I.P. dual degree program description.

Admission Requirements:

Applicants must have a bachelor's or a master's degree in architecture, landscape architecture, urban planning, or engineering. A GPA of at least 3.0 is expected and evidence of potential for graduate study is to be demonstrated by a portfolio, letters of recommendation, GRE scores, and TOEFL scores of 550 (pencil and paper) and 213 (computer-based) in the case of international students.

Bridge Program: Students not sufficiently experienced in design will be required to take an intensive bridge course in design prior to entering the program. This course does not count toward degree credit.

Degree Requirements:

Students must complete 36 course credits through full- or part-time study. Up to 6 credits toward the degree may be waived based on previous academic study. Additional elective courses may be taken in disciplines related to infrastructure planning, but do not count toward degree credit.

Required:

The following courses are required, subject to those waived in individual cases; however, no waivers will be given for studio courses. A typical full-time study plan over two semesters is shown below; degree credits are in parentheses.

Semester 1:

		MIP 601	Interdisciplinary Infrastructure Studio I (6 credits)
		MIP 612	Introduction to Environmental Policy Studies (3 credits)
		MIP 615	Introduction to Transportation Studies (3 credits)
		MIP 631	History and Theory of Infrastructure (3 credits)
		MIP 675	Elements of Infrastructure Planning (3 credits)

Semester 2:

		MIP 602	Interdisciplinary Infrastructure Studio II (6 credits)
	*	MIP 618	Public and Private Financing of Urban Areas (3 credits)
		MIP 652	Geographic Information Systems (3 credits)
	*	MIP 655	Land Use Planning (3 credits)
{		MIP 673	Infrastructure Planning in Practice (3 credits) ***or***
		MIP 674	Infrastructure and Architecture (3 credits)

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* Or substitute selected with the approval of Graduate Advisor.

Catalog and curricula information approved by the relevant academic department.

Internet Engineering

Administered By: Department of Electrical and Computer Engineering (ECE).

Administration

Chair	Atam P. Dhawan
Associate Chair (Undergraduate)	Sui-hoi E. Hou
Associate Chair (Graduate)	Durgamadhab Misra

Faculty

Distinguished Professors	Yeheskel Bar-Ness, Bernard Friedland, Jacob Savir
Professors	Ali N. Akansu, Nirwan Ansari, William N. Carr, changtn, Roy H. Cornely, Atam P. Dhawan, Haim Grebel, Richard A. Haddad, Alexander M. Haimovich, Jacob Klapper, Durgamadhab Misra, Solomon Rosenstark, Yun-qing Shi, Kenneth S. Sohn, Marek Sosnowski, Gerald Whitman, Mengchu Zhou, Sotirios G. Ziavras
Associate Professors	John D. Carpinelli, Hongya Ge, Sui-hoi E. Hou, Walid Hubbi, Constantine N. Manikopoulos, Edip Niver, Sirin Tekinay, Leonid Tsybeskov
Assistant Professors	Ali Abdi, Jie Hu, Swades K. De, Roberto Rojas-Cessa
Special Lecturer	Arthur B. Glaser

Advisors

Undergraduate Advisor	Geny A. Moreno
Undergraduate Advisor	Sui-hoi E. Hou
MS Computer Engineering Advisor	Mengchu Zhou
PHD Computer Engineering Advisor	Durgamadhab Misra
MS in Electrical Engineering Advisor	Durgamadhab Misra
PHD in Electrical Engineering Advisor	Durgamadhab Misra

Degrees Offered: MASTER OF SCIENCE IN INTERNET ENGINEERING

The objective of this program is to educate students in the field of internet engineering, with emphasis on computer internetworking and relevant applications.

Master of Science in Internet Engineering

Admission Requirements:

Applicants should have an undergraduate degree in Computer Engineering, Electrical Engineering or other relevant discipline from an accredited institution (or its equivalent). All applicants must submit scores on the Graduate Record Examinations (GRE) verbal, quantitative, and analytical aptitude tests. International students must also achieve a minimum TOEFL score of 550 (pencil and paper) and 213 (computer-based). Applicants with undergraduate degrees in computer science, computer engineering or electrical engineering from an accredited institution are expected to have a GPA of at least 3.0 on a 4.0 scale. These students should have taken ECE 321 (Random Signal and Noise), or another equivalent course; ECE 333 (Signals and Systems); and CIS 112 (Introduction to Computing or equivalent proficiency in C++ programming).

Bridge Program: The curriculum requires a basic knowledge of computer and communications fundamentals, such as signals and systems (ECE 333), basic communication systems (ECE 481), programming (CS 112 or C++ programming), data structures and algorithms (CS 505), and computer organization (ECE 251). The bridge courses are usually selected from this list, but some additional bridge courses, appropriate to each student's background, may be required.

Degree Requirements:

Candidates must complete a minimum of 30 credits, 9 in core courses and 21 in elective courses; or 21 credits must be from ECE courses.

The required courses provide the basics of Internet Engineering. Electives are to be chosen from the available course pool to tailor the program to the student's professional needs and interests. This program utilizes graduate courses in Electrical and Computer Engineering, Computer and Information Science, Management Information Systems, and Management Programs at NJIT. They provide the necessary blend of education required for appropriate strength in Internet Engineering. All MS students are required to fulfill two semesters of ECE 791 (Graduate Seminar).

Core Courses (9 Credits):

		ECE 637	Internet and Higher-Layer Protocols (3 credits)
		ECE 683	Computer Network Design and Analysis (3 credits)
		CS 602	Java Programming (3 credits)

***Electives (21 Credits):

Select 15 credits if completing a master's thesis; 18 credits if completing a master's project; 21 credits if not completing either a master's project or a thesis.

		ECE 673	Random Signal Analysis I (3 credits)
		ECE 681	High Performance Routers and Switches (3 credits)
		ECE 685	Network Interface Design (3 credits)
		ECE 638	Network Management and Security (3 credits)
		ECE 639	Principles of Broadband Networks (3 credits)
		ECE 649	Compression in Multimedia Engineering (3 credits)
		ECE 645	Wireless Networks (3 credits)
		ECE 636	Computer Networking Laboratory (3 credits)
		CS 604	Client/Server Computing (3 credits)
		Mgmt 620	Management of Technology (3 credits)
		MIS 625	Management Strategies for E-Commerce (3 credits)
		MIS 636	Telecommunications: Policies and Regulations
		ECE 783	Computer Communication Networks (3 credits)
		ECE 745	Advanced Wireless Networks (3 credits)
		ECE 788	Selected Topics in Electrical and Computer Engineering (3 credits) ***or***
		ECE 789	Selected Topics in Electrical and Computer Engineering II (3 credits)

Project, Thesis (optional):

		ECE 700	Master's Project (3 credits)
		ECE 701	Master's Thesis (3 credits)

*** Other (new) courses related to Internet Engineering may be selected as electives with approval from the Graduate Advisor

Manufacturing Systems Engineering

Administered By: Department of Industrial and Manufacturing Engineering

Administrator

Chairperson	Athanassios Bladikas
Associate Chairperson	George Abdou
Program Director	Sanchoy K. Das

Faculty

Professors	Layek Abdel-Malek, Reggie J. Caudill, Sanchoy K. Das, Paul G. Ranky, Donald H. Sebastian, Stephen J. Tricamo, Carl Wolf
Associate Professors	George Abdou, Golgen Bengu, Athanassios Bladikas, Kevin J. Mcdermott, Arijit Sengupta*
Assistant Professors	Jian Yang

Advisors

Graduate Advisors	Sanchoy K. Das

* Joint appointment with Department of Engineering Technology

Degrees Offered: Master of Science in Manufacturing Systems Engineering

The manufacturing engineering discipline addresses problems and methods of manufacturing systems integration. The M.S. in Manufacturing Systems Engineering program emphasizes the interrelationships between manufacturing equipment, processes and controls, and their integration into production factories.

The curriculum is computer and multimedia intensive and includes the use and understanding of new technologies such as robotics, programmable logic controllers, microprocessors and computer-integrated manufacturing and their application in automated production, assembly, automated inspection, and automated packaging. Focus is on computer-aided design and computer-aided manufacturing. Automation laboratories are used that contain many state-of-the-art devices including several industrial robots, CNC millers, CNC lathes, computer vision systems, and a fully automated flexible manufacturing system.

Master of Science in Manufacturing Systems Engineering

This is an interdisciplinary program of advanced study for individuals with backgrounds in engineering, focusing on efficient production in technology-intensive manufacturing industries.

Admission Requirements:

Applicants should be graduates of an accredited undergraduate engineering program. Students with degrees in science may also be considered.

Bridge Program: Students who lack appropriate undergraduate preparation for the program are required to make up deficiencies by taking a program of courses that are designed in consultation with graduate advisors. These courses are taken in addition to the degree requirements and may include undergraduate courses.

Degree Requirements:

A minimum of 30 credits is required: 12 credits of core courses and 18 in an area of specialization. A master's project or thesis is optional.

Students select an area of specialization in consultation with the graduate advisor and must take a set of core, required and elective courses.

Seminar: All students who receive departmental or research-based awards must register each semester for MnE 791 Manufacturing Engineer Seminar.

Core:
12 credits:

		MnE 601	Manufacturing Systems (3 credits)
		MnE 602	Flexible and Computer Integrated Manufacturing (3 credits)
		MnE 603	Management of Manufacturing Systems (3 credits)
		MnE 654	Design for Manufacturability (3 credits)

Project, Thesis, Independent Study (optional):
The following optional courses are appropriate for all areas of specialization:

		MnE 700	Master's Project (3 credits)
		MnE 701	Master's Thesis (6 credits)
		MnE 725	Independent Study in Manufacturing (3 credits)

Area of Specialization:
The range of possible specializations is broad. Students should consult the program director in designing specializations and related degree requirements. Some examples follow.

Design for Manufacturability:
18 credits from:

		CE 736	Finite Element Methods in Structural and Continuum Mechanics (3 credits)
		IE 675	Safety in Facility and Product Design (3 credits)
		ME 620	Stress Methods in Mechanical Design (3 credits)
		ME 621	Energy Methods in Mechanical Design (3 credits)
		ME 622	Finite Element Methods in Mechanical Engineering (3 credits)
		ME 635	Computer-Aided Design (3 credits)
		ME 636	Mechanism Design: Analysis and Synthesis (3 credits)
		MnE 655	Concurrent Engineering (3 credits)

System Automation:
18 credits from:

		CS 651	Data Communications (3 credits)
		CS 652	Computer Networks-Architectures, Protocols and Standards (3 Credits)
		ECE 638	Network Management and Security (3 credits)
		ME 638	Computer-Aided Machining (3 credits)
		ME 735	Advanced Topics in Robotics (3 credits)
		MNE612	

Computer Control of Manufacturing Systems:
18 credits from:

		ECE 601	Linear Systems (3 credits)
		ECE 660	Control Systems I (3 credits)
		ECE 664	Real-time Computer Control Systems (3 credits)
		ECE 666	Control Systems II (3 credits)
		IE 624	Heuristic Methods (3 credits)
		ME 655	Introduction to Modern Control Methods (3 credits)
		ME 755	Adaptive Control Systems (3 credits)

Manufacturing Systems Analysis and Design:
18 credits from:

		CS 631	Data Management System Design (3 credits)
		CS 651	Data Communications (3 credits)
		ECE 683	Computer Network Design and Analysis (3 credits)
		IE616	
		IE 621	Systems Analysis and Simulation (3 credits)
		IE 622	Simulation and Risk Analysis in Operations Management (3 credits)
		IE 651	Industrial Simulation (3 credits)
		IE 652	Facilities Location and Plant Layout (3 credits)
		MnE 655	Concurrent Engineering (3 credits)

Management of Manufacturing Systems:
18 credits from:

		EM 602	Management Science (3 credits)
		EM 635	Management of Engineering Research and Development (3 credits)
		EM 636	Project Management (3 credits)
		EM 640	Distribution Logistics (3 credits)
		EM653	
		EM 660	Financing an Industrial Enterprise (3 credits)
		EM 691	Cost Estimating for Capital Projects (3 credits)
		EM 771	Operations Cost and Management Control (3 credits)
		IE 618	Engineering Cost and Production Economics (3 credits)
		IE 673	Total Quality Management (3 credits)
		IE 674	Quality Maintenance and Support Systems (3 credits)

Material Science and Engineering

Administered By: Committee for the Interdisciplinary Program in Materials Science and Engineering

Administration

Academic Director	Trevor A. Tyson

Degrees Offered: Master of Science in Materials Science and Engineering; Doctor of Philosophy in Materials Science and Engineering

This intercollegiate (CSLA and NCE), interdepartmental, and interdisciplinary degree program is intended for individuals with a strong background in science and/or engineering.

Master of Science in Materials Science and Engineering

Admissions Requirement

Applicants are expected to have an undergraduate degree from an accredited institution. A minimum undergraduate GPA of 3.0 on a 4.0 scale, or equivalent is normally required for admission. An undergraduate major in physics, chemistry, materials science, or a related engineering discipline is preferred. GRE quantitative scores of 700 or higher are highly desirable. Students from countries where English is not the native language should demonstrate TOEFL scores higher than 550 (pencil and paper) and 213 (computer-based).

Bridge Program

Students who lack appropriate undergraduate preparation for the program may be admitted and required to make up deficiencies by taking a program of courses which is designed in consultation with the graduate advisor. These courses are taken in addition to the degree requirements and may include undergraduate courses.

Degree Requirements

Candidates must complete a minimum of 30 credits, including 18 credits of required materials science courses and 12 credits in an area of specialization, which are selected in consultation with the program director or graduate advisor.

Seminar

In addition to the minimum 30 degree credits required, all students who receive program or research-based awards must enroll each semester in MtSE 791 Graduate Seminar.

Required:

		MtSE 601	Fundamentals of Engineering Materials (3 credits)
		MtSE 602	Thermodynamics of Materials (3 credits)
{		MtSE 619	Nano-scale Characterization of Materials (3 credits) ***or***
		ME 619	Nano-scale Characterization of Materials (3 credits)

9 credits from the following:

		MtSE 610	Mechanical Properties of Materials (3 credits)
		MtSE 648	NanoMaterials (3 credits)
		MtSE 655	Diffusion and Solid State Kinetics (3 credits)
		MtSE 681	Composite Materials (3 credits)
		MtSE 682	Introduction to Ceramics (3 credits)
		MtSE 688	Mathematical and Statistical Methods in Materials Science (3 credits)
		BME 672	Biomaterials (3 credits)
{		ChE 681	Polymerization-Principles and Practice (3 credits) ***or***
		CHEM681	
{		ChE 682	Polymer Structures and Properties (3 credits) ***or***
		CHEM682	
		ChE 602	Selected Topics in Chemical Engineering I (3 credits)
		ChE 664	Experiments and Simulations in Particle Technology (3 credits)
		ECE 657	Semiconductor Devices (3 credits)
		PHYS682	
		Phys 687	Physics of Materials (3 credits)

PROJECT OR THESIS:

Required of all students receiving program or research-based awards, optional for all others.

		MtSE 700	Master's Project (3 credits)
		MtSE 701	Master's Thesis (6 credits)

AREAS OF SPECIALIZATION:

The range of possible specialization is broad. Students should consult the graduate advisor in designing the area of specialization and related degree requirements. Three areas and suggested courses are listed below.

Electronic and Photonic Materials

		MtSE 681	Composite Materials (3 credits)
		MtSE 682	Introduction to Ceramics (3 credits)
		MtSE 687	Glass Science and Engineering (3 credits)
		MtSE 688	Mathematical and Statistical Methods in Materials Science (3 credits)
		MtSE 719	Physical Principles of Characterization of Solids (3 credits)
		MtSE 722	Science and Technology of Thin Films (3 credits)
		MtSE 723	Defects in Solids (3 credits)
		MtSE 724	Transport of Electrons and Phonons in Solids (3 credits)
		MtSE 725	Crystallography and Diffraction (3 credits)
		PHYS661	
		PHYS682	
		Phys 687	Physics of Materials (3 credits)
		PHYS762	
		PHYS763	
		PHYS771	
		PHYS781	
		PHYS789	
		ChE 664	Experiments and Simulations in Particle Technology (3 credits)

		ChE 702	Selected Topics in Chemical Engineering II (3 credits)
		Chem 611	Solid-State Inorganic Chemistry (3 credits)
		Chem 626	Chemistry of Contemporary Materials (3 credits)
		ECE 623	Fourier Optics (3 credits)
		ECE 625	Fiber and Integrated Optics (3 credits)
		ECE 626	Optoelectronics (3 credits)
		ECE 657	Semiconductor Devices (3 credits)
		ECE 658	VLSI Design I (3 credits)
		ECE 659	Fabrication Principles of Electronic and Optoelectronic Devices (3 credits)
		ECE 739	Laser Systems (3 credits)
		ECE 760	Solid-State Image Sensors (3 credits)

Polymer and Biomaterials

		MtSE 681	Composite Materials (3 credits)
		MtSE 682	Introduction to Ceramics (3 credits)
		MtSE 687	Glass Science and Engineering (3 credits)
		MtSE 688	Mathematical and Statistical Methods in Materials Science (3 credits)
		MtSE 719	Physical Principles of Characterization of Solids (3 credits)
		MtSE 722	Science and Technology of Thin Films (3 credits)
		MtSE 655	Diffusion and Solid State Kinetics (3 credits)
		BME 669	Engineering Physiology (3 credits)
		BME 672	Biomaterials (3 credits)
		BME 667	Bio-Control Systems (3 credits)
		BME 698	Selected Topics (3 credits)
{		ChE 681	Polymerization-Principles and Practice (3 credits) ***or***
		CHEM681	
{		ChE 682	Polymer Structures and Properties (3 credits) ***or***
		CHEM682	
		ChE 627	Introduction to Biomedical Engineering (3 credits)
		ChE 664	Experiments and Simulations in Particle Technology (3 credits)
		ChE 702	Selected Topics in Chemical Engineering II (3 credits)
		Chem 640	Polymer Chemistry (3 credits)
		Chem 643	Polymer Laboratory I (3 credits)
		Chem 645	Polymer Laboratory II (3 credits)
		Chem 661	Instrumental Analysis Laboratory (3 credits)
		Chem 673	Biochemistry (3 credits)
		Math 661	Applied Statistics (3 credits)
		ME 670	Introduction to Biomechanical Engineering (3 credits)
		ME 671	Biomechanics of Human Structure and Motion (3 credits)
		ME 675	Mechanics of Fiber Composites (3 credits)
		ME 676	Applied Plasticity (3 credits)
		ME 678	Engineering Design of Plastic Products (3 credits)
		ME 679	Polymer Processing Techniques (3 credits)
		ME 680	Polymer Processing Equipment (3 credits)

Courses in metallic biomaaterials and polymeric biomaterials offered at the University of Medicine and Dentistry of New Jersey may be taken as electives. See the program director/graduate advisor for information on how to register for them.

Particulate and Nano Materials

		MtSE 681	Composite Materials (3 credits)
		MtSE 682	Introduction to Ceramics (3 credits)
		MtSE 687	Glass Science and Engineering (3 credits)
		MtSE 688	Mathematical and Statistical Methods in Materials Science (3 credits)
		MtSE 719	Physical Principles of Characterization of Solids (3 credits)
		MtSE 722	Science and Technology of Thin Films (3 credits)
		MtSE 655	Diffusion and Solid State Kinetics (3 credits)
		BME 669	Engineering Physiology (3 credits)
		BME 672	Biomaterials (3 credits)
		ChE 681	Polymerization-Principles and Practice (3 credits) ***or***
		CHEM681	
		ChE 682	Polymer Structures and Properties (3 credits) ***or***
		CHEM682	
		ChE 627	Introduction to Biomedical Engineering (3 credits)
		PHYS661	
		PHYS682	
		Phys 687	Physics of Materials (3 credits)
		ME 675	Mechanics of Fiber Composites (3 credits)
		ME 676	Applied Plasticity (3 credits)
		ME 678	Engineering Design of Plastic Products (3 credits)

Other Fields of Materials Science and Engineering

		MtSE 655	Diffusion and Solid State Kinetics (3 credits)
		MtSE 681	Composite Materials (3 credits)
		MtSE 682	Introduction to Ceramics (3 credits)
		MtSE 687	Glass Science and Engineering (3 credits)
		MtSE 688	Mathematical and Statistical Methods in Materials Science (3 credits)
		MtSE 719	Physical Principles of Characterization of Solids (3 credits)
		MtSE 722	Science and Technology of Thin Films (3 credits)
		MtSE 723	Defects in Solids (3 credits)
		MtSE 724	Transport of Electrons and Phonons in Solids (3 credits)
		MtSE 725	Crystallography and Diffraction (3 credits)
		PHYS661	
		ChE 681	Polymerization-Principles and Practice (3 credits) ***or***
		CHEM681	
		ChE 682	Polymer Structures and Properties (3 credits) ***or***
		CHEM682	
		BME 672	Biomaterials (3 credits)
		BME 667	Bio-Control Systems (3 credits)
		BME 698	Selected Topics (3 credits)

		ChE 627	Introduction to Biomedical Engineering (3 credits)
		ChE 664	Experiments and Simulations in Particle Technology (3 credits)
		ChE 702	Selected Topics in Chemical Engineering II (3 credits)
		Chem 640	Polymer Chemistry (3 credits)
		Chem 643	Polymer Laboratory I (3 credits)
		Chem 645	Polymer Laboratory II (3 credits)
		Chem 661	Instrumental Analysis Laboratory (3 credits)
		Chem 673	Biochemistry (3 credits)
		Math 661	Applied Statistics (3 credits)
		ME 670	Introduction to Biomechanical Engineering (3 credits)
		ME 671	Biomechanics of Human Structure and Motion (3 credits)
		ME 675	Mechanics of Fiber Composites (3 credits)
		ME 676	Applied Plasticity (3 credits)
		ME 678	Engineering Design of Plastic Products (3 credits)
		ME 679	Polymer Processing Techniques (3 credits)
		ME 680	Polymer Processing Equipment (3 credits)
		PHYS682	
		Phys 687	Physics of Materials (3 credits)

Doctor of Philosophy in Materials Science and Engineering

This is an intercollegiate (CSLA and NCE), interdepartmental, and interdisciplinary degree program for superior students who wish to do advanced research in an area of materials science and engineering. Current areas of research include electronic and photonic materials, nano and particulate materials, polymer and biomaterials, and other areas of materials science and engineering.

Admission Requirements:

Applicants are expected to have an appropriate master's degree in materials science or related field, physics, chemistry, or engineering from an accredited institution. Students entering with a master's degree must have at least a 3.5 GPA on a 4.0 scale in previous graduate study. Highly qualified students with bachelor's degrees may be accepted directly into the doctoral program. These students must have at least a 3.5 GPA in undergraduate work.

Degree Requirements:

Students with an appropriate master's degree in materials science or related field, physics, chemistry or engineering, are required to complete a minimum of 60 credits beyond the master's degree: 24 credits of course work, 12 of which must be at the 700 level and none at the 500 level, and no less than 9 are materials science and engineering (MTSE) courses. A minimum of 36 credits of doctoral dissertation research is required. Specific course selection, the area of specialization and dissertation topics are approved by the program advisor on an individual basis.

Students entering with bachelor's degrees are required to complete a minimum of 78 credits: 42 credits of course work and 36 credits of doctoral dissertation research. For the course work, the required courses for the M.S. in Materials Science and Engineering are mandatory; no less than 24 credits must be materials science and engineering courses, and no less than 12 credits must be at the 700 level and none at the 500 level. Specific course selection, the area of specialization, and dissertation topics are approved by the program advisor on an individual basis.

Required:

For those entering with a master's degree:

24 credits of course work beyond the master's degree and 36 credits of MtSE 790 Doctoral Dissertation and every semester of MtSE 791 Graduate Seminar.

For those entering with a bachelor's degree:

42 credits of course work and 36 credits of MtSE 790 Doctoral Dissertation and every semester of MtSE 791 Graduate Seminar. Among the course work, the following 18 credits are mandatory.

		MTSE 601	
		MTSE 602	
		MtSE 619	Nano-scale Characterization of Materials (3 credits)

9 credits from the following:

		MtSE 610	Mechanical Properties of Materials (3 credits)
		MtSE 648	NanoMaterials (3 credits)
		MtSE 681	Composite Materials (3 credits)
		MtSE 682	Introduction to Ceramics (3 credits)
		MtSE 688	Mathematical and Statistical Methods in Materials Science (3 credits)
		BME 672	Biomaterials (3 credits)
		BME 667	Bio-Control Systems (3 credits)
		BME 698	Selected Topics (3 credits)
{		ChE 681	Polymerization-Principles and Practice (3 credits) ***or***
		CHEM681	
{		ChE 682	Polymer Structures and Properties (3 credits) ***or***
		CHEM682	
		Chem 640	Polymer Chemistry (3 credits)
		ChE 602	Selected Topics in Chemical Engineering I (3 credits)
		ChE 664	Experiments and Simulations in Particle Technology (3 credits)
		ECE 657	Semiconductor Devices (3 credits)
		PHYS682	
		Phys 687	Physics of Materials (3 credits)

Qualifying Examination

The student must pass a written and an oral qualifying examination. The written qualifying exam given every summer is administered to test general academic preparation and competence in the research of materials science and engineering. Within one year after passing the written qualifying exam, the student is required to pass the oral qualifying exam to achieve Ph.D. candidacy, in which the potential Ph.D. candidate presents a preliminary research proposal for approval by the dissertation committee. The student will be allowed two attempts to pass the written or oral qualifying exam.

The 4 topics of written qualifying exam are:

		MtSE 601	Fundamentals of Engineering Materials (3 credits)
		MtSE 602	Thermodynamics of Materials (3 credits)
		MtSE 619	Nano-scale Characterization of Materials (3 credits)

One of the following:

		MtSE 722	Science and Technology of Thin Films (3 credits)
		MtSE 648	NanoMaterials (3 credits)
		ChE 664	Experiments and Simulations in Particle Technology (3 credits)
{		ChE 681	Polymerization-Principles and Practice (3 credits) ***or***
		CHEM681	
		BME 672	Biomaterials (3 credits)

Formation of Dissertation Committee:

Within one year of passing the written qualifying examination, doctoral students must form a five-member dissertation committee that meets the approval of the graduate program director for materials science and engineering. The committee must include the dissertation advisor, three additional faculty members from the program, and at least one member from outside the program or NJIT.

Dissertation and Defense:

An oral presentation and public defense of the doctoral dissertation is required.

Areas of Specializations

The range of possible specializations is broad. Students should consult the graduate advisor in designing the area of specializations and related degree requirements. Three focused areas and suggested courses are listed below.

Electronic and Photonic Materials

		MtSE 681	Composite Materials (3 credits)
		MtSE 682	Introduction to Ceramics (3 credits)
		MtSE 687	Glass Science and Engineering (3 credits)
		MtSE 688	Mathematical and Statistical Methods in Materials Science (3 credits)
		MtSE 719	Physical Principles of Characterization of Solids (3 credits)
		MtSE 722	Science and Technology of Thin Films (3 credits)
		MtSE 723	Defects in Solids (3 credits)
		MtSE 724	Transport of Electrons and Phonons in Solids (3 credits)
		MtSE 725	Crystallography and Diffraction (3 credits)
		PHYS661	
		PHYS682	
		Phys 687	Physics of Materials (3 credits)
		PHYS762	
		PHYS763	
		PHYS771	
		PHYS781	
		PHYS789	
		PHYS661	
		ChE 627	Introduction to Biomedical Engineering (3 credits)
		ChE 664	Experiments and Simulations in Particle Technology (3 credits)
		ChE 702	Selected Topics in Chemical Engineering II (3 credits)
		Chem 611	Solid-State Inorganic Chemistry (3 credits)
		Chem 626	Chemistry of Contemporary Materials (3 credits)
		ECE 623	Fourier Optics (3 credits)
		ECE 625	Fiber and Integrated Optics (3 credits)
		ECE 626	Optoelectronics (3 credits)
		ECE 657	Semiconductor Devices (3 credits)
		ECE 658	VLSI Design I (3 credits)
		ECE 659	Fabrication Principles of Electronic and Optoelectronic Devices (3 credits)
		ECE 739	Laser Systems (3 credits)
		ECE 760	Solid-State Image Sensors (3 credits)

Particulate and Nano Materials

Select 12 credits if completing a master's thesis; 15 credits if completing a master's project; 18 credits if not completing either a master's project or thesis from:

		MtSE 681	Composite Materials (3 credits)
		MtSE 682	Introduction to Ceramics (3 credits)
		MtSE 687	Glass Science and Engineering (3 credits)
		MtSE 688	Mathematical and Statistical Methods in Materials Science (3 credits)
		MtSE 719	Physical Principles of Characterization of Solids (3 credits)
		MtSE 722	Science and Technology of Thin Films (3 credits)
		MtSE 725	Crystallography and Diffraction (3 credits)
		MtSE 648	NanoMaterials (3 credits)
		ChE 664	Experiments and Simulations in Particle Technology (3 credits)
		Chem 640	Polymer Chemistry (3 credits)
		BME 672	Biomaterials (3 credits)
{		ChE 681	Polymerization-Principles and Practice (3 credits) ***or***
		CHEM681	
{		ChE 682	Polymer Structures and Properties (3 credits) ***or***
		CHEM682	
		BME 669	Engineering Physiology (3 credits)
		BME 672	Biomaterials (3 credits)
		ChE 627	Introduction to Biomedical Engineering (3 credits)
		PHYS661	
		PHYS682	
		Phys 687	Physics of Materials (3 credits)
		ME 675	Mechanics of Fiber Composites (3 credits)
		ME 676	Applied Plasticity (3 credits)
		ME 678	Engineering Design of Plastic Products (3 credits)

Polymers and Biomaterials

Select 12 credits if completing a master's thesis; 15 credits if completing a master's project; 18 credits if not completing either a master's project or thesis from:

		MTSE 681	
		MtSE 682	Introduction to Ceramics (3 credits)
		MtSE 687	Glass Science and Engineering (3 credits)
		MtSE 688	Mathematical and Statistical Methods in Materials Science (3 credits)
		MtSE 719	Physical Principles of Characterization of Solids (3 credits)
		MtSE 722	Science and Technology of Thin Films (3 credits)
		MtSE 725	Crystallography and Diffraction (3 credits)
		BME 672	Biomaterials (3 credits)
		BME 667	Bio-Control Systems (3 credits)
		BME 698	Selected Topics (3 credits)
		ChE 681	Polymerization-Principles and Practice (3 credits) ***or***

		CHEM681	
		ChE 682	Polymer Structures and Properties (3 credits) ***or***
		CHEM682	
		BME 669	Engineering Physiology (3 credits)
		ChE 627	Introduction to Biomedical Engineering (3 credits)
		ChE 664	Experiments and Simulations in Particle Technology (3 credits)
		ChE 702	Selected Topics in Chemical Engineering II (3 credits)
		Chem 640	Polymer Chemistry (3 credits)
		Chem 643	Polymer Laboratory I (3 credits)
		Chem 645	Polymer Laboratory II (3 credits)
		Chem 661	Instrumental Analysis Laboratory (3 credits)
		Chem 673	Biochemistry (3 credits)
		Math 661	Applied Statistics (3 credits)
		ME 670	Introduction to Biomechanical Engineering (3 credits)
		ME 671	Biomechanics of Human Structure and Motion (3 credits)
		ME 675	Mechanics of Fiber Composites (3 credits)
		ME 676	Applied Plasticity (3 credits)
		ME 678	Engineering Design of Plastic Products (3 credits)
		ME 679	Polymer Processing Techniques (3 credits)
		ME 680	Polymer Processing Equipment (3 credits)

Courses in metallic biomaterials and polymeric biomaterials offered at the University of Medicine and Dentistry of New Jersey may be taken as electives. See the graduate advisor for information on how to register for them.

Other Fields of Materials Science and Engineering

Select 12 credits if completing a master's thesis; 15 credits if completing a master's project; 18 credits if not completing either a master's project or thesis from:

		MTSE 681	
		MtSE 682	Introduction to Ceramics (3 credits)
		MtSE 687	Glass Science and Engineering (3 credits)
		MtSE 688	Mathematical and Statistical Methods in Materials Science (3 credits)
		MtSE 719	Physical Principles of Characterization of Solids (3 credits)
		MtSE 722	Science and Technology of Thin Films (3 credits)
		MtSE 723	Defects in Solids (3 credits)
		MtSE 724	Transport of Electrons and Phonons in Solids (3 credits)
		MtSE 725	Crystallography and Diffraction (3 credits)
		PHYS661	
		BME 672	Biomaterials (3 credits)
		BME 667	Bio-Control Systems (3 credits)
		BME 698	Selected Topics (3 credits)
		ChE 681	Polymerization-Principles and Practice (3 credits) ***or***
		CHEM681	
		ChE 682	Polymer Structures and Properties (3 credits) ***or***

		CHEM682	
		ChE 627	Introduction to Biomedical Engineering (3 credits)
		ChE 664	Experiments and Simulations in Particle Technology (3 credits)
		ChE 702	Selected Topics in Chemical Engineering II (3 credits)
		Chem 640	Polymer Chemistry (3 credits)
		Chem 643	Polymer Laboratory I (3 credits)
		Chem 645	Polymer Laboratory II (3 credits)
		Chem 661	Instrumental Analysis Laboratory (3 credits)
		Chem 673	Biochemistry (3 credits)
		Math 661	Applied Statistics (3 credits)
		ME 670	Introduction to Biomechanical Engineering (3 credits)
		ME 671	Biomechanics of Human Structure and Motion (3 credits)
		ME 675	Mechanics of Fiber Composites (3 credits)
		ME 676	Applied Plasticity (3 credits)
		ME 678	Engineering Design of Plastic Products (3 credits)
		ME 679	Polymer Processing Techniques (3 credits)
		ME 680	Polymer Processing Equipment (3 credits)
		PHYS682	
		Phys 687	Physics of Materials (3 credits)

Catalog and curricula information approved by the relevant academic department.

Mechanical Engineering

Administered By: Department of Mechanical Engineering

Administration

Interim Chairperson	Rajpal S. Sodhi
Associate Chair.	Kwabena A. Narh
Graduate Advisor	Zhiming Ji

Faculty

Distinguished Professors	Robert Altenkirch, William C. Van Buskirk
Professors	Rong-yaw Chen, Ian S. Fischer, Avraham Harnoy, Bernard Koplik, Ernest S. Geskin, Kwabena A. Narh, Anthony D. Rosato, Pushpendra Singh, Rajpal S. Sodhi, Chao Zhu
Associate Professors	Pasquale J. Florio, Zhiming Ji, I J. Rao
Special Lecturers	Andrea Giorgioni, Harry V. Kountouras, Benjamin J. Serico, Herli Surjanhata

Degrees Offered: Master of Science in Mechanical Engineering; Doctor of Philosophy in Mechanical Engineering

Mechanical engineering is concerned with the design, development, manufacture, and operation of a wide variety of energy conversion and machine systems. The research and education facilities of the department are housed in the 60,000-square-foot Mechanical Engineering Building. Major research laboratories include Particle Technology, Energetic Materials, Machine Vision and Motion Analysis, Waterjet Machining, Robotics and Intelligent Manufacturing, Bearing Lubrication, and Plastic Processing and Analysis.

Master of Science in Mechanical Engineering

A program for engineering graduates who want advanced professional preparation and further graduate study in mechanical engineering.

Admission Requirements:

Applicants are expected to have an undergraduate degree in mechanical engineering or a related field. General admissions requirements for master's programs as described in this catalog apply to applicants to the M.S. in Mechanical Engineering. Sufficient preparation in science and mathematics to complete the course of study is also necessary.

Bridge Program: Students who lack appropriate undergraduate preparation may be admitted and are asked to make up deficiencies by taking a program of courses that is designed in consultation with the graduate advisor. These courses are taken in addition to the degree requirements and may include undergraduate courses.

** Degree Requirements:

The Master of Science in Mechanical Engineering program offers three areas of specialization.

CAD/CAM, Mechanisms & Control - computer aided engineering, mechanisms, biomechanical & medical devices, robotics and controls.

Mechanics & Material Processing - tissues & biomechanics, continuum mechanics, plastics, micro/nano materials, particle technology.

Thermo-Fluid Systems & Energy - biofluids, computational & multiphase fluid dynamics, granular science, HVAC, energy.

The student consults the graduate advisor to plan and develop an individualized and cohesive sequence of courses that meet program requirements of at least 30 degree credits.

Seminar: In addition to the minimum 30 degree credits required, every student must take a minimum of two semesters of ME 794 Mechanical Engineering Colloquium. Students who receive departmental or research-based awards must enroll every semester in ME 794.

Project, Thesis:

A thesis is required of all students who receive departmental or research-based awards. For all others, a project or thesis is optional.

ME 700	Master's Project (3 credits)
ME 701	Master's Thesis (6 credits)

Required Courses: *(12 credits)*

ME 616	Matrix Methods in Mechanical Engineering (3 credits) ***or***
Math 651	Methods of Applied Mathematics I (3 credits)

and select 9 credits from:

ME 610	Applied Heat Transfer (3 credits)
ME 611	Dynamics of Incompressible Fluids (3 credits)
ME 614	Continuum Mechanics (3 credits)
ME 620	Stress Methods in Mechanical Design (3 credits)
ME 635	Computer-Aided Design (3 credits)

Elective ME Graduate Courses: *(9 or more credits)*

ME 607	Advanced Thermodynamics (3 credits)
ME 621	Energy Methods in Mechanical Design (3 credits)
ME 622	Finite Element Methods in Mechanical Engineering (3 credits)
ME 624	Microlevel Modeling in Particle Technology (3 credits)
ME 625	Introduction to Robotics (3 credits)
ME 630	Analytical Methods in Machine Design (3 credits)
ME 636	Mechanism Design: Analysis and Synthesis (3 credits)
ME 637	Kinematics of Spatial Mechanisms (3 credits)
ME 655	Introduction to Modern Control Methods (3 credits)
ME 670	Introduction to Biomechanical Engineering (3 credits) ***or***
BME 670	Introduction to Biomechanical Engineering (3 credits)
ME 678	Engineering Design of Plastic Products (3 credits)
ME 679	Polymer Processing Techniques (3 credits)

The following PhD level courses are also available:

ME 712	Mechanics of Viscous Fluids (3 credits)
ME 713	Non-Newtonian Fluid Dynamics (3 credits)
ME 714	Principles of Particulate Multiphase Flows (3 credits)
ME 717	Selected Topics in Mechanical Engineering I (3 credits)
ME 718	(Selected Topics in Mechanical Engineering II) (3 credits)
ME 720	(Selected Topics in Mechanical Engineering IV) (3 credits)
ME 735	Advanced Topics in Robotics (3 credits)
ME 736	Advanced Mechanism Design (3 credits)

General Elective Courses: *(9 or less credits)*

Graduate courses from other departments.

Doctor of Philosophy in Mechanical Engineering

This is a program for superior students with master's degrees in mechanical engineering or allied fields who wish to do advanced research in an area of mechanical engineering. In exceptional circumstances, highly qualified students with bachelor's degrees in mechanical engineering may be accepted directly into the doctoral program.

Admission Requirements:

Applicants should have a master's degree from an accredited institution, and have successfully taken courses in applied mathematics and engineering sciences. In addition, applicants must fulfill the admissions requirements for doctoral study as specified in the Admissions section of this catalog. Students who lack an appropriate background will be required to take additional courses before gaining admission to the program. These courses are prescribed by the department on an individual basis and may not be applied as degree credit.

Degree Requirements:

Specific degree requirements and dissertation topics are approved by the department on an individual basis. Before being permitted to register for dissertation research, students must complete courses specified by the department, pass qualifying examinations and demonstrate that there are facilities and a faculty member available to supervise the research. Should dissertation research not be completed within the normal 36 credits of ME 790, students must register for a minimum of 3 credits per semester until the dissertation is completed and approved. An oral defense of the dissertation is required after submission of the final document to the department for approval.

Qualifying Examination: Once admitted to the program, candidates are expected to pass a qualifying examination. Qualifying in Subject Area will be based on students passing a minimum of 4 Mechanical Engineering graduate courses, one of which must be ME 616, with a cumulative grade point average of not less than 3.6/4.0. Qualifying in Examination of Research Potential will be based on the student's formal research prospectus submitted in written form and an oral examination concerned with student's research ability and general knowledge of mechanical engineering.

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* Note: Before registering for courses, all students must submit a Graduate Registration Form and all new students must obtain approval from the graduate advisor.

Occupational Safety and Health Engineering

Administered By: Department of Industrial and Manufacturing Engineering

Administration

Chairperson	Athanassios Bladikas
Associate Chairperson	George Abdou
Program Director	Arijit Sengupta

Faculty

Professors	Layek Abdel-Malek, Reggie J. Caudill, Sanchoy K. Das, Paul G. Ranky, Stephen J. Tricamo, Carl Wolf
Associate Professors	George Abdou, Golgen Bengu, Athanassios Bladikas, Kevin J. Mcdermott, Arijit Sengupta, Jian Yang

* Joint appointment with the Department of Engineering Technology

Degrees Offered: Master of Science in Occupational Safety and Health Engineering

The curriculum has been designed in accordance with the National Institute for Occupational Safety and Health (NIOSH), which sponsors the program. Through course work and research, individuals are exposed to all of the principal areas of concern to the entry-level safety professional, including how technology and hazardous materials affect the safety of the workplace.

NJIT's program is just one of a handful offered in the United States and the only master's-level program in New Jersey. NIOSH offers a limited number of stipends and tuition remission grants to qualified students.

Master of Science in Occupational Safety and Health Engineering

This program educates engineers in the specialty of occupational safety and health. Upon graduation, students are able to assume both the technical and managerial responsibilities of safety professionals.

Admission Requirements:

An accredited bachelor's degree in an engineering or scientific field is normally required.

Bridge Program: Students who lack an appropriate background may be admitted and required to make up deficiencies by taking a program of courses that is designed in consultation with graduate advisors. These courses are taken in addition to the degree requirements and may include undergraduate courses.

Degree Requirements:

A minimum of 36 credits is required.

Seminar: In addition to the minimum 36 degree credits required, all students who receive departmental or research-based awards must enroll each semester in IE 791 Graduate Seminar.

Required:

18 credits:

		EM 633	Legal Aspects of Health and Safety (3 credits)
		IE 604	Advanced Engineering Statistics (3 credits)
		IE 614	Safety Engineering Methods (3 credits)
		IE 615	Industrial Hygiene and Occupational Health (3 credits)
		IE 665	Applied Industrial Ergonomics (3 credits)
		IE 685	Systems Safety (3 credits)

Thesis:

Required for NIOSH; trainees; optional for all others.

		IE 701	Master's Thesis (6 credits)

Elective:

Select 12 credits if completing a master's thesis; 18 credits if not completing a master's thesis.

		BME 670	Introduction to Biomechanical Engineering (3 credits)
		BME 671	Biomechanics of Human Structure and Motion (3 credits)
		EvSc 603	Hazardous Waste Operations and Emergency Response (3 credits)
		EvSc 614	Quantitative Environmental Risk Assessment (3 credits)
		EvSc 616	Toxicology for Engineers and Scientists (3 credits)
		IE 608	Product Liability Control (3 credits)
		IE 661	Man-Machine Systems (3 credits)
		IE 662	Cognitive Engineering (3 credits)
		IE 664	Advanced Ergonomics (3 credits)
		IE 669	Human Design Factors in Engineering (3 credits)
		IE 675	Safety in Facility and Product Design (3 credits)
		IE 681	Interdisciplinary Seminar in Occupational Safety and Health (1 credit)
		IE 682	Industrial Safety and Health Evaluation (3 credits)
		IE700	
		IE 725	Independent Research (3 credits)
		ME 660	Noise Control (3 credits)

Catalog and curricula information approved by the relevant academic department.

Pharmaceutical Engineering

Administered By: Otto H. York Department of Chemical, Biological and Pharmaceutical Engineering

Administration

Program Director	Piero M. Armenante

Program Objective:

The Master of Science Program in Pharmaceutical Engineering is a program developed and administered by the Otto H. York Department of Chemical, Biological and Pharmaceutical Engineering at NJIT. The primary objective of the program is to educate professionals and provide them with the skills required to work in the pharmaceutical field, with particular emphasis on the engineering aspects of drug manufacturing, pharmaceutical production, pharmaceutical development, and pharmaceutical operations.

The pharmaceutical/medical technology industry is the largest manufacturing industry in New Jersey. New Jersey is home to the headquarters of more global pharmaceutical and medical technology companies than any other state in the country, or any single country throughout the world. NJIT's M.S. program in Pharmaceutical Engineering provides the intellectual climate and the necessary tools needed to prepare students for positions and career advancement within the industry, based on the rigorous technological requirements of this highly regulated work environment.

The program is designed to provide opportunities for specialization in such areas as pharmaceutical processing and manufacturing, validation and regulatory issues in the pharmaceutical industry, pharmaceutical facility design, pharmaceutical packaging technology, reaction engineering for pharmaceutical production, pharmaceutical separation processes, pharmacokinetics and drug delivery, molecular modeling for drug discovery, pharmaceutical synthesis, fluid mixing in the pharmaceutical industry, instrumental analysis, and industrial quality control.

Master of Science in Pharmaceutical Engineering

Admission Requirements:

An undergraduate degree in chemical engineering or, in most cases, mechanical engineering, with a cumulative grade point average (GPA) of at least 3.0 on a 4.0 scale is usually required. Applicants with: (1) a science degree, (2) an engineering degree in a discipline other than chemical or mechanical engineering, or (3) a GPA below 3.0 but at least 2.8, may be conditionally admitted to the program. Conditions may involve completion of a bridge program designed on a case-by-case basis, and typically requiring taking extra bridge courses, as further explained below. Depending on the background of the student, admission conditions may additionally require taking undergraduate courses (e.g., chemistry) or graduate courses. Bridge and undergraduate courses do not count toward degree credit; graduate-level courses do.

Submission of Graduate Record Examination (GRE) scores is encouraged in all cases, and required of those seeking financial support and those whose last prior degree is from an institution outside the United States. International students must also submit scores from the Test of English as a Foreign Language (TOEFL). According to university policy, a minimum TOEFL score of 550 (pencil and paper) and 213 (computer-based) is required.

The admission requirements described above can be partially relaxed for applicants with significant industrial experience in the pharmaceutical industry (5+ years). The admission requirements for such candidates will be established on a case-by-case basis, and will be determined through an interview with the prospective student and the submission of letters of support attesting the level of experience attained.

Bridge Program:

The Pharmaceutical Engineering program has been designed so that applicants with different backgrounds can be admitted. Nevertheless, the program is strongly oriented toward the engineering component of "Pharmaceutical Engineering". In addition, since the pharmaceutical industry is a chemistry-based industry a chemical engineering background is the most appropriate to enter the program (mechanical engineers are also generally well prepared to enter the program). This implies that students who have a science background (e.g., a chemistry or pharmacy B.S. degree) or an engineering degree in a discipline other than chemical or, possibly, mechanical engineering, may be required to take a bridge program.

Depending on the background of the applicant this bridge program may consist of up to (but generally speaking less, at least for students with engineering degrees) three 3-credit courses (PhEn 500, PhEn 501 and PhEn 502) specifically designed to provide non-chemical engineers with the necessary prerequisites to enter the program. The bridge courses cover a variety of topics, such as differential equations, statistics and business math (PhEn 500), mass balances, thermodynamics, and chemical kinetics (PhEn 501), and fluid flow, heat transfer and mass transfer (PhEn 502).

A grade point average of at least 3.0 must be achieved in the bridge courses. Students should pay special attention to the successful completion of the bridge courses, since failure to do so may preclude them from enrolling in regular PhEn courses. PhEn 500 and PhEn 501 can and should be taken concurrently. Both courses are only offered in the fall semester. Successful completion of both PhEn 500 and PhEn 501 is required to enroll in PhEn 502, which is offered only in the spring semester. Students must take the bridge courses before taking any other PhEn courses, with the exception of PhEn 601 and PhEn 604, which can be taken concurrently with the bridge courses. As already mentioned, admission conditions may also include taking additional undergraduate or graduate courses, if needed.

Degree Requirements:

The Master of Science in Pharmaceutical Engineering is a 30-credit program structured along two different tracks. The two tracks have a common 15-credit core. Each track has an additional 6-credit track-core, as described below. Each track has 9 credits of electives selected by the student in consultation with, and subject to, the approval of the program advisor for the selected track

Students have the option of fulfilling 6 of the 9 credits of electives by doing a Master's Thesis. The thesis option is primarily, but not exclusively, meant for full-time students. Full-time students receiving support (full or partial) must complete a Master's Thesis. Part-time students working in the pharmaceutical industry are encouraged to pursue a Master's Thesis, possibly conducted at their site and in collaboration with their supervisor.

Students must maintain an overall cumulative grade point average of at least 3.0 throughout their academic career. Students are certified for graduation only if they:

- achieve an OVERALL cumulative grade point average of at least 3.0; and
- achieve a grade point average of at least 3.0 in the required seven CORE COURSES; and
  achieve a grade point average of at least 3.0 in the BRIDGE COURSES.

Students may not repeat a course without approval of both the Program Director and the Office of Graduate Studies, located in the East Building, Suite 140. The grade received in a repeated course will replace the original grade in the calculation of the cumulative grade point average, although the first grade will still appear on the transcript. A MAXIMUM OF TWO COURSES MAY BE REPEATED. Students who receive an F in a course are required to repeat the course.

Program of Study:

The program of study includes common core courses, track-specific core courses, elective courses, and, if the students so chooses, a thesis (in lieu of some elective courses), as specified below. The common core courses cover a variety of topics ranging from drug dosage forms to drug manufacturing processes, validation and regulatory issues, design criteria and unit operations for pharmaceutical processes, pharmacokinetics and drug delivery.

The program has two tracks, i.e.:

- Track 1 - Process Development and Design for Drug Substance Manufacturing. This track is focused on the engineering aspects of chemical reaction and separation processes required for the manufacturing of active pharmaceutical ingredients.
- Track 2 - Process Development and Design for Drug Product Manufacturing. This track is focused on the engineering aspects of processes required for the manufacturing of final drug products.

All students must take the same five (5) common core courses as well as the two (2) track-specific core courses for the track that they have selected. Irrespective of the track selected, the total number of core courses (7) and the corresponding core credits (21) are the same for both tracks.

Course Requirements:

- Five (5) core courses common to both tracks (3 credits each; 15 credits total), as follows:

		PhEn 601	Principles of Pharmaceutical Engineering (3 credits)
		PhEn 603	Pharmaceutical Unit Operations: Processing of Liquid and Dispersed Phase Systems (3 credits)
		PhEn 604	Validation and Regulatory Issues in the Pharmaceutical Industry (3 credits)
		PhEn 606	Pharmaceutical Unit Operations: Solids Processing (3 credits)
		PhEn 618	Principles of Pharmacokinetics and Drug Delivery (3 credits)

- Two (2) additional core courses specific to the track selected (3 credits each; 6 credits total), as follows:

Track 1 � Process Development and Design for Drug Substance Manufacturing:

		PhEn 612	Pharmaceutical Reaction Engineering (3 credits)
		PhEn 614	Pharmaceutical Separation Processes (3 credits)

Track 2 � Process Development and Design for Drug Product Manufacturing:

		PhEn 602	Pharmaceutical Facility Design (3 credits)
		PhEn 605	Pharmaceutical Packaging Technology (3 credits)

- Three (3) additional elective courses (3 credits each) selected from the list of available courses (9 credits total). Electives can be selected from among pharmaceutical engineering courses (such as the courses in the track not chosen by the student), as well as appropriate courses in disciplines such as chemical engineering, mechanical engineering, industrial engineering, biomedical engineering, chemistry, biology, mathematics, and others. A partial list of electives is provided below.

M.S. THESIS:

Students who are required, or choose, to do a thesis must take 6 credits of PhEn 701 (Master's Thesis) in lieu of 6 credits worth of elective courses. Part-time students working in the pharmaceutical industry are eligible and encouraged to pursue the thesis option. NJIT requires that a student must register for thesis during the last semester before graduation, even if this requires taking addition thesis credit beyond the required 6.

List of Elective Courses:

The following is a non-exhaustive, partial list of courses that can be taken as elective courses [all courses are 3-credits unless otherwise stated]:

		PhEn 602	Pharmaceutical Facility Design (3 credits)
		PhEn 605	Pharmaceutical Packaging Technology (3 credits)
		PhEn 612	Pharmaceutical Reaction Engineering (3 credits)
		PhEn 614	Pharmaceutical Separation Processes (3 credits)
		PHEN616	
		PhEn 700	Master's Thesis (3 credits)
		PhEn 701	Master's Thesis (6 credits)
		PhEn 702	Selected Topics in Pharmaceutical Engineering (3 credits)
		PhEn 725	Independent Study (3 credits)
		BME 627	Introduction to Biomedical Engineering (3 credits)
		BME 672	Biomaterials (3 credits)
		BME 675	Computer Methods in Biomedical Engineering (3 credits)
		ChE 611	Thermodynamics (3 credits)
		ChE 624	Transport Phenomena I (3 credits)
		ChE 626	Mathematical Methods in Chemical Engineering (3 credits)
		ChE 628	Biochemical Engineering (3 credits)
		ChE 656	Industrial Catalysis: Fundamentals & Applications (3 credits)
		ChE 675	Statistical Thermodynamics (3 credits)
		ChE 681	Polymerization-Principles and Practice (3 credits)

		Chem 601	Special Topics in Chemistry I (3 credits)
		Chem 602	Advanced Organic Chemistry II: Reactions (3 credits)
		Chem 603	Advanced Organic Chemistry Laboratory (3 credits)
		Chem 605	Advanced Organic Chemistry I: Structure (3 credits)
		Chem 606	Physical Organic Chemistry (3 credits)
		Chem 644	Fundamentals of Adhesion (3 credits)
		Chem 658	Advanced Physical Chemistry (3 credits)
		Chem 661	Instrumental Analysis Laboratory (3 credits)
		Chem 664	Advanced Analytical Chemistry (3 credits)
		Chem 673	Biochemistry (3 credits)
		CS 610	Data Structures and Algorithms (3 credits)
		CS 631	Data Management System Design (3 credits)
		EM 636	Project Management (3 credits)
		EM 637	Project Control (3 credits)
		EM 640	Distribution Logistics (3 credits)
		IE 604	Advanced Engineering Statistics (3 credits)
		IE 605	Engineering Reliability (3 credits)
		IE 618	Engineering Cost and Production Economics (3 credits)
		IE 672	Industrial Quality Control (3 credits)
		IE 673	Total Quality Management (3 credits)
		IE 674	Quality Maintenance and Support Systems (3 credits)
		IE 704	Sequencing and Scheduling (3 credits)
		ME 624	Microlevel Modeling in Particle Technology (3 credits)
		ME 664	Experiments and Simulations in Particle Technology (3 credits)
		MnE 601	Manufacturing Systems (3 credits)
		MnE 602	Flexible and Computer Integrated Manufacturing (3 credits)

Student Involvement in Research:

In addition to taking courses, students have the opportunity to work, one-on-one, with faculty members on research projects in areas of common interest, allowing maximum flexibility for independent work, and providing students with valuable research experience. Students have the option to complete a Master's thesis. PART-TIME STUDENTS WORKING IN THE PHARMACEUTICAL INDUSTRY ARE ENCOURAGED TO PURSUE A MASTER'S THESIS, POSSIBLY CONDUCTED AT THEIR SITE AND IN COLLABORATION WITH THEIR SUPERVISOR.

Qualified and research oriented students have the option of continuing their studies at NJIT by pursuing a Ph.D. in chemical engineering, industrial engineering, chemistry, or related disciplines. The NJIT-Industry Collaborative Ph.D. Program allows greater flexibility to industrial students who are interested in pursuing their Ph.D. while working full-time in industry.

For further information please contact:

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University Heights, Newark, NJ 07102-1982
Phone: 973-596-3548
Fax: 973-596-8436
Email: piero.armenante@njit.edu

Physics

Administered By: Physics Departments of NJIT and Rutgers-Newark

Administration

Chairperson (NJIT)	Dale E. Gary
Chairperson (Rutgers-Newark)	Zhen Wu
Associate Chairpersons (NJIT)	Haimin Wang
Joint Graduate Program Director and Graduate Advisor	N M. Ravindra
Joint Director of Undergraduate Physics Programs	John F. Federici
Administrative Coordinator	Renee Crawley

NJIT Faculty

Distinguished Professors	Philip R. Goode, Roland A. Levy, Haimin Wang
Professors	Leon J. Buteau, Ken K. Chin, John F. Federici, N M. Ravindra, Dale E. Gary, Gordon A. Thomas, Trevor A. Tyson
Associate Professors	Andrei Sirenko, Andrew J. Gerrard, Nissim M. Towfik, Onofrio L. Russo
Assistant Professors	Armen K. Jermakian, Wenda Cao, Camelia Prodan, Tao Zhou
Distinguished Research Professors	Louis J. Lanzerotti
Research Professors/Special Lecturers	Reginald Farrow, Moses Fayngold, Anthony T. Fiory, Oktay H. Gokce, Richard H. Janow, Jeongwoo Lee, Hee C. Lim, Libarid A. Maljian, Gelu M. Nita, Halina Opyrchal, Jan Opyrchal, Slawomir Piatek, Vitaly A. Shneidman

Rutgers- Newark Faculty

Professors Rank II	Daniel Murnick
Associate Professor	Zhen Wu

Degrees Offered: Master of Science in Physics; Doctor of Philosophy in Physics. Both degrees are offered jointly by NJIT and Rutgers-Newark.

The NJIT and Rutgers-Newark departments of physics offer a unique opportunity to pursue master's and doctoral degree physics in a joint program combining the resources of two of New Jersey's public research universities.

Interdisciplinary physics research is available in collaboration with faculties of NJIT, Rutgers-Newark and Rutgers-New Brunswick, and UMDNJ in areas such as device physics, materials research, ultrafast optical and optoelectronic phenomena, imaging technology, surface physics, free electron laser physics, biophysics, discharge physics, solar physics, and applied laser physics. Cooperative research efforts are underway with the National Solar Observatory, Lucent Technologies Bell Labs Innovations, U.S. Army Research Laboratory, and other industrial and federal research laboratories.

Master of Science in Physics

The program is for students with an undergraduate degree in physics, applied physics, or engineering, who wish to apply physics to optical science, microelectronics, device physics, materials science, surface science, laser physics, solar phenomena, and other related areas.

Admission Requirements:

A bachelor's degree in physics, applied physics, or related areas from an accredited institution is required. An undergraduate GPA above 3.0 is required. Students must submit GRE (general test) scores. In addition, applicants are required to provide letters of recommendation from their previous academic institutions. Students for whom English is not their native language are required to have TOEFL scores no lower than 550 (pencil and paper) and 213 (computer-based).

Degree Requirements:

A minimum of 30 degree credits (600 or 700 level), including a 6-credit thesis or a 3-credit project is required. Of the 30 credits, 18 must be physics courses (including 3 credits of mathematical physics or applied mathematics). The remaining 12 to 15 credits are elective courses.

Seminar: In addition to the minimum 30 degree credits required, all students who receive departmental or research-based awards must enroll each semester in R755:791 Applied Physics Seminar.

Required:

12 credits:

R755:611	Advanced Classical Mechanics (3 credits)
R755:621	Classical Electrodynamics (3 credits)
R755:631	Quantum Mechanics (3 credits)
R755:641	Statistical Mechanics (3 credits)

Project or Thesis (required):

3 credits:

R755:700	Master's Project (3 credits) ***or***
R755:701	Master's Thesis (6 credits)

Elective:

12 credits if completing a master's thesis; 15 credits if completing a master's project: Selected in consultation with a graduate advisor.

Doctor of Philosophy in Physics

This program is for superior students in applied physics who are interested in and committed to scholarly research.

Admission Requirements:

Applicants are expected to have a master's degree in physics, applied physics, or related engineering disciplines from an accredited institution. Highly qualified students with bachelor's degrees may be accepted directly into the doctoral program. A GPA of at least 3.5 in undergraduate and previous graduate studies is normally required for admission. The GRE (general test) and advanced (physics) test scores are required. Applicants are required to provide three letters of recommendation from their previous academic institutions. Students for whom English is not their native language are required to have TOEFL scores no lower than 550 (pencil and paper) and 213 (computer-based).

Degree Requirements:

For students entering with B.S. or B.A. degrees, the Ph.D. requires 75 (600 or 700 level) credits as follows:

39 credits of course work, of which 24 credits are physics courses (including 3 credits of mathematical physics or applied mathematics), and 15 credits are electives. No less than 12 credits must be at the 700 level.

36 credits of R:755:790 Doctoral Dissertation

For students entering with M.S. or M.A. degrees, the Ph.D. requires 54 (above 600 level) credits as follows:

18 credits of course work, of which 9 credits are physics courses (including mathematical physics or applied mathematics), and 9 credits are electives. No less than 12 credits must be at the 700 level.

36 credits of R755:790 Doctoral Dissertation

Seminar: All doctoral students must enroll in R755:791 Applied Physics Seminar each semester, including each semester they are enrolled in R755:790 Doctoral Dissertation.

Required:
18 credits:

		R755:611	Advanced Classical Mechanics (3 credits)
		R755:621	Classical Electrodynamics (3 credits)
		R755:631	Quantum Mechanics (3 credits)
		R755:641	Statistical Mechanics (3 credits)
		R755:721	Classical Electrodynamics II (3 credits)
		R755:731	Quantum Mechanics II (3 credits)

The four 600-level physics courses can be replaced by other courses for entering students who have M.S. degrees and have taken these courses in the master's program.

Qualifying Examination and Research Examination - The student must pass a written qualifying examination and oral research examination. The written qualifying examination is administered yearly to test general academic preparation and competence for research in applied physics. Within one year after passing the written qualifying examination, the student is required to pass the oral qualifying examination to achieve Ph.D. candidacy, in which the prospective Ph.D. candidate presents a preliminary research proposal for approval by the dissertation committee. The student will be allowed two attempts to pass the written or oral qualifying examination.

Dissertation and Defense - An oral presentation and defense of the doctoral dissertation is required. A five-member committee, chaired by the dissertation advisor, must approve the content and presentation of the dissertation research.

Professional and Technical Communication

Administered By: Department of Humanities

Administration

Chairperson	Burt J. Kimmelman
Program Director Undergraduate	Christopher T. Funkhouser
Program Director Graduate	Nancy W. Coppola

Faculty

Professors	Nancy W. Coppola, Norbert Elliot, Burt J. Kimmelman
Associate Professors	Robert S. Friedman, Carol S. Johnson, Nancy L. Steffen, Christopher T. Funkhouser
Assistant Professors	Philip A. Klobucar
Lecturers	Robert P. Myre, Blake Haggerty, Kenneth C. Ronkowitz

Degrees Offered: Master of Science in Professional and Technical Communication

This program is designed to prepare students for careers in the field of technical communication. Students learn to approach communication issues in a scholarly and professional manner, developing abilities in critical thinking, problem solving, and navigating effectively and ethically through our scientific and technological society.

The program is intended for students and communication professionals who want to develop abilities in

- emerging media
- user-centered design
- usability testing and knowledge management
- advanced communication theory and research methods
- technical editing
- writing and speaking in teams, in corporations, and in technology

Masters of Science in Professional and Technical Communication

Please see our web site http://www.njit.edu/MSPTC for updated information.

The Master of Science in Professional and Technical Communication (MSPTC) prepares students for careers in the rapidly growing field of technical communication. This degree enables students to acquire an understanding of information technologies and to approach communication issues with new problem-solving skills. Professional experts will provide strong theoretical foundations within a practical framework. The MSPTC is entirely available online (in distance learning format).

Admission Requirements:

Students must have an undergraduate degree in a field of science, computer science or engineering, or have an undergraduate degree in another area with experience or strong interest in science and technology.

- a statement outlining how the degree will meet personal and professional objectives;

- a current resume;
- two letters of recommendation;
- a portfolio of work (writing, web development, CD-ROM or other appropriate showcase of work);
- Application for Admission to Graduate Study form;
- Official transcripts of all prior work and certificate of graduation;
- GRE scores (These scores are required of all international applicants, all applicants who have earned their last degree outside of the United States, and students who wish to apply for merit-based financial support on individual basis; other applicants do not need GRE scores);
- TOEFL scores of 550 (pencil and paper) and 213 (computer-based) are required of all international applicants.

Graduate Certificate Programs: Three 12-credit graduate certificates are available as a step toward this degree

- Practice of Technical Communications
- User-Centered Design

Please see Graduate Certificates in this catalog for further information. For more information about continuing and distance education, please contact the Division of Continuing Professional Education, 1-800-624-9850 or 973-596-3060; e-mail: cpe@njit.edu.

DEGREE REQUIREMENTS:

Students must complete a minimum of 30 degree credits taken over a minimum of two semesters. Five core courses must be completed by all students; five elective courses allow students to specialize in selected areas of professional and technical communication.

Students must design and maintain an ePortfolio of work completed within the courses. This work, organized around core competencies within each seminar in the program, will be reviewed by the instructional faculty every semester. In the final semester before graduation, students are required to take PTC 691 ePortfolio Capstone Seminar and make an oral presentation of their portfolio.

CORE COURSES:
15 credits:

		PTC 601	Advanced Professional and Technical Communication (3 credits)
		PTC 603	Cultural and Technological Change (3 credits)
		PTC 604	Communication Theory and Research (3 credits)
		PTC 605	Elements of Visual Design (3 credits)
		PTC 606	Advanced Online Design (3 credits)

ePortfolio (required)
3 credits:

		PTC 691	ePortfolio Capstone Seminar (0)

ELECTIVE COURSES
15 credits from:

		PTC 610	Usability: User and Task Analysis (3 credits)
		PTC 620	Proposal Writing (3 credits)
		PTC 622	Working in Teams: Collaborative and Interpersonal Communications (3 credits)
		PTC 624	Professional and Technical Editing (3 credits)
		PTC 626	Hypertext Design Studio (3 credits)
		PTC 631	Communication and Environmental Problem Solving (3 credits)
		PTC 632	Content Management and Information Architecture (3 credits)
		PTC 640	Health Communications (3 credits)
		PTC 642	Corporate Communication (3 credits)
		PTC 644	Communication in Technology Transfer and Innovation (3 credits)
		PTC 650	Web Based Training Design (3 credits)

		PTC 698	Selected Topics in Professional and Technical Communication (3 credits)
		PTC 700	Master's Project (3 credits)
		PTC 701	Master's Thesis (6 credits)
		PTC 725	Independent Study in Professional and Technical Communication (3 credits)

Note: Students may also select 2 courses (6 credits) from another NJIT college.

Public Health

Administered By: Rutgers-Newark and UMDNJ/NJMS

Administration

Acting Program Director (UMDNJ NJMS)	Anthony J. Garro
Associate Program Director (UMDNJ NJMS)	Marian R. Passannante
MPH Administrative Director (UMDNJ NJMS)	Yvette Holding-Ford

NJIT Faculty

Distinguished Professors	Gordon A. Lewandowski, Murray Turoff
Professors	W P. Beaton, Norbert Elliot, Yehoshua Perl, Trattner
Associate Professors	Fadi Deek, James Geller, Michael L. Recce
Assistant Professors	Elizabeth J. Hodge, Linton, Markowit

Rutgers - Newark Faculty

Professors	Dubnick, Holzer
Associate Professors	Canino, Olshfski, Schofer, Stark
Assistant Professors	Burbridge, Gelobter

UMDNJ Faculty

Professors	H. Baker, S. Baker, Bogden, Chinard, Deane M. Evans, Haque, Johanson, Lavenhar, Louria, Najem, Oleske, Reichman, Wedeen
Associate Professors	Caine, Guttman, Holland, Passannante, Sheffet, Skurnick, Julian Weiss
Assistant Professors	Aloi, Brachman, James A. Kennedy, Touger-Decker, Von Hagen, Wenger
Adjunct Professors	Kantor
Adjunct Instructor	Gause
Track Coordinators(NJIT)	Norbert Elliot
(UMDNJ-NJMS)	Marvin A. Lavenhar
(UMDNJ-NJMS)	Marian R. Passannante
(Rutgers-Newark)	Evan Stark

Degrees Offered: Master of Public Health offered jointly with Rutgers-Newark and UMDNJ-NJMS

The Master in Public Health (M.P.H.) degree program, established by UMDNJ/NJMS, Rutgers-Newark, addresses critical issues surrounding the nation's health, especially that of high-risk, urban, and under-served populations. The program in public health develops and applies knowledge from multiple disciplines for the promotion and protection of the health of the human population, giving due consideration to cultural perspectives that abound in our multicultural world. This program is part of the UMDNJ/School of Public Health.

Program participants carry out research, and formulate policies that answer local needs and provide models for similar nationwide and worldwide problems. The three universities collaborate with community-based practitioners and researchers in Newark and in northern New Jersey. Student projects and placements are designed to maximize problem solving in large urban settings.

Master in Public Health

The program is designed to prepare existing professionals to assume new and expanded analytical and administrative roles in the planning and organization of efficient and cost-effective health services, health education, and health policy; to increase the number of public health professional qualified to assist and conduct original community-based research that will lead to advances in health promotion and disease prevention; and to provide systems thinking about public health and social values that relate to physical and mental well being.

Admission Requirements:

Applicants must meet one of these criteria: hold degrees or positions in the health or health-related professions; be graduates of baccalaureate or post-baccalaureate programs with formal training and/or experience in the health field; be candidates for joint degree programs (M.D./M.P.H., D.M.D./M.P.H.); hold exceptionally strong credentials from baccalaureate; post-baccalaureate programs outside of the health field.

Applicants must supply scores from the GRE or its equivalent (e.g., MCAT, GMAT, or LSAT) from within the last five years. Those with a doctoral degree from a U.S. or Canadian university may seek a waiver of test scores by providing supporting documentation with the application. Test score waivers for individuals with other graduate degrees are decided on a case-by-case basis. Contact the administrative director. International students applying for admission must show a TOEFL score of at least 550 (pencil and paper) and 213 (computer-based). All applicants must supply official academic transcripts; an essay/statement addressing career goals, how the course offerings would help meet them, and how previous experience has contributed to personal and professional growth; and three letters of recommendation.

An application may be obtained from Newark Public Health Program at Science Park, UMDNJ/New Jersey Medical School, 185 South Orange Ave., MSB F-506, Newark, N.J. 07103-2714 or by calling (973) 972-7212.

Degree Requirements:

The MPH program requires the successful completion of 45 credits. The credits are divided into 18 credits in core courses, 6 to 12 credits in required courses in one of three tracts, 9 to 15 credits of electives and 3 credits each in fieldwork and thesis.

Three general tracks are available. While they share a common core, each is designed to suit various interests:

Urban and Environmental Health brings a multi-disciplinary perspective to bear on the identification, assessment, and remediation of stressors specific to health problems in the urban environment.

Quantitative Methods: Biostatistics and Epidemiology develops quantitative, analytic, and research skills for public health practitioners.

Health Policy and Administration teaches the concepts, principles, and scientific skills necessary for health services management, policy development, and program evaluation.

Core:

18 credits:

		BINF 601/BINF 5005	Health Care Information Systems (3 credits)
		Hist 634	Environmental History of North America (3 credits)
		Hist 635	History of Technology, Environment and Medicine: Theory and Method (3 credits)
		MPH 650	Medical Geography (3 credits)

Quantitative Methods: Epidemiology and Biostatistics:

Select either epidemiology or biostatistics.

Required:

6 credits:

		QM 611	Design of Epidemiological Studies and Clinical Trials (3 credits)
		QM 612	Linear Models: Regression and Analysis of Variance (3 credits)

Epidemiology:

6 credits:

		EPI 615	Introduction to Epidemiology and Control of Chronic and Infectious Diseases (3 credits)
		EPI 616	Advanced Topics in Infectious and Chronic Diseases Epidemiology (3 credits)

9 credits from:

		BINF7570	
		EPI 621	Survey Research Methods/Questionnaire Design (3 credits)
		EPI 625	Community-Based Epidemiological Research (3 credits)
		EPI 626	Emerging and Re-emerging Infections (3 credits)
		EPI 627	Innovations in Public Health (3 credits)
		EPI 628	Pharmacoepidemiology (3 credits)
		EPI 629	Oral Epidemiology of Chronic and Infectious Diseases (3 credits)

The following courses are in development: genetic epidemiology, and environmental and occupational epidemiology

Biostatistics:

6 credits:

		BIO 613	Life Tables and Survival Analysis (3 credits)
		BIO 614	Categorical Data Analysis (3 credits)

9 credits from:

		BIO 618	Nonparametric Statistical Methods (3 credits)
		BIO 619	Biostatistical Consulting (2 credits)

Health Policy and Administration:

Select either health policy or health care administration.

Required:

6 credits

		R834:582	Health Care Management (3 credits)
		R834:585	Health Care Policy (3 credits)

Health Policy:

15 credits from:

		R790:501	Policy Making in the American Political System (3 credits)
		R790:512	Ethical Issues in Public Policy and Administration (3 credits)
		R790:516	Urban Public Policy (3 credits)
		R834:541	Political Economy and Public Administration (3 credits)
		R834:562	Policy and Program Assessment (3 credits)
		R834:586	Violence in the United States (3 credits)
		R834:587	
		R834:602	Decision Making and Policy Analysis (3 credits)
		MPH 660	Health Economics (3 credits)

The following courses are in development: law, health care and public policy; advanced policy analysis; human rights in health care; public health and family; privatization and public health; comparative health care; and quality assurance in health.

Health Care Administration:

12 credits from:

		R705:534	Community Health Nursing Theory II (3 credits)
		R834:521	Technology and Public Administration (3 credits)
		R834:523	Human Resources Administration (3 credits)
		R834:524	Strategic Planning and Management (3 credits)
		R834:527	
		R834:584	Health Care Finance (3 credits)
		R834:542	Government Budgeting Systems (3 credits)

The following courses are in development: accounting and financial analysis; public budgeting; managing managed care; health services research; fundamentals of human resource administration; cases in public sector productivity.

Catalog and curricula information approved by the relevant academic department.

Telecommunications

Administered By: Department of Electrical and Computer Engineering(ECE) and Department of Computer Science(CS)

Administration

Interim Chair	Timothy N. Chang
Associate Chair (Undergraduate)	Sui-hoi E. Hou
Associate Chair (Graduate)	Durgamadhab Misra

Faculty

Distinguished Professors	Yeheskel Bar-Ness, Bernard Friedland, Jacob Savir
Professors	Ali N. Akansu, Nirwan Ansari, William N. Carr, changtn, Roy H. Cornely, Atam P. Dhawan, Haim Grebel, Richard A. Haddad, Alexander M. Haimovich, Jacob Klapper, Durgamadhab Misra, Yun-qing Shi, Kenneth S. Sohn, Marek Sosnowski, Gerald Whitman, Mengchu Zhou, Sotirios G. Ziavras
Associate Professors	John D. Carpinelli, Hongya Ge, Sui-hoi E. Hou, Walid Hubbi, Edip Niver, Leonid Tsybeskov
Assistant Professors	Ali Abdi, Jie Hu, Swades K. De, Roberto Rojas-Cessa, Yanchao Zhang
Special Lecturer	Arthur B. Glaser

Advisors

Undergraduate Advisor	Shivon S. Boodhoo
Undergraduate Advisor	Sui-hoi E. Hou
MS Electrical Engineering Advisor	Durgamadhab Misra
PHD Electrical Engineering Advisor	Durgamadhab Misra
MS Computer Engineering Advisor	Mengchu Zhou
PHD Computer Engineering Advisor	Durgamadhab Misra
MS Telecommunications Advisor	Roberto Rojas-Cessa

Degrees Offered: Master of Science in Telecommunications

Telecommunications is one of the most rapidly growing fields in engineering. Telecommunications specialization also is rapidly becoming necessary in such diverse fields as banking, reservation systems, office information systems, corporate networks, and the Internet. Rapid technological progress in gigabit optical networks, multimedia communications, and wireless network access, make the future of the field very exciting.

Master of Science in Telecommunications

The objective of this program is to educate individuals in one or more telecommunication specializations.

Admission Requirements:

Applicants are expected to have an undergraduate degree in computer science, computer engineering or electrical engineering from an accredited institution (or its equivalent) with a minimum GPA of 3.0 on a 4.0 scale. These students should have taken CS 333, ECE 321 and ECE 333 (or their equivalents) or ECE 501 . Students without this course work will be required to complete a bridge program. Applicants having degrees in other fields may be considered for admission on an individual basis and required to complete a bridge program. GRE scores must be submitted. International students must also achieve a minimum TOEFL score of 550 (pencil and paper) and 213 (computer-based).

Bridge Program: The curriculum requires a basic knowledge of computer and communications fundamentals such as programming, data structures, computer architecture, signals and systems, and basic communication systems. Bridge courses do not count toward the degree. The bridge courses are selected from the following list depending on individual background in consultation with the graduate advisor. See the undergraduate catalog for descriptions of 200- to 400-level courses.

{		CS 251	Computer Organization (3-0-3) ***or***
		ECE 353	Computer Organization and Architecture (3-0-3) ***or***
		ECE 252	Microprocessors (3-0-3)
		CS 332	Principles of Operating Systems (3-0-3)
		CS 333	Introduction to UNIX Operating Systems (3-0-3)
		CS 505	Programming, Data Structures, and Algorithms (3 credits)
	*	ECE 501	Linear Systems and Random Signals (3 credits)
		ECE 321	Random Signals and Noise (3-0-3)
		ECE 333	Signals and Systems (3-0-3)
		ECE 481	Communications Systems (3-0-3)

Graduate Certificate Program - A 12-credit graduate certificate in Telecommunications Networking is available as a step toward this degree. See "Graduate Certificates" in this catalog. For further information about extension programs and graduate certificates, call the associate vice president of continuing and distance education, Division of Continuing Professional Education, 1 (800) 624-9850 or (973) 596-3060; e-mail cpe@njit.edu

Degree Requirements:

Candidates must complete a minimum of 30 credits: 15 in core courses and 15 in elective courses in an area of specialization with a minimum overall GPA of 3.0. In addition, a minimum cumulative 3.0 GPA is required in the five core courses. Students with an exceptionally strong telecommunications background may be allowed to replace required courses with advanced electives. Permission of the graduate advisor is required.

Core:

15 credits:

		CS 630	Operating System Design (3 credits)
		CS 651	Data Communications (3 credits)
{		CS 652	Computer Networks-Architectures, Protocols and Standards (3 Credits) ***or***
		ECE 683	Computer Network Design and Analysis (3 credits)
		ECE 642	Communication Systems I (3 credits)
		ECE 644	Introduction to Wireless and Personal Communications Systems (3 credits)

Elective:

Select 9 credits if completing a master's thesis; 12 credits if completing a master's project; 15 credits if not completing either a master's project or thesis. These courses are to be used in an area of specialization.

		CS 604	Client/Server Computing (3 credits)
		CS 631	Data Management System Design (3 credits)
		CS 633	Distributed Systems (3 credits)
		CS 637	Real-Time Systems (3 credits)
{		CS 650	Computer Architecture (3 credits) ***or***
		ECE 690	Computer Systems Architecture (3 credits)
		CS 654	Telecommunication Networks Performance Analysis (3 credits)
{		CS 656	Internet and Higher-Layer Protocols (3 credits) ***or***
		ECE 637	Internet and Higher-Layer Protocols (3 credits)
{		IS 658	Multimedia Systems (3 credits) ***or***
		ECE 649	Compression in Multimedia Engineering (3 credits)
		CS 665	Algorithmic Graph Theory (3 credits)
{		CS 668	Parallel Algorithms (3 credits) ***or***
		ECE 785	Parallel Processing Systems (3 credits)
		IS 679	Management of Computer and Information Systems (3 credits)
{		CS 696	Network Management and Security (3 credits) ***or***
		ECE 638	Network Management and Security (3 credits)
{		CS 697	Principles of Broadband ISDN and ATM (3 credits) ***or***
		ECE 639	Principles of Broadband Networks (3 credits)
		CS 752	Communication Protocol Synthesis and Analysis (3 credits)
		ECE 673	Random Signal Analysis I (3 credits)
		ECE 685	Network Interface Design (3 credits)
		ECE 742	Communication Systems II (3 credits)
		ECE 755	Advanced Topics in Digital Communications (3 credits)
		ECE 757	Advanced Wireless Communications (3 credits)
		ECE 783	Computer Communication Networks (3 credits)
		MIS 635	Management of Telecommunications (3 credits)
		MIS 636	Telecommunications: Policies and Regulations

Project, Thesis (optional):

3 credits:

{		CS700	***or***
		ECE 700	Master's Project (3 credits)

6 credits:

		CS701	
		ECE 701	Master's Thesis (3 credits)

Area of Specialization:

The following are suggested areas of specialization and sample elective courses for each. Students may develop an individual area of specialization in consultation with a graduate advisor.

Management and Administration:

{		CS 696	Network Management and Security (3 credits) ***or***
		ECE 638	Network Management and Security (3 credits)
		CIS 679	Management of Computer and Information Systems (3 credits)
		MIS 635	Management of Telecommunications (3 credits)
		MIS 636	Telecommunications: Policies and Regulations

and one additional course.

Communication Systems:

{		CS 697	Principles of Broadband ISDN and ATM (3 credits) ***or***
		ECE 639	Principles of Broadband Networks (3 credits)
{		IS 658	Multimedia Systems (3 credits) ***or***
		ECE 649	Compression in Multimedia Engineering (3 credits)
		ECE 673	Random Signal Analysis I (3 credits)
		ECE 742	Communication Systems II (3 credits)
		ECE 755	Advanced Topics in Digital Communications (3 credits)
		ECE 757	Advanced Wireless Communications (3 credits)
		ECE 685	Network Interface Design (3 credits)

Networking:

		CS 604	Client/Server Computing (3 credits)
		CS 633	Distributed Systems (3 credits)
		CS 637	Real-Time Systems (3 credits)
{		CS 650	Computer Architecture (3 credits) ***or***
		ECE 690	Computer Systems Architecture (3 credits)
		CS 654	Telecommunication Networks Performance Analysis (3 credits)
{		CS 656	Internet and Higher-Layer Protocols (3 credits) ***or***
		ECE 637	Internet and Higher-Layer Protocols (3 credits)
		CS 665	Algorithmic Graph Theory (3 credits)
{		CS 668	Parallel Algorithms (3 credits) ***or***
		ECE 785	Parallel Processing Systems (3 credits)
{		CS 696	Network Management and Security (3 credits) ***or***
		ECE 638	Network Management and Security (3 credits)
{		CS 697	Principles of Broadband ISDN and ATM (3 credits) ***or***
		ECE 639	Principles of Broadband Networks (3 credits)
		ECE 673	Random Signal Analysis I (3 credits)
		ECE 783	Computer Communication Networks (3 credits)

Information Technologies:

		CS 604	Client/Server Computing (3 credits)
		CS 631	Data Management System Design (3 credits)
{		IS 658	Multimedia Systems (3 credits) ***or***
		ECE 649	Compression in Multimedia Engineering (3 credits)
{		CS 696	Network Management and Security (3 credits) ***or***
		ECE 638	Network Management and Security (3 credits)

one additional course.

Other CS and ECE courses related to telecommunications may be selected as elective courses with the written approval of the corresponding graduate advisor.

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* ECE 321 and ECE 333 may be substituted for ECE 501.

Transportation

Administered By: Executive Committee for the Interdisciplinary Program in Transportation

Administration

Program Director	Athanassios Bladikas

Faculty

Professor	Lazar Spasovic, I J. Chien
Associate Professors	Athanassios Bladikas, Janice R. Daniel, Rongfang Liu, Jian Yang

Degrees Offered: Master of Science in Transportation; Doctor of Philosophy in Transportation

NJIT's transportation program prepares students to be transportation planners, engineers, and managers who can plan, design, operate, and manage transportation systems capable of satisfying society's transportation needs.

Transportation is vital to our society's proper functioning, providing mobility of people, goods and services. It enables people to access job markets and participate in recreational, cultural, educational, and social activities. It adds value to products by moving them to their destination in time for their use. The transportation field also is a major contributor to the economy, as a consumer of resources and as a supplier of jobs.

Transportation functions in a very complex environment which, at the beginning of the 21st Century, is characterized by constant change in the technological, regulatory and legal frameworks. Transportation professionals must not only be able to meet the technological challenges of new systems, they must also be capable of fitting these systems into the social, economic, and physical environments in a manner that improves the quality of life for all.

Through the NJIT-based Institute for Transportation, the transportation graduate program provides excellent opportunities for students to engage in research on all forms of transportation, including all phases of activities concerned with the provision of services and the movement of people and goods. The Institute for Transportation is a major resource for public and private organizations and is well-known for its academic programs and research activities.

Master of Science in Transportation

This is a program for students from diverse educational backgrounds with a variety of career goals that prepares them for careers in designing, planning, operating, maintaining and managing urban and rural transportation systems. The master's degree is a valued professional credential for individuals engaged in the transportation field.

Off-Campus Programs: At the New Jersey Department of Transportation (NJ DOT), in Trenton, NJIT offers sufficient courses to fulfill all degree requirements. All courses are taught by NJIT faculty and are open to non-DOT employees. For further information about extension programs, call the associate vice president of continuing and distance education, Division of Continuing Professional Education, 1 (800) 624-9850 or (973) 596-3060; e-mail cpe@njit.edu

Admission Requirements:

Applicants should have a bachelor's degree from an accredited institution with some undergraduate background in economics, mathematics, probability and statistics, and computers.

Bridge Program: Students who lack an appropriate background may be admitted and required to make up deficiencies by taking a program of courses designed in consultation with graduate advisors. These courses are taken in addition to the degree requirements. See the undergraduate catalog for descriptions of 100- to 400-level courses. Students may be required to take or demonstrate that they already have taken courses equivalent to the following:

	*	CE 350	Transportation Engineering (3-0-3)
		CIS 101	Computer Programming and Problem Solving (2-1-2)
		Econ 265	Microeconomics (3-0-3)
		Math 105	Elementary Probability and Statistics (3-0-3)
		Math 309	Mathematical Analysis for Technology (4-0-4)

Degree Requirements:

Students must select one area of specialization and take a minimum of 30 credits. Tran 792 Seminar is required for all students who receive departmental or research-based awards. A maximum of 6 credits may be taken from the 500-level courses for the master of science.

Three general areas of specialization are available. While they share a common methodological core, each is designed to suit various interests:

Transportation Engineering focuses on traffic engineering, physical design and operational aspects of transportation systems. This area is best suited for students with an undergraduate engineering degree.

Transportation Planning emphasizes the analysis and planning aspects, in particular the integration of transportation systems with urban and regional considerations such as economics, land use, and the environment.

Advanced Transportation Systems and Technologies emphasizes the use of emerging technologies such as intelligent transportation systems in planning, design and operations of multi- and inter-modal transportation systems.

Core:

Required for all specializations

9 credits:

		Tran 603	Introduction to Urban Transportation Planning (3 credits)
{		Tran 610	Transportation Economics (3 credits) ***or***
		Econ 565	Managerial Economics (3 credits)
{		Tran 650	Urban Systems Engineering (3 credits) ***or***
		EM 602	Management Science (3 credits)

Project, Thesis (optional):

Students may elect to complete a master's project or thesis. These courses are considered as electives.

		Tran 700	Master's Project (3 credits)
		Tran 701	Master's Thesis (6 credits)

Areas of Specialization:

Additional elective courses for all areas of specialization may be taken with approval of the graduate advisor.

Transportation Engineering:

Required:

9 credits:

		Tran 615	Traffic Studies and Capacity (3 credits)
		Tran 625	Public Transportation Operations and Technology (3 credits)
		Tran 752	Traffic Control (3 credits)

Elective:

Select 6 credits if completing a master's thesis; 9 credits if completing a master's project; 12 credits if not completing either a master's project or thesis, from:

		CE 611	Project Planning and Control (3 credits)
		EM 691	Cost Estimating for Capital Projects (3 credits)
		EnE 671	Environmental Impact Analysis (3 credits)
		HRM 601	Organizational Behavior (3 credits)
		IE 651	Industrial Simulation (3 credits)
		Math 661	Applied Statistics (3 credits)
		ME 635	Computer-Aided Design (3 credits)
		Mgmt 692	Strategic Management (3 credits)
		MIS 648	Decision Support Systems for Managers (3 credits)
		Mrkt 632	Marketing Strategy for Technology-Based Organizations (3 credits)
		Tran 552	Geometric Design of Transportation Facilities (3 credits)
		Tran 602	Geographic Information Systems (3 credits)
		Tran 608	Behavioral Issues in Transportation Studies (3 credits)
		Tran 640	Distribution Logistics (3 credits)
		Tran 653	Traffic Safety (3 credits)
		Tran 659	Flexible and Rigid Pavements (3 credits)
		Tran 700	Master's Project (3 credits)
		Tran 701	Master's Thesis (6 credits)
		Tran 753	Airport Design and Planning (3 credits)
		Tran 754	Port Design and Planning (3 credits)
		Tran 755	Intelligent Transportation Systems (3 credits)
		Tran 760	Urban Transportation Networks (3 credits)

Transportation Planning:
Required:
9 credits:

		Tran 655	Land Use Planning (3 credits)
{		Tran 625	Public Transportation Operations and Technology (3 credits) ***or***
		Tran 705	Mass Transportation Systems (3 credits)
		Tran 765	Multi-modal Freight Transportation Systems Analysis (3 credits)

Elective:
Select 6 credits if completing a master's thesis; 9 credits if completing a master's project; 12 credits if not completing either a master's project or thesis, from:

		CE 611	Project Planning and Control (3 credits)
		EnE 671	Environmental Impact Analysis (3 credits)
		Fin 630	Applied Business Econometrics (3 credits)
		HRM 601	Organizational Behavior (3 credits)
		HRM 606	Human Resource Management (3 credits)
		HRM 662	Organizational Diagnosis and Development (3 credits)
		Math 661	Applied Statistics (3 credits)
		Mgmt 691	Legal and Ethical Issues (3 credits)
		Mgmt 692	Strategic Management (3 credits)
		MIS 620	E-Commerce Technologies (3 credits)
		Mrkt 632	Marketing Strategy for Technology-Based Organizations (3 credits)
		Tran 602	Geographic Information Systems (3 credits)

		Tran 604	Public and Private Financing of Urban Areas (3 credits)
		Tran 608	Behavioral Issues in Transportation Studies (3 credits)
		Tran 615	Traffic Studies and Capacity (3 credits)
		Tran 640	Distribution Logistics (3 credits)
		Tran 643	Transportation Finance (3 credits)
		Tran 653	Traffic Safety (3 credits)
		Tran 720	Discrete Choice Modeling for Travel Demand Forecasting (3 credits)
		Tran 740	Management of Transportation Carriers (3 credits)
		Tran 753	Airport Design and Planning (3 credits)
		Tran 755	Intelligent Transportation Systems (3 credits)
		Tran 760	Urban Transportation Networks (3 credits)

Advanced Transportation Systems and Technologies :
Required:
9 credits:

		Tran 615	Traffic Studies and Capacity (3 credits)
		Tran 755	Intelligent Transportation Systems (3 credits)
		Tran 765	Multi-modal Freight Transportation Systems Analysis (3 credits)

Elective:
Select 6 credits if completing a master's thesis; 9 credits if completing a master's project; 12 credits if not completing either a master's project or thesis, from:

		CIS 610	Data Structures and Algorithms (3 credits)
		CIS 651	Data Communications (3 credits)
		CIS 661	Systems Simulation (3 credits)
		ECE 609	Artificial Neural Networks (3 credits)
		ECE 642	Communication Systems I (3 credits)
		EM 714	Multicriteria Decision Making (3 credits)
		EnE 671	Environmental Impact Analysis (3 credits)
		HRM 601	Organizational Behavior (3 credits)
		IE 624	Heuristic Methods (3 credits)
		IE 642	Network Flows and Applications (3 credits)
		IE 644	Application of Stochastic Modeling in Systems Control (3 credits)
		IE 651	Industrial Simulation (3 credits)
		IE 705	Mathematical Programming in Management Science (3 credits)
		IE 706	A Queueing Approach to Performance Analysis (3 credits)
		Math 661	Applied Statistics (3 credits)
		ME 635	Computer-Aided Design (3 credits)
		MIS 648	Decision Support Systems for Managers (3 credits)
		Mrkt 632	Marketing Strategy for Technology-Based Organizations (3 credits)
		Mrkt 636	Design and Development of High Technology Products (3 credits)
		Mrkt 640	Industrial Marketing Management (3 credits)
		Tran 602	Geographic Information Systems (3 credits)
		Tran 608	Behavioral Issues in Transportation Studies (3 credits)
		Tran 625	Public Transportation Operations and Technology (3 credits)
		Tran 640	Distribution Logistics (3 credits)
		Tran 752	Traffic Control (3 credits)

		Tran 760	Urban Transportation Networks (3 credits)

Doctor of Philosophy in Transportation

The doctoral program is for well-qualified students who are mature in scholarship and purpose. It offers a well-balanced mixture of theoretical studies and experimental research. A student must demonstrate creative thinking, self-motivation, and ability to do independent research. In their research, students are expected to deal with complex issues, effectively formulate difficult problems, devise new methodology, and achieve new and exceptional results.

Admission Requirements:

Students should have adequate preparation in mathematical and other analytical techniques, and substantial knowledge of the ideas and techniques of synthesis. A thorough understanding of the social and economic factors intrinsic to the functioning and development of transport in urban areas also is necessary. It is expected that students will have earned a minimum GPA of 3.5 in a master's degree program in engineering, planning, or business administration from an accredited university. Outstanding students with baccalaureate degrees also may be accepted. All applicants must take the GRE. Full-time study is preferred for doctoral studies.

Degree Requirements:

Requirements consist of a minimum of 54 credits of course work beyond the bachelor's degree, including at least 12 credits of 700-level courses, passage of a qualifying examination, a minimum of 36 credits of Tran 790 Doctoral Dissertation and Tran 791 Doctoral Seminar. Independent original research must be conducted by the candidate in a specific area of transportation. Dissertation work must be of publishable quality.

Dissertation: A program committee must approve a dissertation topic and an NJIT faculty member, approved by the program, must be available to supervise the dissertation research. An oral defense of the dissertation is required after the dissertation committee accepts the written document.

Qualifying Examination: All doctoral students must pass a doctoral qualifying examination. To prepare adequately for the examination, students should take appropriate course work in transportation engineering, transportation planning, and advanced transportation systems and technologies, as well as other related subjects.

The examination has four parts: the first three are written, and the fourth is oral. The oral part is given after the written parts are evaluated.

Part I Analytical Techniques

Part II Transportation Facilities and Operations

Part III Transportation Planning and Technologies

Part IV Oral (includes a field problem)

For additional information about doctoral degree requirements, refer to the Academic Policies and Procedures section of this catalog.

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* Students who have demonstrated professional transportation work experience may have this course wavied.

Catalog and curricula information approved by the relevant academic department.

2009-2010 Graduate Courses

Administered By: New Jersey Institute of Technology

- Accounting
- Architecture
- BioInfomatics
- Biology
- Biomedical Engineering
- Biostatistics
- Chemical Engineering
- Chemistry
- Civil Engineering
- Computer Science
- Ecology and Evolution
- Economics
- Electrical and Computer Engineering
- Engineering Management
- English
- English as a Second Language
- Environmental Engineering
- Environmental Policy Studies
- Environmental Science
- Epidemiology
- Financial Management
- Geology
- History
- Human Resource Management
- Industrial Engineering
- Infrastructure Planning
- Information Systems
- Information Technology
- International Studies
- Management
- Management Information Systems
- Manufacturing Systems Engineering
- Marketing
- Marketing Management
- Materials Science and Engineering
- Mathematics
- Mechanical Engineering
- Mechanics
- Nursing
- Operations Management
- Optical Science and Engineering
- Pharmaceutical Bioprocessing

Accounting: Offered by the School of Management. See Management course list for faculty.

UNDERGRADUATE COURSES:

Acct 115 - Principles of Accounting I (3-0-3)
Basic accounting concepts, documents, work sheets, ledgers, and procedures for keeping accounts. Emphasis given to inventory and job order accounting methods.

Acct 116 - Principles of Accounting II (3-0-3)
Prerequisite: Acct 115. A continuation of Acct 115. Valuation, depreciation, costing methods, overhead accumulations, and distribution. Emphasis given to standard costs, cost estimating and budgets.

Acct 117 - Principles of Financial Accounting (3-0-3)
This is an introductory course designed to develop fundamentals of financial accounting-a process of identifying, recording, and communicating economic events of an organization. This course will provide students with an opportunity to develop skills in applying financial accounting principles to record basic economic transactions, summarize and present such transactions in financial statements as well as analyze reported accounting information by using ratios. **Effective From: Fall 2009**

Acct 215 - Managerial Accounting (3-0-3)
Prerequisites: Acct 116 or Acct 117. This course introduces fundamentals of cost and managerial accounting, including an introduction to job orders and process costing systems, cost allocation, cost behavior, managerial decision models, cost and budgetary planning and control, standard costing, analysis of variance, and responsibility accounting. The course is designed to develop the fundamentals of managerial accounting and provide students with a working knowledge of how accounting data are used by management in planning, decision-making and operational control. **Effective From: Fall 2009**

Acct 315 - Accounting for Managerial Decision Making (3-0-3)
This course wil concentrate on management decisions and the contribution of accounting toward making these decisions. Emphasis is upon using accounting information to solve business problems.

Acct 317 - Managerial Accounting (3-0-3)
Prerequisites: Acct 115, Acct 116. The techniques of evaluating labor, material and overhead costs. Rate of return, variance analysis, and break-even analysis.

Acct 325 - Managerial Accounting II (3-0-3)
A study of the concepts and techniques used by cost accountants to assist decision-makers within the organization. In-depth, real-world scenarios will be discussed including process accounting, job-order accounting, measuring quality costs, activity-based costing, and evaluating performance. Students will be introduced to methods currently being used by American busiensses, including service firms, as well as manufacturers. **Effective From: Spring 2010**

Acct 415 - Auditing (3-0-3)
An examination of current auditing theory and procedures employed in carrying out the audit. The course will cover the life cycle of the audit from accepting an audit, gathering evidence to giving an opinion on a company's financial reports. **Effective From: Spring 2010**

Acct 425 - Tax Accounting I (3-0-3)
Prerequisite: Acct 115 or Acct 117. This course is the first part of the two tax accounting courses, with a focus on federal individual income taxation. It is designed to give the students a comprehensive understanding of personal income tax laws and to able him to prepare personal income tax returns of considerable complexity. Topics covered in this course will include gross income, property transactions, capital gains/losses, itemized deductions employee expenses, depreciation, accounting methods and tax credits, among others. **Effective From: Fall 2010**

Acct 435 - Intermediate Accounting II (3-0-3)

Prerequisite: Acct 325. This is the second part of the two intermediate level financial accounting courses designed to review the basic financial required statements and provide accounting students with in-depth study of accounting principles advanced by responsible professional organizations. Topics covered include the classification, presentation and disclosure of assets, liabilities and stockholders' equity for external users of financial information. **Effective From: Fall 2010**

GRADUATE COURSES:

Acct 515 - ManagerialAccounting (3 credits)
Case study approach to accounting issues that have an impact on management decision making: nature of managerial accounting, cost behavior, cost-volume-profit analysis, full costing and its use, standard costs, variances, differential cost analysis, and responsibility accounting.

Acct 610 - Internal Auditing Concepts and Procedures (3 credits)
The entire internal audit function including planning, surveying, audit performance, work paper documentation, reporting, standards, controls, sampling, and fraud detection.

Acct 615 - Management Accounting (3 credits)
Builds on traditional concepts of managerial accounting (break-even analysis, alternate choice decisions, profit planning, and transfer pricing) and develops the skills that an executive needs in strategic cost analysis. Explores strategic decisions of value chains and activity-based management. Emphasis on using managerial accounting data in executive planning and control.

Acct 630 - Concepts and Applications of Control (3 credits)
Examines the need for and implementation of internal controls to protect corporate assets. Emphasizes the role of the controller in the organization.

Acct 650 - Operational Auditing (3 credits)
Stresses the functions of the auditor in assessing the effectiveness and efficiency of operations. Includes such areas as environmental auditing, auditing the human resource management function, auditing OSHA, psychological impact on internal auditors, auditing in a just-in-time environment, ethics, and auditing for fraud. Financial areas are discussed only to the extent of their operational impact.

Acct 670 - Seminar in Accounting Theory (3 credits)
Focuses on contemporary areas relating to accounting theory. Taught from the viewpoint of the corporate controller.

Acct 680 - Seminar in Auditing (3 credits)
Discusses contemporary auditing topics as they impact on management control and decisions.

Acct 690 - Seminar in Taxation (3 credits)
Focuses on contemporary issues in taxation as they impact on the corporate decision making process.

Architecture: Offered by the New Jersey School of Architecture

UNDERGRADUATE COURSES:

Arch 155 - Modes of Design Communication I (2-3-3)
Techniques of graphic presentation introduced as a basic language of architecture. Students work with a broad range of graphic presentation methods. Skills developed in drawing and architectural delineation. Fundamentals of perspective drawing, rendering techniques and format layout examined through an array of projects.

Arch 156 - Modes of Design Communication II (2-4-3)
Prerequisite: Arch 155. This course deals with advanced knowledge and skill acquisition of the diverse categories of information delivery required by the design professionals. **Effective From: Spring 2007**

Arch 163 - Introduction to Design I (1-12-5)
Introduction to an array of basic principles and elements of design. Emphasis on design methods, sensitivity to context, manipulation of form and space, and representation skills. General design fundamentals presented in the lecture hour.

Arch 164 - Introduction to Design II (1-12-5)
Prerequisite: Arch 163. A continuation of Arch 163.

Arch 225 - Building Systems I (0-3-3)
This course is an introductory survey of the general principles and application of Sustainable Design, Site Systems, Structural Systems, Environmental Systems, Envelope Systems, Materials and Assembly Systems. This course will primarily focus on low-rise wood and steel structures. **Effective From: Fall 2007**

Arch 226 - Building Systems II (0-3-3)
Prerequisites: Arch 164, Arch 156 and Arch 225. Continuing Systems I, this course is an introductory survey of the interrelationship of the principles and application of Sustainable Design, Site Design, Structural Systems, Environmental Systems, Envelope Systems and Materials and Assembly Systems. This course will primarily focus on low and medium-rise concrete and masonry structures and is coordinated with a studio design/build experience. **Effective From: Fall 2007**

Arch 241 - Architectural Construction I (3-0-3)
Prerequisite: Arch 155. Introduction to the construction process and its role in architecture. Materials and methods of wood, heavy timber and masonry construction presented. Em-phasis on process, compatibility of materials and drawings as a communication tool in construction.

Arch 242 - Architectural Construction II (3-0-3)
Prerequisite: Arch 241. A continuation of Arch 241 that relates construction to architectural design. The study of materials and methods of construction concentrates on steel, precast and poured-in-place concrete. Emphasis on criteria for selection of materials and systems, materials research, standards and test methods, and forces of deterioration.

Arch 251 - History of Architecture I (3-0-3)
Introduces architectural history, theory and design, providing a conceptual framework for looking at the built environment. A critical study of selected historical and contemporary buildings presented in class and documented in readings.

Arch 252 - History of Architecture II (3-0-3)
Prerequisite: Arch 251. A survey of the social, political, technological, functional, and aesthetic concerns of architecture and urban forms from their earliest beginnings through the Middle Ages around the Mediterranean basin and Western Europe.

Arch 263 - Architecture Studio I (1-12-5)
Prerequisite: Arch 164. Utilizing knowledge and skills gained in Introduction to Design I and II, students learn about architectural design. Examination

of the technological, social and environmental issues as they relate to architectural design. Lecture hour used to explore in-depth aspects of architecture.

Arch 264 - Architecture Studio II (1-12-5)
Prerequisite: Arch 263. A continuation of Arch 263. Lecture hour used to explore in-depth aspects of architectural design.

Arch 282 - Structures I (3-0-3)
Prerequisite: Phys 102, Math 113. Introduces structural statics through timber and steel design. Influences of materials and structural system choice analyzed relative to their impact on building design. Responsibilities of the architect during the structural design phase are introduced.

Arch 283 - Special Topics (3)
Investigation of problem of special interest in architecture.

Arch 301 - Digital Modeling and Fabrication (3-0-3)
The seminar in Digital Modeling and Fabrication is a 3-credit course for upper level students exploring advanced 3-dimensional computer modeling techniques and data export for assembly and fabrication to various computer numerically controlled (CNC) hardware available at the School of Architecture. Specifically, students engage in NURBS and solid modeling using Rhinoceros 3D and export data through various Rhino plug-ins including RhinoCAM, which writes G- and M- Codes for 2 and 3D milling operations. CNC hardware available as of Spring 2010 includes two (2) Universal Laser Cutters, each with 18" x 32" beds; two (2) Z-Corporation Z-310 3 dimensional printers; and a Precix 9100 Industrial CNC Router with a 48" x 96" bed. Students model and fabricate full scale assemblies individually and in teams and contribute to a final exhibition of student work. Familiarity with various software tools available at the College of Architecture and Design is encouraged but not required. Admission to the course to students in their second year of study by discretion of instructor. **Effective From: Fall 2010**

Arch 310 - Co-op Work Experience I (3)
Prerequisites: completion of the third year studio class, approval of the school and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. A designated faculty member monitors and evaluates the student's work and project. Requirements include mandatory participation in seminars and completion of a report and/or project. Apply in third year.

Arch 312 - Environmental Education I (2-3-3)
Prerequisite: Arch 264. Involves architecture students in working with grade school or high school students in the solution of a joint environmental design project. Participants first work toward developing their own understanding and sensitivity of the manmade environment. Emphasis on learner-directed and discovery-guided inquiry, and educational methods to increase awareness of the physical settings created for human activities. Projects developed in nearby schools which focus on the interaction of individuals and small groups with the environment.

Arch 316 - Computer Applications to Architecture (2-3-3)
Prerequisite: CIS 104. Introduces both philosophical and technical approaches to the use of the computer in architectural design and analysis. Explores the use of existing computer programs for spatial allocation, energy analysis, life cycle costing, problem analysis, and computer simulation. Projects include development of computer programs applicable to architecture.

Arch 317 - Advanced Architectural Graphics (2-3-3)
Prerequisite: Arch 155, Arch 264. Gives students advanced techniques for architectural expression, including Chinese ink wash and air brush techniques. Emphasis on how drawing may be used to reveal the inner qualities of design. A basic knowledge of drawing methods, media, materials, and projection techniques is assumed.

Arch 318 - New York City Lab (1-6-3)
Prerequisite: Arch 364. Explores the architectural and environmental development of New York City during the past 200 years in an organized series of field trips. Each week's trip encompasses a section and/or representative aspect of the city's evolution.

Arch 325 - Building Systems III (0-3-3)
Prerequisite: Arch 226. An introductory survey of the basic principles of building, environmental control, and service systems as these relate to the building envelope, this course will primarily cover thermal enclosure, climate modification, environmental systems, energy use, and sustainable design. It also introduces the principles of health and safety in the design of buildings. **Effective From: Fall 2007**

Arch 326 - Building Systems IV (0-3-3)
Prerequisite: Arch 325. This is an intermediate course focusing on the understanding of the principles, performance criteria, and applications of environmental and building service systems including lighting, acoustical, plumbing, electrical, vertical transportation, egress, communication, security, and fire protection systems. **Effective From: Fall 2007**

Arch 328 - Urban Values (2-3-3)

Prerequisites: Arch 363. A survey of urban planning practice and historical, contemporary, and theoretical urban design approaches. Considers the physical environment as a response to human values, and explores how nature, the city, and the user influence the form and content. Case studies include cities, towns, and specialized recreation and retirement communities. Laboratory work includes field trips, demonstration exercises, and analysis of case studies.

Arch 331 - Landscape Architecture (3-0-3)

An overview of the opportunities and constraints of landscape designs. Emphasis on developing a practical understanding of the potentials of earth, water and plants in architecture. Students given an overview of social and ecological determinants of relations between land and buildings.

Arch 332 - Architecture: Image and Word I (2-3-3)

This course will present films on Architecture in which architects are speaking about and showing their own work. What we think is true about architecture is often wrong. Single images tend to abstract and greatly simplify why and how great architecture is created. Rarely are buildings seen in their content. Rarely are climatic, cultural and technical issues of design illustrated. As a result, we often speculate about architecture based upon superficial or incomplete information. **Effective From: Fall 2007**

Arch 333 - Architecture: Image and Word II (2-3-3)

This course will present films on Architecture in which architects are speaking about and showing their own work. Theoreticians provide "facts" to create a unified theory of design, which may lie outside the realm of historical reality, or the intention of the architect. The culture of architectural education and the nature of the design studio results in second hand knowledge, and design myth. Surveys of modern architecture leave a fragmentary memory of great works of architecture. **Effective From: Fall 2007**

Arch 334 - Color Theory/Electronic Color (3-0-3)

The multiple-media course includes lectures with supplemental readings, videos, in-class analysis and laboratory work, and homework requiring a variety of media including watercolor and computer graphics - all of which address a range of issues including interaction of color, psychology of color, design for color deficient vision, color mixing and color palettes, color reproduction, color models, color composition in art and architecture, and others. Digital applications are integrated throughout. **Effective From: Fall 2007**

Arch 335 - Digital Tectonics (3-0-3)

This course uses 3D modeling tools to investigate the relationship of digital models to physical construction. The term digital tectonics refers to an idea regarding the qualities of works of contemporary architecture that seem to be influenced by the use of digital tools. In this course, students are asked to investigate this hypothesis by testing structure, skin, assemblage, form and space making methodologies that are aided by digital tools and rationalized through digital operations. **Effective From: Fall 2007**

Arch 337 - Building Information Modeling (3-0-3)

This course explores both technical and philosophical approaches to the use of the computer in architectural analysis, design development, information management, and document delivery. Autodesk Building Systems and Autodesk Revit Building will be used for 3D modeling and 2D documentation employing a systems-approach framework for spatial allocation, energy analysis, and structural considerations. The workings of the foundational information databases of the respective software will be thoroughly explored. Projects requirements will include building program resolution, solar analysis, asset scheduling, document layout, and design visualization. Proficiency with Autodesk Autocad (2D) and understanding of general CAD principles are required prerequisites; the formal prerequisite course is Arch 316/647. **Effective From: Fall 2007**

Arch 342 - Architecture Construction III (3-0-3)

Prerequisite: Arch 242. Develops the architect's understanding of the relationship between building material selection, building codes, testing, construction procedure, and life safety.

Arch 363 - Architecture Studio III (1-12-5)

Prerequisite: Arch 264. A continuation of Arch 264. Lecture hour explores in depth the nature of technology, environment, and social order as they relate to studio work. Students will be required to purchase course materials.

Arch 364 - Architecture Studio IV (1-12-5)

Prerequisites: Arch 363. A continuation of Arch 363. Lecture hour explores in depth the nature of technology, environment, and social order as they relate to studio work. Students will be required to purchase course materials.

Arch 381 - History of Architecture III (3-0-3)

Prerequisite: Arch 252. Continuation of Arch 251 covering the period from the 15th Century to 1900. Among its emphases are theoretical debates, technological developments, and the impact of the industrial revolution and modernity on architecture and urban forms. While the geographical focus on Western Europe and North America, case studies from other contexts are also introduced.

Arch 382 - History of Architecture IV (3-0-3)

Prerequisite: Arch 381. The last in the sequence of history surveys, this course covers the architecture of the twentieth century. The issues discussed include reactions and responses to modernism, re-evaluations of history, universalism and regionalism, utopias and anti-utopias. While the focus is on European and American architecture, developments in other parts of the world are also introduced.

Arch 383 - Structures II (3-0-3)

Prerequisite: Arch 282. Methods and details of timber and steel design summarized. Structural design taught in the context of architectural design and cost constraints.

Arch 384 - Structures III (3-0-3)

Prerequisite: Arch 383. Continuing with the content of Structures I and II, develop a systematic overview of important differences between wood, steel and concrete structural systems. Learn methods and procedures for selecting between alternative structural systems. Advanced topics such as complex structural behavior, prestressed concrete and new structural technologies are introduced.

Arch 386 - Building Performance (3-0-3)

Prerequisites: Phys 102, Phys 103. Develop an understanding of the physical concepts of heat, air movement, and thermal mass for use in architectural design. Approaches to dynamic analysis and energy conservation are examined.

Arch 387 - Environmental Control Systems (3-0-3)

Prerequisite: Arch 386. A framework for making informed selections of building systems and equipment. Students provide the necessary background to analyze the advantages and disadvantages of alternative system designs for mechanical, electrical, plumbing, and transportation systems in buildings. An introduction to working with consulting engineers and conducting life-cycle costing of building systems.

Arch 403 - The American Home and Household I (3-0-3)

Prerequisite: junior or senior standing. A cultural, architectural analysis of American homes and households throughout history. Included are the Puritan society and Colonial home, the Victorian home and family, the frontier homestead, 19th century utopian communes, immigrants, the working class poor and urban tenements, war housing, and suburban homes. Students explore the meaning, use and design of each domestic setting from the point of view of society, the family and the individual, considering differences based on race, sex and class.

Arch 404 - The American Home and Household II (3-0-3)

Prerequisite: junior or senior standing. Analyzes the architecture of 20th century American homes and households, hotels, apartment houses, war housing, suburban homes, public projects, collectives, communes, self-help housing, and housing concepts for the future. Psychological, sociological, and cultural perspectives are considered insofar as they affect the architecture of the home.

Arch 408 - Advanced Landscape Architecture (2-3-2)

Prerequisite: Arch 331. Introduces the design, construction and management of contemporary landscape projects through case studies, field trips, and personal contact with prominent practicing landscape architects. A historical perspective of landscape architecture is used as a context for discussion.

Arch 410 - Co-op Work Experience II (3)

Prerequisites: Arch 310 or approval of the school and permission of the Office of Cooperative Education and Internships. Provides major-related work experience. A designated faculty member monitors and evaluates the student's work and project. Requirements include mandatory participation in seminars and completion of a report and/or project.

Arch 419 - Architectural Photography (2-3-3)

Prerequisite: Arch 364. Gives a wide range of photographic solutions for presentations and portfolios. Lectures consist of orientation on general topics, including light and space, using relevant text selections and slide presentations for reinforcement. Includes basic demonstrations of darkroom techniques and unorthodox methods to encourage experimentation.

Arch 422 - Mythical House (3-0-3)

Prerequisites: Arch 172, Arch 252, Arch 363. Shows that the house develops not only in response to reasoning, laws of physics, and biological needs, but also in response to magic, ritual, culture, personality, fantasy, and dreams.

Arch 425 - Building Systems V (0-3-3)

Prerequisite: Arch 326. This is an intermediate course focusing on the principles of structural behavior in withstanding gravity and lateral forces and on the evolution, range, and appropriate application of structural systems and the criteria for selecting various structural systems in contemporary architecture. Specific architectural precedents from the 20th century are used as validating examples. **Effective From: Fall 2007**

Arch 426 - Building Systems VI (0-3-3)

Prerequisite: Arch 326. This is an advanced course focusing on the integration of all building systems including new materials and methods as they relate to high-rise structures and other specialty building types. **Effective From: Fall 2007**

Arch 431 - Advanced Representational Techniques (3-0-3)
This course is intended for upper level architecture students who have completed a number of academic or professional projects. Students must have a basic understanding of computer use. Topics covered will be critical analysis of content, organization of material, and translation of existing work. Instruction will be given in layout software packages such as Adobe Illustrator. Direction will also be given in web site design using Macromedia Flash in an architectural content. **Effective From: Spring 2008**

Arch 432 - P3 Post Presentation Processing (2-3-3)
The project is deemed Architecture, with a capital A, but there remains nagging questions: What would the project be like if viewed stereoscopically? If it were rendered as a 360 degree panoramic view, what would the space be like? If it was accurately superimposed into the site (lighting, color, texture, camera angle), does the design improve when in the context? Would rendering styles using "natural media" be more descriptive? What would the architecture be like at night? **Effective From: Fall 2007**

Arch 433 - Cinematic Literacy for Architects & Urban Designers (3-0-3)
This course will use the digital video camera, digital compositing, and interactive DVD to introduce alternate means of communicating architectural ideas. The course will explore narrative techniques, linear and random-access sequencing and will cover critical analysis of film technique, storyboarding, and the authoring of short vignettes. The final project will be a digital image set on authored DVD expressing an architectural case study of a chosen building, site analysis, and/or urban issue. **Effective From: Fall 2007**

Arch 434 - Simulated Environments (3-0-3)
This course will explore the application of desktop, non-immersive virtual reality to the representation of architecture. Course exercises and projects are designed to uncover both advantages and limitations of this emerging technology, on both practical and theoretical levels. The major focus of the course will be personal evaluation of these tools in the design of both object-specific and the spatial in architectural problem solving. The collaborative nature of the toolkit will inform design decisions vis-a-vis observation of participant behavior and open discussion with interactive critics. **Effective From: Fall 2007**

Arch 463 - Option Studio 1 (1-12-5)
Prerequisite: Arch 364. All 100, 200, 300 level core courses must be completed. Studio methodology allows the students to select from various building programs, the nature of design dealing with technology, environment and the social order. **Effective From: Fall 2007**

Arch 464 - Option Studio II (1-12-5)
Prerequisite: Arch 463. Studio methodology allows students to select from various building programs, the nature of design dealing with technology, environment and the social order. **Effective From: Fall 2007**

Arch 472 - Architectural Programming and Project Development (3-0-3)
Prerequisite: Arch 264. Covers the essentials for programming a building and understanding the full scope of project development that precedes and follows the programming phase. Identify major stakeholders in the building design and production process and examine their roles. Lectures and assignments include: user requirements and client values, methods of pro forma analysis for project development and approval, and how the development process changes over time.

Arch 483/483H - Special Topics (3)
Group investigation of problem of special interest in architecture.

Arch 491 - Independent Study (1)
null

Arch 492 - Independent Study (2)
null

Arch 493 - Independent Study (3)
null

Arch 525 - Building Systems VII (0-3-3)
Prerquisite: Arch 425. This is an advanced course that uses in-depth, detailed case studies of four to six well-designed buildings of various types, from small scale to large, from simple to complex, to illustrate the totality of building systems integration. **Effective From: Fall 2007**

Arch 526 - Building Systems VIII (0-3-3)

Prerequisite: Arch 425. This is an advanced course dealing with structural computation that will conclude with rigorous case study investigations of hybrid and complex structural systems. **Effective From: Fall 2007**

Arch 530 - Methodologies of Architectural History, Theory and Criticism (3-0-3)
Prerequisites: Arch 382. A seminar examining the salient methodologies of architectural history, theory and criticism. Structured around a series of critical texts, with each set of core readings intended to provide a basis for analyzing and assessing the approach in question.

Arch 531A - History of Renaissance Architecture (3-0-3)
Prerequisites: Arch 382. An examination of the development of Renaissance architecture and urban design in Italy and elsewhere in Europe. The re-emergence of the classical tradition is considered within the context of social, political and economic developments as well as formal intentions.

Arch 531B - History of Baroque Architecture (3-0-3)
Prerequisites: Arch 382. An investigation of architectural development from the 17th and 18th centuries in Europe and Latin America, including consideration of stylistic variations, social and political factors, and trends in garden and urban design.

Arch 531C - History of Modern Architecture (3-0-3)
Prerequisites: Arch 382. A study of major tendencies of architectural theory and practice from the mid-19th to the mid-20th centuries. Formal and stylistic transformation is considered in relation to theoretical intentions as well as social, cultural, and technical developments.

Arch 531D - History of American Architecture (3-0-3)
Prerequisites: Arch 382. An investigation of the guiding ideals and dominant stylistic trends in American architecture and planning from colonial times to the mid-20th century. Critical shifts in conception and scope of architectural production considered in relation to the prevailing cultural, socio-economic, and technical contexts out of which they evolved.

Arch 531E - History of Non-Western Architecture (3-0-3)
Prerequisites: Arch 382. An examination of major architectural traditions of China, Japan, Southeastern Asia, India, and the Middle East. Each area is considered with reference to a conceptual, iconographic and stylistic paradigm that evolved from a particular historical context.

Arch 531F - Thresholds of Architectural Theory (3-0-3)
Prerequisites: Arch 382. A seminar that investigates key thresholds of Western architectural theory, from Vitruvius to Robert Venturi, with emphasis on examining the corresponding critical theoretical texts and related didactic buildings and projects.

Arch 531H - Aspects of Urban Form (3-0-3)
Prerequisites: Arch 382. An examination of the major forms and patterns of urban development from classical antiquity to the 20th century, considered in relation to the changing conceptions of the city as well as cultural, socio-economic, and political development.

Arch 532 - Problems and Methods in Architectural Preservation (3-0-3)
Prerequisites: Arch 382. Theory and practice of preservation planning, with emphasis on current concepts, problems and techniques of area preservation in the United States. Exploration of the successive guiding ideals and _approaches to historic preservation in America, together with their European parallels and ante-edents. Discussion of theories of continuity and change in the urban environment and of planning concepts and techniques that further preservation planning objectives in relation to programs for community development and neighborhood conservation.

Arch 533 - Case Studies in Architectural Creativity (3-0-3)
Prerequisite: Arch 364. Considers creativity in architecture from psychological, philosophical and autobiographical perspectives. The buildings, writings and lives of contemporary architects are discussed in the context of general theories of creativity. Each student chooses an individual architect noted for creative accomplishments and prepares a case study of his or her life.

Arch 534 - History of Architectural Technology (3-0-3)
Prerequisites: Arch 382. Survey of the development of building methods and materials. Impact of structural and environmental technology on architectural form and the design process. The role of technology in contemporary architectural theory and practice, including the modern movement, is emphasized.

Arch 535 - History of Architectural Ideas (3-0-3)
Prerequisite: Arch 382. Discusses seminal architectural ideas in the western world from Vitruvius to the present day. Read books written by leading architectural theorists and analyze them in detail.

Arch 536 - Landscape and American Culture (3-0-3)
Prerequisite: Arch 331. As in architecture, the parallel discipline of landscape architecture involves artistic intention set in conjunction with utilitarian concerns. As such, designs on the land include the integration of the arts and sciences of human culture with nature. Discusses landscape as

a manifestation of American culture.

Arch 537 - Advanced Structures (3-0-3)
Prerequisite: Arch 384. Covers advanced material in structures related to steel and wood design including: steel industrial buildings, rigid frames and earthquake design, wood structures under axial loads, and combined bending and axial loads.

Arch 538 - Sustainable Architecture (3-0-3)
Follows two precepts: accepting responsibility for the consequences of design decisions upon human well-being, and the long-term viability of natural systems. Topics include sustainable site design and development, environmentally sensitive building materials, lifecycle cost benefit analysis of building systems, and adaptive reuse.

Arch 539 - Advanced Construction (3-0-3)
Pre-requisite: Arch 242. Explores the relationship between an architect's design intention and the construction document. Design a small building or addition and complete construction drawings of the design. Addresses problems and procedures encountered by an architect during the construction documents phase.

Arch 540 - Acoustics (3-0-3)
Prerequisites: Arch 241, Arch 242, Arch 342. Architectural acoustics: how we hear, physics of sound and materials, aesthetics of design and the processes of construction. Audible sounds, their interaction, perception of echo and directional hearing are applied to interior and exterior building transmission, room acoustics, and setting acceptable acoustical environments.

Arch 543 - Lighting (2-2-3)
Prerequisites: Arch 386 and Arch 387 or equivalents. Explores, through modeling and calculation, the means by which architectural form and detail influence the luminous environment. Perceptual responses such as visual comfort and delight are examined. Topics include daylighting footprints, model design and testing, and computer-assisted light level analysis. Areas of investigation include the relationship between daylight and electric light in architecture; the variations of light with time; analysis of seasonal and weather differences; role of task in lighting strategies; and means of control for light quantity and quality.

Arch 545 - Case Studies in Architectural Technology (3-0-3)
Prerequisite: senior standing. Technological systems involved in the construction and use of buildings. Students conduct in-depth investigation of technology-related problems in architecture and construction. Case study method is used. Construction documents and reports are analyzed. Field visits are required.

Arch 546 - Designing and Optimizing the Building Enclosure (3-0-3)
Prerequisites: Arch 386, CIS 104. Considers the "building envelope,?? the boundary dividing the inside of a structure from the outside environment. Study and design optimal enclosures considering energy exchange, the relationship between energy and light, and life cycle costs.

Arch 547 - Special Topics in Computer Applications (2-2-3)
Prerequisite: senior standing. Evaluation, utilization, and development of computer programs for analysis, simulation and information management. Programs range from energy analysis, building structures analysis, and mechanical systems design to spatial allocation, graphics and computer-aided design. Different theories of information transformation and delivery used in terms of architectural applications. Course hardware ranges from computer-aided design and drafting systems, through micro and mini, to mainframe computers.

Arch 549 - Life Safety Issues in Contemporary Buildings (3-0-3)
Prerequisites: Arch 386, Arch 387. A variety of life safety and comfort situations studied in terms of specific building types. Topics include building evacuation, compartmentalization, fire fighting and suppression, evaluation and testing of new building materials and systems, systems control and management. Special emphasis is on such building types as multi-use, high-density, schools, hospitals, and other institutional categories.

Arch 550 - Building Economics (3-0-3)
Prerequisite: senior standing. Economic issues and methods of analysis influencing the building process and product are presented. The focus is on relations between architectural decisions and economic consequences. Students use computer models to manage building cost data and conduct life cycle costing.

Arch 552 - Real Estate Analysis for Architects (3-0-3)
Prerequisite: completion of the third year. Introduction to the economic, financial and political aspects of real estate and their effect on architectural decision-making. Topics include needs assessment, real estate appraisal, financial instruments, regulations and real estate, design as value-adding, and the effect of tax policies on real estate development.

Arch 556 - Systems Approach to Design and Construction (3-0-3)

Prerequisite: completion of the third year. Lectures, case studies and student projects on understanding human aspiration and needs through design. Topics include land, finance, management, technology, and labor.

Arch 557 - Problems in Modern Housing (3-0-3)
Prerequisite: Arch 382 Historical approach places housing in its social, economic, and political context. Attempts to provide decent, affordable and well-designed housing for broad segments of society are examined. Dwelling is examined through analysis of proto-typical design solutions in urban environments.

Arch 558 - Professional Architectural Practice (3-0-3)
Prerequisite: Arch 364. A forum for examination of the structure and practices of the profession of architecture. The formal and informal relationships between architects, and between architects and clients, government officials, and consultants are studied. Basic principles of office management for the small and large architectural firm are introduced.

Arch 559 - Social Issues in Housing (3-0-3)
Lecture/seminar explores the historical, economic, social, technological, and political basis for current American housing policy and practice. Examines government, community-based and private sector attempts, both failed and successful, at providing decent, affordable, and well-designed housing for broad segments of society. Student teams analyze and discuss, in a series of classroom debates, the housing and planning implications of controversial social problems?from homelessness and racial segregation to caring for the elderly and people with HIV/AIDS? with an emphasis on the role of the architect.

Arch 563 - Pre-comprehensive Studio (1-12-5)
Prerequisites: Arch 463. Studio focuses on the student's ability to assess, select, and conceptually integrate structural systems, building envelope systems, environmental systems, life-safety systems, and building service systems in the building design. **Effective From: Fall 2007**

Arch 564 - Comprehensive Studio (1-12-5)
Prerequisite: Arch 463 and 563. Studio focuses on the student's ability to produce a comprehensive architectural project based on a building program and site that includes development of programmed spaces demonstrating an understanding of structural and environmental systems, building envelope systems, life-safety provisions, wall sections and building assemblies and the principles of sustainability. **Effective From: Fall 2007**

Arch 565 - Comprehensive Studio Lab (0-3-1)
Prerequisites: Arch464. Corequisite: Arch 563 or Arch 564. Held in design studio each week, the lab consists of presentations by the instructor on relevant technical and life safety -issues and student exercises applying these principles to their current design studio project or to existing buildings.

Arch 566 - Senior Thesis (0-15-5)
Prerequisite: Arch 563. An independent study option, which may be chosen by the student with the approval of the school, and in place of Arch 564.

Arch 571 - Everyday Life in the Public Realm (3-0-3)
A significant portion of everyday life takes place in the public realm of streets, sidewalks, parks, transit stations, government buildings, commercial establishments, and cultural institutions. Focuses on recent descriptions and critiques of public space and proposals for change.

Arch 572 - Architecture and Social Change (3-0-3)
Prerequisite: senior standing. Architectural form is analyzed in relation to political, economic and technological change, and change in social values. Buildings and other designed environments such as parks, streets and neighborhoods are studied relative to the social processes and institutions that generate and transform them. The role of the design professions in initiating or supporting change also is considered

Arch 573 - Technologies for Community and Urban Design (3-0-3)
Prerequisite: senior standing. Advanced and traditional technologies analyzed with regard to their role in community and city design, construction and reconstruction. Emphasis on technological systems influencing location, configuration and use. Examples are infrastructures, communication systems and construction technologies. Develops skills in using methods to evaluate alternative technologies relative to their social, economic and physical promise, problems and feasibility.

Arch 574 - Case Studies in Community and Urban Design (3-0-3)
Prerequisite: senior standing. In-depth investigation of specific real-world problems of urban or community design carried out using case method approach. Current practices in the U.S. and other countries studied using interviews with designers, developers, community groups and government agencies. Site visits, reports and other documents provide important sources of information. Final report with supporting documentation required.

Arch 576 - The Architecture of Utopia (3-0-3)

Prerequisite: senior standing. Seminar for the review of utopian projects that have attempted to embody and strengthen social ideas through transformations in the structuring of space. Architectural implications of different literary and philosophical utopias analyzed with an emphasis on those experimental proposals which were realized, in whole or in part, in built form.

Arch 583/583H - Special Topics (3)
Group investigation of problem of special interest in architecture.

Arch 584 - Video and Animation (3-0-3)
Prerequisite: Arch 363. Presents the concepts of 3-D surface modeling, rendering, key frame animation, and video production in the context of the design process using the computer program ALIAS STUDIO. Emphasizes the underlying geometric principles of surface modeling, the components of color theory and texture mapping, the principles of key frame animation, and video production. The project for the semester is a short animated video. Also discusses scene Description Language programming. **Effective Until: Spring 2010**

Arch 585 - Imaginary Worlds: Architecture in Motion Pictures (3-0-3)
Prerequisites: Arch 363, Arch 381. Like childhood photographs in family albums, movies are part of our collective memories and become a unique way of "remembering?? an era or place even one that has never existed or could exist. The study of imaginary worlds in motion pictures provides students with opportunities to gain an awareness of architecture and study it from different perspectives. Movies studied will be limited to those that postulate new, or unique, environments rather than those films that faithfully document reality. Discussions will focus on architectural issues raised by the movies studied as well as those found in critical essays.

Arch 588 - Architoons (3-0-3)
Prerequisite: Arch 364. Through the medium of film, applies literary devices to architectural contexts, including caricature, parody, lampoon, satire and farce. Studies historical and contemporary animations and short films for their treatment of meaning, story line and sequence, timing, environmental and psychological mood, atmosphere and emotion. Using 3-D modeling and animation software, each student produces an animated short subject illustrating an architectural principle or providing a humorous look at architectural history and theory.

Arch 591 - Independent Study (1)
null

Arch 592 - Independent Study (2)
null

Arch 593 - Independent Study (3)
null

GRADUATE COURSES:

Arch 500G - Computer Programming and Graphics Problems (2 credits)
Introductory computer science with applications in computer graphics for architecture. Emphasizes programming methodology using a high-level language as the vehicle to illustrate concepts. Basic concepts of computer systems, software engineering, algorithm design, programming languages, and data abstraction, with applications.

Arch 501G - Architectural Design I (5 credits)
Prerequisite: graduate level standing. Core Studio. Fundamentals of architectural design. Sequence of projects explore two- and three-dimensional design. Choice of form and aesthetics is related to spatial resolution of function and context. Design as a representational medium is emphasized. Taken concurrently with Arch 555G.

Arch 502G - Architectural Design II (5 credits)
Prerequisites: Arch 501G, Arch 521G, Arch 528G, Arch 555G. Core Studio. Extends the knowledge of design, basic concepts and ideas introduced in Arch 501G. Emphasis is on developing technical drawing, and model-making skills. Also covered are two- and three-dimensional composition. Links to the history and theory sequence are made.

Arch 503G - Architectural Design III (5 credits)
Prerequisites: Arch 502G, Arch 511G, Arch 522G, Arch 529G, Core Studio, Intermediate design studio. Introduction to structure. Properties of materials both physical and in the abstract. Builds on knowledge gained from construction and structures courses, spatial demands and design possibilities of different structural systems. Design of structure type, model and context, and comparisons of building typology for rational structure. Drawing and its role in design thinking.

Arch 504G - Architectural Design IV (5 credits)

Prerequisites: Arch 503G, Arch 512G, Arch 523G. Arch 500G, Core Studio. Second semester intermediate design studio. Design of buildings and integration of systems, physical and conceptual. Design methodology generates new information on buildings as coherent assemblies of systems. Also covers analysis and synthesis of form and introduction to applications of computer-assisted design (CAD). Preparation of design portfolio will complete core studio sequence.

Arch 505G, Arch 506G, Arch 507G - Advanced Design Options I, II, III (6 credits each)
Prerequisites: completion of all core courses or their equivalent. Required vertical studio electives; must be taken sequentially. Covers arange of advanced design issues in depth: integration of organizational, social, technical, spatial, and aesthetic issues within consistently articulated applied design solutions. abcd www

Arch 511G - Structures I (3 credits)
Prerequisites: graduate level standing, college level physics and calculus or equivalent, Arch 521G. Introduces structural statics through timber and steel design. Analysis and selection of building materials and structural systems related to their impact on building design. **Effective Until: Summer 2007**

Arch 512G - Structures II (3 credits)
Prerequisites: Arch 511G, Arch 522G. Builds on information presented in Arch 511G. Emphasizes details and methods of concrete design, mixing, pouring and testing. Methods and details of steel design are summarized. **Effective Until: Summer 2007**

Arch 513G - Structures III (3 credits)
Prerequisite: Arch 512G. Review of methods and procedures for choosing structural systems. Overview of differences among wood, steel and concrete systems. Students are introduced to complex structural behavior, prestressed concrete and new structural technology.

Arch 521G - Construction I (3 credits)
Prerequisite: graduate level standing. Introduction to the construction process and how it relates to architecture. Compatibility of materials and methods of construction are studied with respect to wood, heavy timber, steel and masonry construction. Emphasis is placed on materials compatibility, construction technology, and the role of architectural documents in the construction process. **Effective Until: Summer 2007**

Arch 522G - Construction II (3 credits)
Prerequisite: Arch 521G. Continuation of 521G. Construction practices and details of steel, precast and poured-in-place concrete construction. Review of testing methods, procedures for setting standards, forces of determination, and new materials research. Emphasis is on materials and systems selection criteria. **Effective Until: Summer 2007**

Arch 523G - Building Performance (3 credits)
Prerequisites: Arch 522G, college level physics or equivalent. Impact on building design of heat, air movement, and thermal mass in an array of climatic conditions. Also covered are dynamic thermal and passive solar analysis for energy-conscious architectural design. **Effective Until: Summer 2007**

Arch 524G - Environmental Control Systems (3 credits)
Prerequisite: Arch 523G. Analysis of different configurations of building equipment systems related to building design and life cycle costs. Relationships among mechanical, electrical, plumbing and transport systems are examined. The role of the architect and other professionals in equipment design and selection are studied, with an emphasis on criteria for system selection. **Effective Until: Summer 2007**

Arch 528G - History of Architecture I (3 credits)
Prerequisite: graduate level standing. Introduction to the history of architecture. Emphasis on classical architecture from antiquity to the modern period. Evolution of the various themes and theories that underlie western architecture is presented chronologically.

Arch 529G - History of Architecture II (3 credits)
Prerequisite: Arch 528G. Continuation of Arch 528G. Introduces concepts of modernism and brings the history of western architecture to the contemporary period.

Arch 541G - Building Systems I: Intro. to Building Technologies (3 credits)
This course is an introductory survey of the general principles and application of Sustainable Design, Site Systems, Structural Systems, Environmental Systems, Envelope Systems, Materials and Assembly Systems. This course will primarily focus on low-rise wood and steel structures. **Effective From: Fall 2007**

Arch 542G - Building Systems II: Integrated Building Technologies (3 credits)
Continuing Systems I. This course is an introductory survey of the interrelationship of the principles and applications of Sustainable Design, Site

Design, Structural Systems, Environmental Systems, Envelope Systems and Materials and Assembly Systems. This course will primarily focus on low and medium-rise concrete and masonry structures and is coordinated with a studio design/build experience. **Effective From: Fall 2007**

Arch 543G - Building Systems III: Analysis Building Envelope (3 credits)
An introductory survey of the basic principles of building, environmental control, and service systems as these relate to the building envelope. This course will primarily cover thermal enclosure, climate modification, environmental systems, energy use, and sustainable design. It also introduces the principles of health and safety in the design of buildings. **Effective From: Fall 2007**

Arch 544G - Building Systems IV: Intro. Building Services (3 credits)
This is an intermediate course focusing on the understanding of the principles, performance criteria, and applications of environmental and building service systems including lighting, acoustical, plumbing, electrical, vertical transportations, egress, communication, security, and fire protection systems. **Effective From: Fall 2007**

Arch 545G - Building Systems V: Structural Principles and APPS (3 credits)
This is an intermediate course focusing on the principles of structural behavior in withstanding gravity and lateral forces and on the evolution, range, and appropriate application of structural systems and the criteria for selecting various structural systems in contemporary architecture. Specific architectural procedents from the 20th century are used as validating examples. **Effective From: Fall 2007**

Arch 546G - Building Systems VI: High Rise and Special APPS (3 credits)
This is an advanced course focusing on the integration of all building systems including new materials and methods as they relate to high-rise structures and other specialty building types. **Effective From: Fall 2007**

Arch 547G - Building Systems VII: Contemporary Case Studies (3 credits)
This is an advanced course that uses in-depth, detailed case studies of four to six well-designed buildings of various types, from small scale to large, from simple to complex, to illustrate the totality of building systems integration. **Effective From: Fall 2007**

Arch 548G - Building Systems VIII: Structural Computation (3 credits)
This is an advanced course dealing with structural computation that will conclude with rigorous case study investigation of hybrid and complex structural systems. **Effective From: Fall 2007**

Arch 555G - Architectural Graphics (3 credits)
Prerequisite: graduate level standing. Documentary, descriptive and denotative media are introduced. Also covers methods of representation, delineation and reproduction. Skills are developed in technical drawing, perspective construction, projections, and format design. Taken concurrently with Arch 501G.

Arch 569G - Building and Development (3 credits)
Familiarization with the larger process of building production, of which architecture is one important part. Focus on the role of the architect in the areas of current building development: an examination of how redefinition or change might improve the process. Lectures deal with all factors of the building process and interviews with the various actors involved in designing, approving, financing and making buildings. Students have various assignments including a major term project.

Arch 579G - Professional Architectural Practice (3 credits)
Prerequisite: completion of M.Arch. core sequence. Review of the formal, informal, legal, and ethical obligations of the professional architect. Traditional relationships among the architect, clients, engineers and other participants in the design and building industry are studied. Principles of office management and problems of liability are introduced. Also fulfills core requirement of dual degree option for M.Arch./Master of Science in Management.

Arch 619 - Architectural Photography (3 credits)
Prerequisites: Arch 501G, Arch 502G, Arch 503G. Photography for architectural presentations and portfolios. Lectures include orientation on light and space, slide presentations, and the use of text to reinforce photographic material. Demonstrations include basic darkroom techniques, and methods to encourage experimentation in photography.

Arch 630 - Methodology of Architectural History, Theory and Criticism (3 credits)
Prerequisites: Arch 528G, Arch 529G. This seminar is structured around notable readings on architectural history, theory and criticism to provide students with a sound basis for critical analysis and assessment. It is recommended for students who select history and theory as their area of concentration.

Arch 631A - History of Renaissance Architecture (3 credits)
Prerequisites: Arch 528G, Arch 529G. Development of architecture and urban design in Italy and elsewhere in Europe during the Renaissance:

re-emergence of the classical Greek and Roman architectural tradition; social, political and economic developments; formal intentions and transformations in the 16th and 17th centuries.

Arch 631B - History of Baroque Architecture (3 credits)
Prerequisites: Arch 528G, Arch 529G. The emergence of baroque architecture and urban design in Rome in the 17th century; analysis of the works of Bernini, Borromini, Cortona and their contemporaries and successors through 1750. Development of baroque architecture elsewhere in Italy and Europe; late baroque and rococo; the advent of neo-classicism.

Arch 631C - History of Modern Architecture (3 credits)
Prerequisites: Arch 528G, Arch 529G. Major tendencies in architectural theory and practice from the mid-19th to the mid-20th centuries. Formal and stylistic transformation considered in relation to theory, social, cultural, and technical developments.

Arch 631D - History of American Architecture (3 credits)
Prerequisites: Arch 528G, Arch 529G. Aesthetic, social, cultural and technical developments in American architecture and planning, from colonial times to the mid-20th century.

Arch 631E - History of Non-Western Architecture (3 credits)
Prerequisites: Arch 528G, Arch 529G. Examination of major architectural traditions and styles of China, Japan, Southeast Asia, India and the Middle East.

Arch 631F - Thresholds of Architectural Theory (3 credits)
Prerequisites: Arch 528G, Arch 529G. Seminar on Western architectural theory dating from Vitruvius to the present time. Examines critical texts and studies related building and projects.

Arch 631H - History and Theory of Infrastructure (3 credits)
Prerequisites: Arch 528G, Arch 529G. The historical role of infrastructure in the formation of cities and the relation of planning theories to urban culture. Case studies are used to develop effective ways of learning urban design; method and substance are equally emphasized. Concentration on the social, economic, political, technological and topographic factors that affect urban form; analysis of urban design schemata and their relation to patterns of use; and the critical appraisal of planning ideologies and strategies. Same as MIP 631.

Arch 632 - Problems and Methods in Architectural Preservation (3 credits)
Prerequisites: Arch 528G, Arch 529G. Theory and practice of preservation planning. Compares American and European preservation concepts, problems and techniques. Also covers theories on continuity and change in urban environments, and preservation-planning for community development and neighborhood conservation.

Arch 633 - Case Studies in Architectural Creativity (3 credits)
Prerequisite: Arch 528G, Arch 529G. Considers creativity in architecture from psychological, philosophical and autobiographical perspectives. The buildings writings and lives of contemporary architects are discussed in the context of general theories of creativity. Each student chooses an individual architect noted for creative accomplishments and prepares a case study of his or her life.

Arch 634 - History of Architectural Technology (3 credits)
Prerequisites: Arch 528G, Arch 529G. Survey of the development of building methods and materials. Impact of structural and environmental technology on architectural form and the design process. The role of technology in contemporary architectural theory and practice including the modern movement is emphasized. Recommended for students who select building science as their area of concentration.

Arch 640 - Acoustics (3 credits)
Prerequisites: completion of core sequence or equivalent. Architectural acoustics: how we hear, physics of sound and materials, aesthetics of design and the processes of construction. Audible sounds, their interaction, perception of echo and directional hearing are applied to interior and exterior building transmission, room acoustics, and setting acceptable acoustical environments.

Arch 641 - Experiments in Structural Form (3 credits)
Prerequisites: completion of core sequence or equivalent. Architectural form through model design, construction and testing of minimum structures, including elements of soap film study, orthogonal and diagonal grids, design of tension grids through deflection loading, photoelastic models and calculation. Also compares geometric systems, patterning and proportion, symmetry, asymmetry, relative size, nesting, linearity and spiral orders, rectilinear patterns, and randomness in architectural structure and form.

Arch 643 - Lighting (3 credits)
Prerequisites: Arch 501G, Arch 502G, Arch 503G, Arch 523G, Arch 524G. Through modeling and calculation, influence of the luminous environment on architectural form and detail. Perceptions of visual comfort and daylight are examined. Topics include daylighting footprints, model design and

testing, and computer-assisted, light-level analysis. Relationship between daylight and artificial light in architecture, variations of light with time, analysis of seasonal and weather differences, role of task in lighting strategies, and means of control for light quantity and quality.

Arch 644 - Systems Approach to Design and Construction (3 credits)
Prerequisite: completion of core sequence. Lectures, case studies and student projects on understanding human aspirations and needs through design. Topics include land, finance, management, technology and labor.

Arch 645 - Case Studies in Architectural Technology (3 credits)
Prerequisite: completion of core sequence. Case-study method used for in-depth investigation of the relationship among various technological systems in a building and technologically-related problems in architecture and construction.

Arch 646 - Designing and Optimizing the Building Enclosure (3 credits)
Prerequisite: completion of core sequence. Considers the "building envelope," the boundary dividing the inside of a structure from the outside environment. Students study and design optimal enclosures considering energy exchange, the relationship between energy and lighting, and life cycle costs.

Arch 647 - Special Topics in Computer Applications (3 credits)
Prerequisite: completion of core sequence. Evaluation and use of computer graphics hardware and software for architectural applications. Focus is on computers as tools, operating systems and methods of data manipulation. Two- and three-dimensional modeling software are discussed, and assignments using such software are given to provide understanding of the modeling of built environments.

Arch 649 - Life Safety Issues in Contemporary Buildings (3 credits)
Prerequisite: completion of core sequence. A variety of life safety and comfort situations are studied in different building types. Topics include building evacuation, compartmentalizing, fire fighting and suppression, evaluation and testing of new building materials and systems, systems control and management. Special attention is placed on multi-use, high-density buildings.

Arch 650 - Economy of Building (3 credits)
Prerequisite: completion of core sequence or equivalent. Economic consequences of design decisions. Topics include: relationship among economy, efficiency and quality; life-cycle cost of design; improving the economy of building processes and products through innovation; and environmental concerns. This course is required for the dual degree M.Arch./Master of Science in Management program. It can also be used as an elective in the M.Arch. program.

Arch 651 - Real Estate Analysis for Architects (3 credits)
Prerequisite: completion of core sequence. Introduction to the economic, financial and political aspects of real estate and their effect on architectural decision-making. Topics include: needs assessment, real estate appraisal, financial instruments, regulations and real estate, design as value-adding, and the effect of tax policies on real estate development. This course is required for the dual degree M.Arch./Master of Science in Management program. It can also be used as an elective in the M.Arch. program.

Arch 652 - Architectural Project Management (3 credits)
Prerequisites: completion of core sequence and Arch 579G. Management of architectural projects: project costs, timing, personnel, documentation, professional ethics and resource management. This course is required for the dual degree M.Arch./Master of Science in Management program. It may be used as an elective in the M.Arch. program.

Arch 661 - Directed Studies of Architecture (3 credits)
Prerequisites: completion of core and two elective courses; and approval from the graduate advisor. Independent, in-depth research on an analytical, theoretical or technical area of architecture. Student prepares formal research proposal with permission of faculty advisor and approval of graduate advisor. Required as pre-thesis research. See also course description for MARC 701.

Arch 662 - Special Topics in Architecture (3 credits)
Topics vary each semester. Refer to the School of Architecture bulletin during university registration periods for a list of current topics and possible prerequisites.

Arch 663 - Introduction to Sustainable Architecture (3 credits)
Prerequisite: Arch 523G. Environment design of buildings. The five characteristics of green buildings: sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality. The US Green Building Council's Green Building Rating System, review of several major buildings of exemplary design.

Arch 664 - Indoor Environmental Quality in Sustainable Design Buildings (3 credits)
Prerequisite: Arch 523G. Supportive ambient conditions, including thermal comfort and acceptable indoor air quality, visual comfort, and

appropriate acoustical quality, overall physical and psychological well-being for workplace quality, performance and productivity.

Arch 665 - Sustainable Design of Energy Efficient Buildings (3 credits)
Prerequisite: Arch 523G. Evaluation of heating and cooling loads, impact on fuel consumption, energy software analysis for design and efficiency. Technology of passive solar design and building integrated photovoltaics.

Arch 666 - Sustainable Design with Efficient Materials and Resources (3 credits)
Prerequisite: Arch 523G. Environmentally sensitive site design; issues of wildlife habitat, erosion, ground water recharge, and threats to water quality of surface water bodies and aquifers. Water reclamation, materials and energy conservation, waste reduction and recycling.

Arch 672 - Architecture and Social Change (3 credits)
Prerequisite: graduate level standing. Analysis of architectural form with respect to political, economic and technological change. The built environment is studied in relation to society and culture. The role of design professions in initiating or supporting change is also considered.

Arch 673 - Infrastructure Planning in Practice (3 credits)
Infrastructure planning principles, methods and tools. Through selected examples, acquaintance with infrastructure planning theories and models, quantitative methods of research and analysis, information management, decision making, and implementation techniques. Same as MIP 673.

Arch 674 - Infrastructure and Architecture (3 credits)
Examination of areas of overlap and continuity between architecture, landscape architecture, urban design, building science and infrastructure. Topics include the typology, programming and design of public facilities; the housing fabric; the relation between built form, urban space and infrastructure. Same as MIP 674.

Arch 675 - Elements of Infrastructure Planning (3 credits)
Introductory survey of the basic principles, operation and design of physical infrastructure systems including roads, public transportation, community facilities, public open space, surface drainage, and electric, gas, water, waste disposal, and telecommunications services. Same as MIP 675.

Arch 676 - The Architecture of Utopia (3 credits)
Prerequisite: graduate level standing. Seminar looks at several ideas of utopia from literature and philosophy and how they embody transformations in the structure of space, and their architectural implications.

Arch 678 - Graduate Problems in Modern Housing (3 credits)
Prerequisite: graduate level standing. Students learn to analyze political, technical and economic aspects of contemporary housing policy and practice. Attempts to provide well-designed, affordable housing responsive to the needs of large numbers of people are examined. Examples of housing from the mid-19th century to the present day are outlined.

Arch 680 - Graduate Co-op Work Experience I (3 additive credits)
Prerequisites: completion of core sequence, permission from graduate advisor and Division of Career Development Services. Students gain work experience and reinforcement of their academic programs. An architecture faculty Co-op advisor monitors and evaluates student work and project. Co-op work experiences may be acceptable equivalents for apprenticeships mandated by the New Jersey State Board of Architects and for eligibility to take the architecture licensing examination. This course is required for participation in the Housing Scholars Program. Course does not fulfill degree requirements.

Arch 681/682 - Graduate Co-op Work Experience II and III (3 additive credits)
Prerequisites: completion of core sequence, permission of graduate advisor and Division of Career Development Services. Used for extended summer-fall (681) or spring-summer (682) work experience. Does not fulfill degree requirements.

Arch 686 - Research Methods for Environmental Design (3 credits)
Introduction to methods of inquiry useful to professionals planning and designing buildings, communities and cities. Skills developed in problem definition and phenomena: measurement, modeling, testing and evaluation. Open to undergraduates with permission of instructor.

Arch 770 - Development of the American City (3 credits)
Prerequisite: Enrollment in the Urban Systems PhD program or permission of the instructor. Introduction to research in urban history, focusing on the American city. Key texts that deal with the development of the American city will be studied in depth, with particular emphasis on the approaches, methodologies, and sources. Each student will conduct bibliographic research on a city or urban sector from a defined perspective.

Arch 771 - Pathology of Urban Systems (3 credits)
Prerequisite: Enrollment in the Urban System PhD program or permission of the instructor. Definition of pathology of urban systems as large-scale disasters that have resulted in major destruction of the urban fabric and called for radical re-planning projects. Investigation of historic case

studies. The aftermath of natural and man-made disasters including war; contemporary case studies.

MARC 701 - Master's Thesis (6 credits)

Prerequisites: Arch 506G, Arch 661, and approval from graduate advisor. Alternative to Arch 507G. Under the supervision of a faculty advisor, independent study of issues in the student's area of concentration developed during Arch 661.

MSAS 701 - Master of Science in Architectural Studies Thesis (6 credits)

Prerequisites: completion of required courses, electives, Arch 661 and approval from MSAS advisor. Under supervision of a thesis advisor, independent, in-depth examination of a subject in the student's area of concentration developed during Arch 661.

BioInformatics:

UNDERGRADUATE COURSES:

BNFO 135 - Programming for Bioinformatics (3-0-3)
The ability to use existing programs and to write small programs to access bioinformatics information or to combine and manipulate various existing bioinformatics programs has become a valuable part of the skill set of anyone working with biomolecular or genetic data. This course provides an unerstanding of the architecture of bioinformatics toolkits and experience in writing small bioinformatics programs using one or more of the scripting ("glue") languages frequently employed for such tasks. **Effective From: Spring 2009**

BNFO 136 - Programming for Bioinformatics II (3-0-3)
Advanced programming skills in Perl or Python with appliations to bioinformatics. **Effective From: Spring 2010**

BNFO 235 - Programming for Bioinformatics (3-0-3)
The ability to use existing programs and to write small programs to access bioinformatics information or to combine and manipulate various existing bioinformatics programs has become a valuable part of the skill set of anyone working with biomolecular or genetic data. This course provides an understanding of the architecture of bioinformatics toolkits and experience in writing small bioinformatics programs using one or more of the scripting ("glue") languages frequently employed for such tasks. **Effective From: Fall 2006 Until: Fall 2008**

BNFO 240 - Principles of Bioinformatics II (3-0-3)
Prerequisites: Math 211, R120:301, CS 114 or permission of the instructor. This course provides an introduction to the field of bioinformatics. It includes a description of the molecular basis of genomics and proteomics, the computer-based and mathematical methods used in bioinformatics, and the application of these methods toward understanding biological systems at the cellular and molecular level. It also includes a description of the application of bioinformatics to drug discovery. **Effective From: Fall 2006**

BNFO 340 - Data Analysis for Bioinformatics (3-0-3)
Advanced data analysis skills with applicaitons to popular bioinformatics problems. **Effective From: Spring 2010**

BNFO 482 - Databases and Data Mining in Bioinformatics (3-0-3)
Surveys biological databases and tools for managing them. Covers concepts and principles of data mining in bioinfomratics. Hands-on experience for mining genomic data using ORACLE and SQL. **Effective From: Spring 2010**

BNFO 491H - Honors Computer Science Project (3-0-3)
Prerequisites: CS 490, senior standing in the Honors College and project proposal approval. A course similar to CS 491, with a project of greater depth and scope. **Effective From: Fall 2006** **(Archived Versions)**

GRADUATE COURSES:

BNFO 601 - Foundations of Bioinformatics I (3 credits)
Introduction to script programming and basic biomolecular sequence analysis. Topics covered include sequence alignment, dynamic programming algorithms, hidden Markov models, and their implementation with a scripting language. **Effective From: Fall 2009**

BNFO 602 - Foundations of Bioinformatics II (3 credits)
Topics in bioinformatics such as phylogeny reconstruction, genome-wide association study analysis, structure and sequence analysis, and machine learning and statistical approaches. Focus of the course is on a hands-on project on a contemporary bioinformatics problem.
Effective From: Fall 2009

BNFO 615 - Data Analysis in Bioinformatics (3 credits)
Data structures, algorithms, and statistical approaches in bioinformatics. The course emphasis is on statistical models, algorithms, and data structures with relevant biological background and motivation. **Effective From: Fall 2009**

BNFO 644 - Data Mining and Management in Bioinformatics (3 credits)

Concepts and principles of data management in bioinformatics. Presents methods for indexing, querying, and mining data obtained from molecular and evolutionary biology. Provides hands-on experience in designing a simple information system for querying and mining genomic data using ORACLE or MySQL.

Biology: Offered by the Federated Department of Biological Sciences at NJIT and Rutgers-Newark

UNDERGRADUATE COURSES:

Biol 222 - Evolution (3-0-3)
Prerequisites: R120:101 and R120:102, Rutgers General Biology I and II. This course will provide a comprehensive introduction to the field of evolutionary biology. Topics will include: the development of evolutionary theory, the history of the evolution of life on Earth, the genetic basis of variation and heredity, natural selection, evolution and development, and speciation. **Effective From: Fall 2009**

Biol 225 - Insects and Human Society (3-0-3)
Prerequisite: R120:101 and R120:102 (General Biology sequence). This course, through lecture and discussion, will cover the breadth of influence insects have on society, from the provision of ecosystem services to the economic and social costs associated with their role as vectors of disease. Student will learn how insects are used in science, agriculture and indicators of global climate change and water quality. Students will also learn some insect biology and have the opportunity to observe insects (living and dead) to gain a better understanding of the diversity and complexity of these creatures. **Effective From: Spring 2010**

Biol 310 - Research and Independent Study (3-0-3)
Prerequisites: Departmental approval and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the co-op office. Mandatory participation in seminars and completion of a report. **Effective From: Spring 2007**

Biol 342 - Developmental Biology (Embryology) (3-0-3)
Prerquisite: R120:301. Descriptive and experimental approaches to molecular, cellular and organismal changes during embryonic development; mechanisms of cell differentiation, organogenesis, morphogenesis, and pattern formation. **Effective From: Fall 2009**

Biol 368 - The Ecology and Evolution of Disease (3-0-3)
This course addresses those aspects of ecology and evolutionary biology most relevant to understanding the origin, dynamics and treatment of disease (both infectious and hereditary/genetic). The class will be a mixture of lecture and discussion of case studies. Material covered will include biology, mathematical models, and some aspects of human behavior. **Effective From: Fall 2008**

Biol 375 - Conservation Biology (3-0-3)
Prerequisites: R120:101, R120:102 General Biology I & II. This course will provide a comprehensive introduction to the field of conservation biology, as well as philosophical and economic concerns. **Effective From: Fall 2009**

Biol 383 - Neural Basis of Behavior (3-0-3)
Prerequisite: R120:301 Foundations of Biology. This lecture course explores the neural mechanisms underlying animal behavior. This course is intended for upper-level undergraduate students who have some background in biology, hence the prerequisite for Foundation of Biology. This courses would also be of interest to graduate students interested in neuroscience, such as, students in the Quantitative Neuroscience (QNS) program, students in the Integrative Neuroscience (INS) program, and students at the Center for Molecular and Behavioral Neuroscience (CMB). It is unnecessary for the students to have taken animal behavior or neurobiology; however, these courses would be helpful. **Effective From: Fall 2008**

Biol 405 - Cell Physiology and Imaging (1-3-4)
Prerequisites: Phys 111, Phys 121 and R120:355. This course will examine celluar phenomena, such as subcellular structure, secretion, intracellular calcium regulation, etc., from a physiological perspective and using imaging techniques as a tool to understand them. Cell biology, and optics and the user of microscopes, will be discussed in detail **Effective From: Spring 2009**

Biol 410 - Work Experience II (3-0-3)
Prerequisites: Biol 310, departmental approval and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic progam. Work assignments facilitated and approved by the co-op office. Mandatory participation

in seminars and completion of a report. **Effective From: Spring 2007**

Biol 447 - Cellular and Systems Neuroscience (3-0-3)
Prerequisite: R120:201,R120:202 Foundations of Biology. This course will examine, from both a cellular and a systems perspective, neurophysiological phenomena such as excitability, impulse conduction, integration of activity at the cellular and at the network level, and network level behavior of the nervous system. The goal is to provide students with the basic knowledge to understand neurobiological processes at all levels of complexity. **Effective From: Spring 2010**

Biol 463 - Insects and Human Society (3-0-3)
This course, through lecture and discussion, will cover the breadth of influence insects have on society, from the provision of ecosystem services to the economic and social costs associated with their role as vectors of disease. Students will learn how insects are used in science, agriculture and as indicators of global climate change and water quality. Students will also learn some insect biology and have the opportunity to observe insects (living and dead) to gain a better understanding of the diversity and complexity of these creatures. **Effective From: Spring 2010**

Biol 475 - Ecological Field Methods and Analysis (3-0-3)
Prerequisites: R120:370 Plant Ecology or R120:380 Animal Ecology or permission of instructor. This field-orientated class will study animal and plant communities using a combination of field, laboratory and theory work. The goal of this course is to understand ecological principles and to introduce students to modern methodology for field work, the techniques and instruments used, as well as the theoretical basis for their application. Students will collect data, analyze them and report the results in written and oral format. **Effective From: Fall 2009**

Biol 491 - Honors Research Project (3-0-3)
Prerequisites: Honors College students only. Departmental approval required. Research in Biology. Each student works under the supervision of a Biology or associated faculty member. A research paper and poster are required. **Effective From: Fall 2007**

Biol 492 - Research and Independent Study (3-0-3)
Prerequisite: Departmental approval required. Research in Biology. Each student works under the supervision of a Biology or associated faculty member. **Effective From: Spring 2007**

R120:101 - General Biology I (3-3-4)
For more details go to Rutgers Catalog.

R120:104 - Human Health and Disease (3)
For more details go to Rutgers Catalog.

R120:109 - Basic Plant Science (3)
For more details go to Rutgers Catalog.

R120:110 - Basic Plant Science Laboratory (1)
For more details go to Rutgers Catalog.

R120:203 - Plant Biology (3)
For more details go to Rutgers Catalog.

R120:204 - Economic Botany (3)
For more details go to Rutgers Catalog.

R120:205 - Environmental Issues (3)
For more details go to Rutgers Catalog.

R120:206 - General Horticulture (3)
For more details go to Rutgers Catalog.

R120:207 - Horticulture Laboratory (1)
For more details go to Rutgers Catalog.

R120:208 - Human Sexuality (3)
For more details go to Rutgers Catalog.

R120:211 - Plant Kingdom (4)
For more details go to Rutgers Catalog.

R120:230 - Biology of Seed Plants (4)
For more details go to Rutgers Catalog.

R120:235 - Microbiology (3)
For more details go to Rutgers Catalog.

R120:241 - Anatomy and Physiology (4,4)
For more details go to Rutgers Catalog.

R120:301 - Foundations of Biology: Cell and Molecular Biology (3-0-3)
For more details go to Rutgers Catalog.

R120:311 - Taxonomy of Vascular Plants (4)
For more details go to Rutgers Catalog.

R120:320 - Comparative Anatomy of Vertebrates (3-3-4)
For more details go to Rutgers Catalog.

R120:322 - Evolution (3)
For more details go to Rutgers Catalog.

R120:325 - Animal Parasites (3)
For more details go to Rutgers Catalog.

R120:326 - Laboratory Exercises in Parasitology (1)
For more details go to Rutgers Catalog.

R120:327 - Biology of Invertebrates (4)
For more details go to Rutgers Catalog.

R120:328 - Ornithology (3)
For more details go to Rutgers Catalog.

R120:330 - Plant Physiology (4)
For more details go to Rutgers Catalog.

R120:335 - General Microbiology (4)
For more details go to Rutgers Catalog.

R120:340 - Mammalian Physiology (3-3-4)
For more details go to Rutgers Catalog.

R120:342 - Developmental Biology (4)
For more details go to Rutgers Catalog.

R120:352 - Genetics (3)
For more details go to Rutgers Catalog.

R120:355 - Cell Biology (3)
For more details go to Rutgers Catalog.

R120:356 - Molecular Biology (3)
For more details go to Rutgers Catalog.

R120:358 - Microanatomy of Cells and Tissues (4)
For more details go to Rutgers Catalog.

R120:360 - Elementary Biochemistry (3)
For more details go to Rutgers Catalog.

R120:370 - Plant Ecology (3)
For more details go to Rutgers Catalog.

R120:371 - Field Studies in Plant Ecology (3)
For more details go to Rutgers Catalog.

R120:380 - Animal Ecology (3)
For more details go to Rutgers Catalog.

R120:381 - Field Studies in Animal Ecology (2)
For more details go to Rutgers Catalog.

R120:382 - Animal Behavior (3)
For more details go to Rutgers Catalog.

R120:403 - Biological Ultrastructure (3)
For more details go to Rutgers Catalog.

R120:404 - Light and Electron Microscopy (4)
For more details go to Rutgers Catalog.

R120:413 - Mycology (4)
For more details go to Rutgers Catalog.

R120:414 - Phycology (4)
For more details go to Rutgers Catalog.

R120:415 - Paleobotany (4)
For more details go to Rutgers Catalog.

R120:430 - Plant Growth and Development (4)
For more details go to Rutgers Catalog.

R120:435 - Microbial Physiology and Metabolism (3)
For more details go to Rutgers Catalog.

R120:443 - Immunology (3)
For more details go to Rutgers Catalog.

R120:445 - Endocrinology (3)
For more details go to Rutgers Catalog.

R120:451 - Laboratory in Cellular and Molecular Biology I: Cellular Biophysics (4)
For more details go to Rutgers Catalog.

R120:452 - Laboratory in Cellular and Molecular Biology II: Molecular Biotechniques (4)

For more details go to Rutgers Catalog.

R120:455 - Molecular Cell Biology (3)
For more details go to Rutgers Catalog.

R120:456 - Virology (3)
For more details go to Rutgers Catalog.

R120:470 - Field Ecology (3)
For more details go to Rutgers Catalog.

R120:471 - Ecological Physiology (3)
For more details go to Rutgers Catalog.

R120:472 - Environmental Assessment (3)
For more details go to Rutgers Catalog.

R120:473 - Ecology of Microorganisms (3)
For more details go to Rutgers Catalog.

R120:481 - Marine Biology (4)
For more details go to Rutgers Catalog.

R120:486 - Tropical Field Biology (2)
For more details go to Rutgers Catalog.

R120:491 - Problems in Biology (BA,BA)
For more details go to Rutgers Catalog.

GRADUATE COURSES:

Biol 612 - Comparative Animal Physiology (3 credits)
This course will explore how animals, from invertebrates to vertebrates, function from the cellular to the organism level. The study of the structure and function of the various organs provides insight into how animals survive extreme environments and how they respond to changes in their environment. The comparative approach shows that the underlying physiological principles that govern life are common to all animals and yet animals have evolved unique and sometimes startling physiological solutions to problems posed by their particular environments.
Effective From: Fall 2009

Biol 622 - Evolution (3 credits)
This course will provide a comprehensive overview of research in the field of evolutionary biology. Topics will include: the development of evolutionary theory, the history of the evolution of life on Earth, the genetic bases of variation and heredity, natural selection, evolution and development, and speciation. The format will be brief lectures to review topics covered in text, followed by class discussions of relevant primary literature. Students will write two papers on the topic of their choice and will be required to lead a minimum of one class discussion.
Effective From: Spring 2010

Biol 630 - Critical Thinking for the Life Sciences (3 credits)
Researchers in the biological sciences must understand and be able to effectively apply the scientific method, and they must also be able to clearly communicate their ideas and results. This course will involve heavy student participation and discuss the scientific method, analyze and discuss data gathering and organizing, and will analyze existing grant proposals with the goal of enabling graduate students to write a clear and convincing grant proposal. **Effective From: Fall 2009**

Biol 638 - Computational Ecology (3-0-3)
An overview of computational approaches to the study of mathematical models in ecology. Topics include one-, two-, and multi-species models, life history analysis, spatial dynamics, epidemiology. The course is taught as a hands-on computer lab in which students explore models, perform simulations and solve problems. **Effective From: Spring 2006**

Biol 698 - Selected topics in Biology (3-0-3)

Survey of recent research topics in Biology at the Master's level. **Effective From: Spring 2008**

Biol 699 - Selected Topics in Biology (3-0-3)
Survey of recent research topics in Biology at the Masters level. **Effective From: Spring 2008**

Biol 788 - Selected Topics in Biology (3-0-3)
Survey of recent research topics in Biology at the doctoral level. **Effective From: Spring 2008**

Biol 789 - Selected Topics in Biology (3-0-3)
Survey of recent research topics in Biology at the doctoral level. **Effective From: Spring 2008**

Biol 791 - Biology Seminar (0)
This seminar includes student and faculty presentations on current papers, student presentations related to their research and occasional outside speakers. It will acquaint students with possible topics for dissertation search, and provide an opportunity to present and receive feedback on current work.

Biol 794 - Computational Biology Colloquium (1 credit)
Prerequisite: graduate standing. Students and outside speakers present and discuss current research activities in computational biology and related scientific areas.

R120:501 - Neuroanatomy (3 credits)
For more details go to Rutgers Catalog.

R120:503 - Plant Morphology (3 credits)
For more details go to Rutgers Catalog.

R120:504 - Plant Physiology (3 credits)
For more details go to Rutgers Catalog.

R120:505 - Biostatistics and Computer Methodology (3 credits)
For more details go to Rutgers Catalog.

R120:506 - Quantitative Plant Ecology (3 credits)
For more details go to Rutgers Catalog.

R120:509 - Advanced Problems in Biology (1 to 6 credits by arrangement)
For more details go to Rutgers Catalog.

R120:512 - Mammalian Physiology (3 credits)
For more details go to Rutgers Catalog.

R120:515 - Molecular Biology of Eukaryotes (3 credits)
For more details go to Rutgers Catalog.

R120:517 - Developmental Neurobiology (3 credits)
For more details go to Rutgers Catalog.

R120:518 - Nucleic Acids (3 credits)
For more details go to Rutgers Catalog.

R120:519 - Microbial Metabolism (3 credits)
For more details go to Rutgers Catalog.

R120:523 - Biogeography (3 credits)
For more details go to Rutgers Catalog.

R120:526 - Cell Biology (3 credits)
For more details go to Rutgers Catalog.

R120:530 - Biophysical Membrane Physiology (4 credits)
For more details go to Rutgers Catalog.

R120:532 - Evolution (3 credits)
For more details go to Rutgers Catalog.

R120:536 - Multivariate Biostatistics (3 credits)
For more details go to Rutgers Catalog.

R120:538 - Topics in Molecular Genetics (3 credits)
For more details go to Rutgers Catalog.

R120:551 - Biology of Pollution (3 credits)
For more details go to Rutgers Catalog.

R120:552 - Paleobotany (4 credits)
For more details go to Rutgers Catalog.

R120:561 - Quantitative and Analytical Light Microscopy (4 credits)
For more details go to Rutgers Catalog.

R120:563 - Developmental Plant Physiology (3 credits)
For more details go to Rutgers Catalog.

R120:564 - Techniques in Developmental Botany (2 credits)
For more details go to Rutgers Catalog.

R120:565 - Medical Mycology (3 credits)
For more details go to Rutgers Catalog.

R120:566 - Neurophysiology and Behavior (3 credits)
For more details go to Rutgers Catalog.

R120:568 - Neuroendocrinology and Behavior Laboratory (3 credits)
For more details go to Rutgers Catalog.

R120:571 - Biochemistry (4 credits)
For more details go to Rutgers Catalog.

R120:584 - Plant Responses to the Environment (3 credits)
For more details go to Rutgers Catalog.

R120:585 - Behavioral Ecology (3 credits)
For more details go to Rutgers Catalog.

R120:586 - Landscape Ecology (3 credits)
For more details go to Rutgers Catalog.

R120:587 - Systems Ecology: Ecosystems in the Landscape (3 credits)
For more details go to Rutgers Catalog.

R120:588 - Topics in Advanced Ecology (3 credits)

For more details go to Rutgers Catalog.

R120:589 - Chemical Bases of Neural Function (3 credits)
For more details go to Rutgers Catalog.

R120:593 - Physiological Ecology (3 credits)
For more details go to Rutgers Catalog.

R120:594 - Systematics (3 credits)
For more details go to Rutgers Catalog.

R120:601 - Human Molecular Genetics (3 credits)
For more details go to Rutgers Catalog.

R120:604 - Microbiology: Principles and Applications (3 credits)
For more details go to Rutgers Catalog.

R120:616 - Topics in Biology (1 to 3 credits by arrangement)
For more details go to Rutgers Catalog.

R120:640 - Topics in Immunology (3 credits)
For more details go to Rutgers Catalog.

R120:697 - Neuroendocrinology (3 credits)
For more details go to Rutgers Catalog.

Biomedical Engineering: Offered by the Department of Biomedical Engineering

UNDERGRADUATE COURSES:

BME 101 - Introduction to Biomedical Engineering (1-0-0)
This course is open only to freshmen and new transfer students. Faculty members describe their research in biomedical engineering.

BME 105 - Introduction to Human Physiology I (2-0-2)
This course is open only to freshmen and transfer students. An overview of human physiology is presented as an introduction to subsequent core courses in the Biomedical Engineering curriculum. Not intended to be an exhaustive review of physiology, the course will instead emphasize key examples that highlight understanding of the interaction between the biomedical and engineering worlds. This course is the first of two freshman courses; this one will focus on cellular and neural-system basic physiology. Effective From: Fall 2006

BME 106 - Introduction to Human Physiology II (1-0-1)
Prerequisite: BME 105. This course is open only to freshmen and transfer students. An overview of human physiology is presented as an introduction to subsequent core courses in the Biomedical Engineering curriculum. Not intended to be an exhaustive review of physiology, the course will instead emphasize key examples that highlight understanding of the interaction between the biomedical and engineering worlds. This course is the first of two freshman courses; this one will focus on basic physiology of respiratory and cardiovascular systems. Effective From: Spring 2007

BME 301 - Electrical Fundamentals of Biomedical Engineering (1-3-3)
Prerequisites: Math 111, Math 112, Phys 111, Phys 121. Course lectures and laboratories will address important issues for biomedical engineers at the introductory level; covering the origins of bio-electric signals and the instrumentation involved in collection of biopotentials from the electrodes to processing of the signals on the computer. Some other topics included are the transducers/sensors and modern engineering software used in bio-instrumentation. Laboratory work will provide hands-on experience in all of these topics. The course will also address practical issues in design of medical devices such as noise, resolution, linearity, and saturation. This course is offered in Studio format that involves the integration of lectures and labs into one highly participatory structure. Effective From: Fall 2008

BME 302 - Mechanical Fundamentals of Biomedical Engineering (1-3-3)
Prerequisites: Math 111, Math 112, Phys 111, Phys 121. BME 301 is not a prerequisite. The format is identical to that of BME 301. Course lectures and laboratories will address important issues covering the mechanical fundamentals that are important bases for later learning experiences. This course introduces the students to biomaterials (tissues), biomechanics (forces and motion), biofluids and biostatistics, and then integrates them with a final design project on neuromuscular engineering. Effective From: Fall 2008

BME 303 - Biological and Chemical Foundations of Biomedical Engineering (3-0-3)
Prerequisites: Chem 126 and Phys 121. This course covers organic chemistry, biochemistry and cellular mechanics in sufficient depth to give biomedical engineering students a strong enough background for them to understand the introductory aspects of biomedical engineering, which focus on the application of engineering principles to medicine and surgery.

BME 310 - Biomedical Computing (3-1-3)
Prerequisite: BME 301. This course covers the application of digtal signal processing to biomedical problems. Labview, a graphical programming language common in engineering, is used for both signal acquisition and processing. Applications include analysis of the electrocardiogram and other electrical signals generated by the body. Effective From: Spring 2008

BME 311 - Co-op Work Experience (3 additive credits)
Prerequisites: completion of sophomore year, approval of department, and permission of Career Development Services. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated by the co-op office and approved by the department. Mandatory participation in seminars and completion of a report.

BME 333 - Biomedical Signals and Systems (3-0-3)

Prerequisites: BME 310 and Math 222. BME Tools such as the Laplace and Fourier Transforms, time-frequency analysis are introduced. Applications include signals and noise, processing of the ECG, mathematics of imaging and derivation of useful physiological parameters from input signals. Effective From: Fall 2006

BME 351 - Introduction to Biofluid Mechanics (3-0-3)

Prerequisites: BME 302 and Mech 236. Recommended co-requisite: Mech 320. Introduction to the principles of fluid flow. Basic fluid principles, such as fluid properties, fluid statics, conservation of mass, momentum, and energy will be discussed and presented in bioengineering context. Special attention will be given to the non-Newtonian nature of blood, viscous flow in arteries, unsteady flows, and to the fluidic output of the heart. The textbook material will be supplemented throughout the course to emphasize examples relative to bioengineering. Effective From: Spring 2007

BME 372 - Biomedical Electronics (3-0-3)

Prerequisite: BME 301. The first of a two-semester sequence. It covers the design of electronic circuits for Biomedical applications. This course covers basic operational amplifier circuits as well as the operation of semiconductor diodes and transistors. An introduction to digital logic circuits is also provided. Pspice computer simulation as well as hands-on breadboarding of electronic circuits are used throughout the course to supplement the lectures.

BME 373 - Biomedical Electronics II (3-0-3)

Prerequisite: BME 372. A continuation of BME 372 emphasizing biomedical applications of oscillators, active filters, and wave-shaping circuits.

BME 381 - Engineering Models in Physiology I (3-2-3)

Prerequisites: Math 222, BME 106 and Phys 121. Some knowledge of programming required. Mathematical models of organs and organ systems are described from an engineering viewpoint. Anatomy and physiology are quantified. Heart and circulation, gas exchange in the lungs, electrical properties of excitable membranes, renal countercurrent mechanism and muscle mechanics are among the topics covered. Emphasis will be placed on feedback control, mathematical modeling and numerical simulation. Effective From: Spring 2006

BME 382 - Engineering Models in Physiology II (3-2-3)

Prerequisites: Math 222, BME 106 and Phys 121. BME 381 is not a prerequisite. Some knowledge of programming required. Mathematical models of organs and organ systems are described from an engineering viewpoint. Anatomy and physiology are quantified. Heart and circulation, gas exchange in the lungs, electrical properties of excitable membranes, renal countercurrent mechanism and muscle mechanics are among the topics covered. Effective From: Spring 2006

BME 383 - Measurement Lab for Physiological Systems & Tissue (1-3-3)

Prerequisites: BME 105, BME 106, BME 302, BME 310. Through laboratory experiences, students will apply engineering methods for measuring and interpretating the properties of physiological systems and biological tissues. Topics include measurements relevant to cardio-pulmonary, nerve and muscular systems, and epithelial transport. Effective From: Spring 2008

BME 384 - Biomechanics Laboratory (1-3-3)

Introduction to the experimental analysis of the biomechanics of human motion. Laboratory experiments include the application and integration of anatomical and mechanical concepts to a wide variety of activities. Students will develop basic competence in a systematic approach to the observation, analysis and evaluation of human movement in clinical, educational, and industrial environments. Effective From: Spring 2009

BME 385 - Cell and Biomaterial Engineering Laborarory (1-3-3)

Prerequisite: BME 303. Co-requisite: BME 420. This laboratory course is designed to provide students with valuable hands-on experience in the field of cell and biomaterial engineering. Experiments include biomaterial fabrication and characterization, mechanical testing of biomaterials, colorimetric protein assay, cell-based assay, the basics of cell culture techniques, the basics of light and electron microscopy, and image capture and analysis. A lecture on the principles of a given technique will be followed by laboratory activity. Effective From: Spring 200

BME 386 - Bioinstrumentation Laboratory (1-3-3)

Prerequisites: ECE 251, BME 372 and BME 373. Laboratory exercises involve projects at all levels of a bioinstrumentation system from sensors to data acquisition and data processing. Analog and digital circuits are constructed to condition the signals from sensors and convert them into a format that can be displayed or acquired into a computer. The final projects help to develope the skills to integrate various parts of a bioinstrumentation system, collect and analyze data and troubleshoot a circuit. Effective From: Spring 2009

BME 411 - Co-op Work Experience (3 additive credits)

Prerequisites: BME 311 and completion of sophomore year, approval of department, and permission of Career Development Services. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated by the co-op office and approved by the department. Mandatory participation in seminars and completion of a report. May count as BME or approved elective. Grade will now be issued as a letter grade. Effective From: Spring 2009

BME 420 - Biomaterials and Compatibility (3-0-3)

Prerequisites: Physics 121, Chemistry 126, Mech 320. An introduction to the field of biomaterials. The goal of this course is to understand material selection and the limitations imposed by current materials on device performance. The first part of the course will provide an overview of the current medical devices/implants with respect to their clinical relevance. Subsequently, the structure and properties of metals, ceramics, and polymers will be discussed. Properties include mechanical behavior, thermal, and surface characteristics. The second part of the course will discuss biocompatibility and implant design. Immunological and various histological responses will be described. Material properties of hard and soft tissues, their response to implants and the material selection for such tissues will be discussed.

BME 422 - Biomaterials Characterization (3-0-3)

Prerequisites: BME 420 or MTSE 301. The quantum mechanical origins of spectroscopy, the relationship of spectroscopic behavior to thermal characteristics of a material, and the differences in approach to the chemical and physical characterization of synthetic and biological polymers are discussed. Effective From: Spring 2007

BME 427 - Biotransport (3-0-3)

Prerequisite: Math 222 and CHE 230. Introduction to basic concepts in thermodynamics and transport phenomena as applied to biological systems. The structure and composition of the body will be covered followed by an exploration of the properties of the blood and its flow in the cardiovascular system, and the body as a heat source and as a series of compartments involved in the mass transfer of materials (such as those in the kidneys and lungs). Design of artificial kidneys and heart-lung machines is also explored.

BME 430 - Fundamentals of Tissue Engineering (3-0-3)

Prerequisite: BME 420. This course is an introduction to the field of tissue engineering as a therapeutic approach to treating damaged or diseased tissues in the biotechnology industry. In essence, new and functional living tissue can be fabricated by delivering cells, scaffolds, DNA, proteins, and/or protein fragments at surgery. This course will cover the advances in the fields of cell biology, molecular biology, material science and their relationship towards developing novel "tissue engineered" therapies. Effective From: Fall 2006

BME 451 - Biomechanics I (3-0-3)

Prerequisites: Mech 320 and BME 351. Tensor analysis. Kinematics of continuous media. Stress. The elastic solid. Newtonian fluid. Conservation principles of mass, momentum and energy. Viscometric flows. Formulation of constitutive equations. Applications to the modeling of bone and other living tissues. Effective From: Fall 2007

BME 452 - Biomechanics II (3-0-3)

Continuation of BME 451, Biomechanics I. The primary emphasis of this course is on physiological flows in the human body. Constitutive relations. Blood rheology. Flow in the microcirculation. Bernoulli's equation. Boundary layer theory. Lubrication theory. Pulse propagation and blood flow in the large arteries. Effective From: Spring 2007

BME 469 - Introduction to Human Physiology (3-0-3)

This course is not open to Biomedical Engineering students. Available to non-biomedical engineering students who have an interest in going on to medical, dental or allied health careers. An introduction to mammalian physiology, particularly the heart, circulation, lungs and kidneys.
Effective Until: Fall 2003

BME 478 - Introduction to CAD for Biomechanics (2-2-3)

Prerequisites: BME 302 and Mech 320. Introduction to Computer Aided Designing and analysis as applied to biomedical engineering design programs. Topics include theoretical insight into the process of design and geometrical modeling and design using industry standard CAD (Computer Aided Design) software packages. The course will also include several projects involving the applicaiton of design principles to standard problems in biomedical design. Effective From: Spring 2007

BME 479 - BioMicroElectroMechanical Systems (3-0-3)

Prerequisites: Chem 126 and Phys 121. Knowledge of mechanics, optics, electromagnetism and general chemistry. Micro- and nanosystems used in advanced analytical techniques for microfluidic devices, implantable chips, non-invasive biomedical sensors, DNA chips and microelectronic array systems. Microelectronic processing design for micromaching and piezoelectric materials for biomedical applications. Biomedical sensors and actuators. BioMEMS active ultrasonic transducers for medical imaging, for micro-valves and for implantable medication delivery systems are studied.

BME 489 - Medical Instrumentation (3-0-3)

Prerequisites: BME 373, BME 310 and ECE 251. The hardware and instrumentation needed to measure variables from different physiological systems. Electrodes, sensors and transducers. Bioelectric amplifiers. Hardware for measurement of the ECG, EEG, EMG, respiratory system, nervous system . Clinical laboratory instruments. Medical ultrasound. Electrical safety. Computers in biomedical instrumentation.

BME 491 - Research and Independent Study I (3-0-3)
Needs permission of professor. Senior standing. Planning and execution of engineering projects. Intellectual property: publications and priority documents; invention disclosures and patents. Safety: engineering codes and standards. Engineering ethics. Professional organizations. Professional registration. Preparation of a technical proposal for a senior project and its approval are required.

BME 492 - Research and Independent Study II (1-2-3)
Needs permission of professor. A biomedical engineering design project, selected by the student, which has been approved in BME 491. Involves information from the professional literature, research, design and prototype testing. An oral presentation and a written report are required.

BME 495 - Capstone Design I (2-3-3)
Prerequisites: BME 372 or BME 420 or BME 351. Senior standing or permission of the instructor. To provide students with the guidance to choose a capstone design topic and advisor and to prepare the design proposal. The course introduces the student to the definition of design as well as introducing issues of intellectual property, bioethics and safety, and professional societies. Effective From: Fall 2008

BME 496 - Capstone Design 2 (2-5-3)
Prerequisites: BME 495 Implementation of the project approved in BME 491. This portion of the project includes library research, time and cost planning, oral and written reports, as well as construction, troubleshooting and demonstration of a working prototype. Effective From: Fall 2008

GRADUATE COURSES:

BME 593 - Graduate Co-op Work Experience IV (0 credits)
Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

BME 601 - Seminar (3 credits)
Required every semester of all master's students in biomedical engineering who receive departmental or research-based support and all doctoral students. To receive a satisfactory grade, students must attend at least five seminars per semester, as approved by the seminar supervisor.

BME 611 - Engineering Aspect of Molecular and Cellular Bio I (1 credit)
Molecular and cellular biology is a foundation of the understanding of the biological sciences and is vital to the study of advanced biomedical engineering. This course is to be taken simultaneously with UMDNJ N551 to enrich the crossover between engieering and life sciences. Course topics parallel those covered in N551 and both add engineering relevance, and provide engineering students with a stronger understanding of molecular and cellular biology. For students in joint BME PhD program. Effective From: Fall 2009

BME 612 - Engineering Aspects of Molecular and Cellular Bio 2 (1 credit)
Molecular and cellular biology is a foundation of the understanding of the biological sciences and is vital to the study of advanced biomedical engineering. This course is to be taken simultaneously with UMDNJ N552 to enrich the crossover between engineering and life sciences. Course topics parallel those covered in N552 and both add engineering relevance, and provide engineering students with a stronger understanding of molecular and cellular biology. For students in joint BME PhD program. Effective From: Fall 2009

BME 627 - Introduction to Biomedical Engineering (3 credits)
Prerequisite: undergraduate courses in thermodynamics and differential equations. Introduction to the structure and composition of the body followed by an exploration of the properties of the blood and its flow in the cardiovascular system; the body as a heat source and as a series of compartments involved in the mass transfer of materials (such as those in the kidneys and lungs). Design of artificial kidneys and heart-lung machines is also explored. Same as ChE 627.

BME 651 - Principles of Tissue Engineering (3-0-3)
Tissue Engineering is a therapeutic approach to treating damaged or diseased tissues in the biotechnology industry. In essence, new and functional living tissue can be fabricated using living cells combined with a scaffolding material to guide tissue development. Such scaffolds can be synthetic, natural, or a combination of both. This course will cover the advances in the fields of cell biology, molecular biology, and materials science towards developing novel "tissue engineered" materials. Effective From: Spring 2005

BME 652 - Cellular and Molecular Tissue Engineering (3 credits)
This course explores molecular, cellular and tissue level interactions that are an important component of all tissue engineering strategies. Topics include how a cell moves, reacts and maintains viability and function based on its surroundings. We will discuss how to engineer our materials, tissue grafts and implants to integrate with the body. We will also liearn about bodily reactions and the biocompatibility of tissue engineered devices such as immunoreactivity and blood coagulation. Effective From: Spring 2010

BME 653 - Micro/Nanotechnologies for Interfacing Live Cells (3 credits)
In this course, we will study technologies and tools available for interfacing live cells from a sub-cellular, single-cell, and multi-cellular (tissue models) approach. We will introduce key concepts of the biology of cells and tissues and will explore the technologies (micro-/nanotechnologies) and tools (sensors and actuators) available for the investigation of cell and tissue biology. Same as ECE 653. Effective From: Spring 2010

BME 661 - Neural Engineering (3 credits)
Neural Engineering focuses on understanding how the brain functions using engineering principles. The course discusses different instrumentation and signal processing algorithms to study how the brain functions, how to detect different pathologies and new applications for research. Topics include; basic overview of neurology, vector populations, neural networks, vision research, functional MRI, functional electrical stimulation, neural prosthetics, and other advanced research topics studying neurology.

BME 667 - Bio-Control Systems (3 credits)
The course provides an introduction to dynamic and control in biological systems, with particular emphasis on engineering aspects of biological oscillators/waves which govern the basic operations of all living organisms and especially higher order life forms. A combination of theoretical and simulation tools will be applied to analyze the qualitative and quantitative properties of selected biological systems. Feedback and control mechanisms in selected biological systems will be introduced. Same as ECE 667. Effective From: Spring 2010

BME 668 - Medical Imaging Systems (3 credits)
This course provides a detailed introduction to medical imaging physics, instrumentation, data acquisition and image processing systems for reconstruction of multi-dimensional anatomical and functional medical images. Three-Dimensional medical imaging modalities including X-ray, Computer Tomography, Magnetic Resonance Imaging, Single Photon Emission Computer Tomography, Positron Emission Tomography, Ultrasound and optical imaging modalities are included. Same as ECE 668. Effective From: Spring 2010

BME 669 - Engineering Physiology (3 credits)
To enable students to apply basic tools in engineering analysis, mathematics, computer science, general physics and chemistry courses so that they can develop models that quantitatively predict the functioning of physiological systems in the human body. To enable students to apply engineering systems analysis to systematic physiology and employ the ideas of feedback control, signal procession, mathematical modeling and numerical simulation. Same as ECE 669. Effective From: Spring 2010

BME 670 - Introduction to Biomechanical Engineering (3 credits)
Prerequisites: undergraduate thermodynamics, statics, and dynamics. Introduction to biomechanical engineering of physiological systems; fluid flow, structural, motion, transport, and material aspects; energy balance of the body, and the overall interaction of the body with the environment. Same as ME 670.

BME 671 - Biomechanics of Human Structure and Motion (3 credits)
Prerequisites: undergraduate statics, kinematics, and dynamics. Principles of engineering mechanics and materials science applied to human structural and kinematic systems and to the design of prosthetic devices. Topics include anatomy; human force systems; human motion; bioengineering materials; and design of implants, supports, braces, and replacements limbs.

BME 672 - Biomaterials (3 credits)
Prerequisite: Mech 232 (see undergraduate catalog for description) or the equivalent. Materials and processes used to develop devices that are implanted in the human body; clinical aspects of biomechanical engineering; federal government requirements for design and testing of human implant devices; biocompatibility, metal implant devices, material design parameters, plastic and ceramic devices, sterilization techniques, and their effect on biocompatibility.

BME 673 - Biorobotics (3 credits)
Basics of control of a robot and telemanipulation are studied. Computer simulations, MATLAB are used to explore biomimetic autonomous robots. This is a studio-based course with hands-on exercises with small robots and actuators. Topics include understanding how biological robots (humans and animals) differ from designed robots, as well as sensors (touch, stereo and position), actuators (muscles, smart materials), and intelligent (neural and computer controlled systems. Effective From: Spring 2009

BME 674 - Principles of Neuromuscular Engineering (3 credits)
Neurophysiology, motor control and robotics are used to study the human motor system. Sensorimotor learning and acquisition of new motor skills are emphasized. Topics include the central nervous system, muscle properties, spinal motor circuitry and dynamics of limb motion. The relation of motor control problems to neurophysiology of the motor system and how motor disorders affect movement control are studied. MATLAB and Simulink are used in simulations and movement date analysis. Effective From: Fall 2009

BME 675 - Computer Methods in Biomedical Engineering (3 credits)
This course uses MATLAB to concentrate on methods that allow students to produce original software that can be used to acquire, process, analyze

and present data. Topics include advanced graphics and animation, graphical user interfaces, interfacing to and data acquisition from laboratory instrumentation, filtering and processing of acquired data, and interfacing to user interfaces (e.g. joysticks). Applications in speech, bioelectrical signals, images and virtual reality will be included. Effective From: Fall 2009

BME 680 - BioMEMS Design and Applications (3 credits)

The advance of bioMEMS (Micro Electrical Mechanical Systems) technology is a key component in making the next generation medical diagnostic tools possible. We will learn how bioMEMS devices are fabricated and combine engineering analysis with knowledge of known biological responses and biomolecule interactions to understand how bioMEMS are designed and function. Topics will include biological, mechanical, electrical, and chemical biosensors, and microfluidics as applied to biotechnology. Effective From: Fall 2009

BME 681 - Medical Imaging (3 credits)

The basic principles of medical imaging: physical basis, signal acquisition, image formation and image processing. Image modalities include x-rays, computed tomography CT), magnetic resonance imaging (MRI), ultrasound, positron image tomography (PET), and functional MRI (fMRI).

BME 683 - BioMicroElectroMechanical Systems (3 credits)

Prerequisites: Knowledge of mechanics, optics, electromagnetism and general chemistry. Micro- and nanosystems used in advanced analytical techniques for microfluidic devices, implantable chips, non-invasive biomedical sensors, DNA chips and microelectronic array systems. Microelectronic processing design for micromaching and piezoelectric materials for biomedical applications. Biomedical sensors and actuators. BioMEMS active ultrasonic transducers for medical imaging, for micro-valves and for implantable medication delivery systems are studied.

BME 687 - Design of Medical Instrumentation (3 credits)

Prerequisite: undergraduate course in electronics. Principles and practice of medical instrumentation. Instrument components and medical instrument systems design. Examples taken from electrocardiography, clinical chemistry, medical imaging. Microprocessor-based systems emphasized.

BME 698 - Selected Topics (3 credits)

Selected topics for Biomedical Engineering.

BME 700 - Master's Project (3 credits)

Prerequisite: written approval of project advisor. An extensive paper involving design, construction, and analysis, or theoretical investigation. Joint projects with industry or governmental agencies may be acceptable. Work is carried out under the supervision of a member of the department faculty.

BME 701 - Master's Thesis (6 credits)

Prerequisite: written permission from thesis advisor. Projects include design, construction, experimental or theoretical investigation of the engineering applications to the diagnosis and/or treatment of disease. Research may be in cooperation with industry or medical institutions. Completed work should be of sufficient quality to be acceptable for publication. Oral presentations are required.

BME 710 - Foundations of Biomedical Research (3 credits)

This course provides an overview of biomedical research issues as they relate to biomedical engineering. The course provides students with a working knowledge of the fundamental tools of: 1) a critical literature review, 2) research design, 3) bioethics, 4) statistical analysis of data, 5) protection of animal and human subjects, 6) patent protection and 7) FDA regulations.

BME 725 - Independent Study I (3 credits)

Prerequisite: departmental approval. Program of study prescribed and approved by student's faculty coordinator. This special course covers areas of study in which one or more students may be interested but is not of sufficiently broad interest to warrant a regular course offering. Master's degree students cannot count BME 725 as degree credit but can count these credits to qualify for full-time status.

BME 726 - Independent Study II (3 credits)

Prerequisite: departmental approval. Program of study prescribed and approved by student's faculty coordinator. This special course covers areas of study in which one or more students may be interested but is not of sufficiently broad interest to warrant a regular course offering. Master's degree students cannot count BME 725 as degree credit but can count these credits to qualify for full-time status. This course is not available to master's students.

BME 788 - Selected Topics (3 credits)

Selected topics for Biomedical Engineering. (Archived Versions)

BME 790 - Doctoral Dissertation (Credits as designated)

Required of all students working toward the Ph.D. in Biomedical Engineering. A minimum of 36 credits is required. The student must register for at least 6 credits of dissertation per semester; registration for additional credits may be permitted beyond the 6, with the approval of the advisor, up to a maximum of 12 credits per semester. If the student is still actively engaged in the research after completion of 36 credits, continued registration of 3 credits per semester is required.

BME 792 - Pre-Doctoral Research (3 credits)

Prerequisite: Permission of the department. For students admitted to the program leading to the Ph.D. in Computer Engineering or Electrical Engineering. Research carried on under the supervision of a designated member of the department faculty. If the student's research activity culminates in doctoral research in the same area, up to a maximum of 6 credits may be applied toward the 36 credits required under BME 790 after the student fulfills requirements of doctoral candidacy.

UMDNJ 313 - Membranes and Transport (null)

For more details go to UMDNJ website.

UMDNJ 501 - General Pathology (null)

For more details go to UMDNJ website.

UMDNJ 5040 - Biostatistics (null)

For more details go to UMDNJ website.

UMDNJ 507 - Introduction to Animal Experiments (null)

For more details go to UMDNJ website.

UMDNJ 602 - Principles of Pharmacology (null)

For more details go to UMDNJ website.

UMDNJ 605 - Advanced Biometrics (null)

For more details go to UMDNJ website.

UMDNJ 610 - Topics in Biochemical Pharmacology (null)

For more details go to UMDNJ website.

UMDNJ 612 - Clinical Pharmacology (null)

For more details go to UMDNJ website.

UMDNJ 701 - Human Physiology (null)

For more details go to UMDNJ website.

UMDNJ 703 - General Endocrinology (null)

For more details go to UMDNJ website.

UMDNJ 704 - Neuroscience (null)

For more details go to UMDNJ website.

UMDNJ 705 - Cardiorespiratory Physiology (null)

For more details go to UMDNJ website.

UMDNJ 715 - Neurophysiology Seminar (null)

For more details go to UMDNJ website.

UMDNJ 716 - Microcirculatory Physiology (null)

For more details go to UMDNJ website.

Biostatistics: Offered by the UMDNJ-New Jersey Medical School

GRADUATE COURSES:

BIO 613 - Life Tables and Survival Analysis (3 credits)

Prerequisites: biostatistics core course; a thorough knowledge of pre-calculus mathematics is assumed; calculus is strongly recommended but not required. Introduction to theory and applications. Recognition of situations that call for life table methods. Selection and application of methods and analysis. Explanation and interpretation of analyses.

BIO 614 - Categorical Data Analysis (3 credits)

Prerequisites: biostatistics core course or equivalent. A practical introduction to methods for analysis of frequency tabulations commonly used in public health research. Exercises are based on public health literature. Evaluate relationships between categorical factors by which frequency data are cross-classified. Apply principles of study design and sample size planning. Provide statistically valid interpretation of results from categorical data analysis. A statistical computer package such as SAS, STATA or SPSS is used for computation.

BIO 618 - Nonparametric Statistical Methods (3 credits)

Prerequisites: biostatistics core course or equivalent. Choose and apply the most appropriate parametric or nonparametric test or procedure for analyzing a given set of research data, taking into consideration the manner in which the sample was drawn, the nature of the population from which it was drawn, and the kind of measurement or scaling that was employed to define the variables in the study.

BIO 619 - Biostatistical Consulting (2 credits)

Prerequisites: biostatistics, epidemiology, and health information systems core courses. Provides skills needed for statistical consulting in public health.

Chemical Engineering : Offered by the Otto H. York Department of Chemical, Biological and Pharmaceutical Engineering.

UNDERGRADUATE COURSES:

ChE 101 - Introduction to Chemical Engineering (1-0-0)

Prerequisites: None. An introduction to the field of chemical engineering and to the Otto H. York Department of Chemical Engineering. Topics include the curriculum, tours of department teaching laboratories and computing facilities, undergraduate research opportunities, cooperative employment, and student professional societies. Also included are visits by alumni who discuss their careers after graduation from the department.

ChE 210 - Chemical Process Calculations I (3-0-2)

Prerequisites: Chem 126 (or Chem 123). Corequisites: Math 112 and CS 101. Analysis of chemical processes is introduced, emphasizing steady and unsteady-state mass and species balances. This course uses primarily chemistry and algebra to determine, for a wide variety of processes and applications, the flow and concentrations of different chemical species. Effective From: Fall 2009

ChE 210W - Chemical Process Calculations I (0-1-0)

Workshop Effective From: Fall 2008

ChE 221 - Material Balances (4-0-4)

Prerequisites: Chem 126 or Chem 123, and Math 112. Co-requisites: CIS 101, FED 101. An introduction to the analysis of chemical processes with special emphasis on steady state mass balances. The course introduces mass balances in unsteady state. Effective Until: Spring 2005

ChE 230 - Chemical Engineering Thermodynamics I (3-0-3)

Prerequisites: Chem 126, (or Chem 123), Math 112, Phys 111, (or Phys 106). Corequisite Math 211 (or Math 213). The Fundamentals of thermodynamics are applied to chemical engineering processes. Thermophysical properties and their engineering correlations are covered. Applications include chemical engineering and related fields such as environmental and biomedical engineering. Effective From: Fall 2008

ChE 230W - Chemical Engineering Thermodynamics I Workshop (0-1-0)

Workshop Effective From: Fall 2008

ChE 232 - Chemical Engineering Thermodynamics I (2-2-3)

Prerequisite: ChE 221. Corequisite: Chem 231. A course emphasizing the concepts of energy balances and energy balance calculations. Uses engineering correlations and thermodynamics to estimate properties used in batch and flow systems. Effective Until: Fall 2005

ChE 240 - Chemical Process Calculations II (3-0-3)

Prerequisites: ChE 210, ChE 230, Math 211 (or Math 213). Corequisite: Math 222. This course covers the basic principles of energy balances for a variety of engineering systems. Combined with material from other sophomore courses, simple designs of chemical processes are considered. The course also introduces chemical process simulation software. Effective From: Fall 2008

ChE 240W - Chemical Process Calculations II (0-1-0)

Workshop Effective From: Fall 2008

ChE 260 - Fluid Flow (3-0-3)

Prerequisite: ChE 230. Corequisite: ChE 240, Math 222. This course considers the principles of molecular and turbulent transport of momentum, particularly as they apply to pressure drop calculations in piping systems, packed columns, and other flow devices. Flow around submerged objects is also considered. Effective From: Fall 2005

ChE 310 - Co-op Work Experience I (3 additive credits)

Prerequisites: completion of the sophomore year, approval of the department, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the co-op office. Mandatory participation in seminars and completion of a report. Cannot be used for degree credit.

ChE 311 - Co-op Work Experience II (3 credits)

Prerequisites: ChE 310. Continuation of ChE 310. Can be used for degree credit. Effective From: Spring 2009

ChE 342 - Chemical Engineering Thermodynamics II (3-0-3)

Prerequisites: ChE 230, Math 211 (or Math 213), Chem 236. The principles and methods developed in Chemical Engineering Thermodynamics I are extended to multicomponent systems, and used to treat phase and chemical equilibrium as well as such applications as chemical reactors and refrigeration systems. Effective From: Fall 2005

ChE 349 - Kinetics and Reactor Design (3-0-3)

Prerequisites: ChE 342, ChE 370, Math 222, Chem 236. Derive and solve species and energy balances for single chemical reactors; introduces heterogeneous catalysis, non-ideal reactors as ideal reactor combinations, and special topics such as polymeric or biochemical reactions. Effective From: Fall 2005

ChE 360 - Separation Processes I (3-0-2)

Prerequisites: ChE 342, ChE 370. This is the first course in separations, examines traditional methods and technologies by which chemical engineers separate and purify mixtures. Emphasis here is on strippers, absorbers, distillations, and extractions. Effective From: Fall 2008

ChE 363 - Transport Operations I (3-0-3)

Prerequisites: ChE 232, Phys 111, CIS 101, and FED 101. Corequisite: Math 222 Considers principles of the molecular and turbulent transport of momentum, particularly as they apply to pressure drop calculations in piping systems, packed columns, and other flow devices. Also considered is flow around submerged objects. Effective Until: Spring 2007

ChE 364 - Transport Operations II (3-0-3)

Prerequisites: ChE 232, Math 222. Corequisite: ChE 363. The principles of molecular and turbulent transport of energy are considered, particularly as they apply to design of heat exchangers. Also considered is radiant heat transfer.

ChE 365 - Techniques for Process Simulation (3-0-2)

Prerequisites: ChE 240, CIS 101, Math 222. This course reviews chemical engineering applications of LaPlace transforms, partial fractions, and linear algebra in preparation for the ChE course in process control. It introduces dedicated software for chemical process simulation and control used in the senior capstone courses. Effective From: Fall 2008

ChE 367 - Diffusional Systems (3-0-3)

Prerequisites: ChE 363, Math 222. Covers principles of molecular and turbulent transport of mass, particularly as they apply to design of packed columns, and other mass transfer devices. Effective Until: Spring 2007

ChE 370 - Heat and Mass Transfer (4-0-4)

Prerequisites: ChE 240, ChE 260, Math 222. The principles of heat and mass transfer in chemical engineering systems are covered. Steady and unsteady heat transfer is examined, with emphasis on the heat exchanger design. Mass transfer by steady and unsteady molecular diffusion, and turbulent convective mass transfer is studied. Effective From: Fall 2005

ChE 375 - Structure, Properties and Processing of Materials (3-0-3)

Prerequisites: Chem 236, (or Chem 235), Mech 320 (can be taken as co-requisite). Tailoring materials properties by engineering their microscopic/macroscopic structures via processing is central to product design and development in the chemical industry. This course introduces the principles of materials engineering from the perspective of structure-property-processing relationships. Instead of covering different types of materials separately, this course will use the principles common to engineering of all important materials as an underlying theme. These are atomic/molecular structure, nanoscale, morphology, principles of phase transformation, structure development during processing, and property dependence on structure. All these topics will be introduced through the paradigm of comparing metals, ceramics and polymers. Besides single component systems, advanced materials such as multiphase and/or multicomponent systems (e.g. composites and gels) and nanomaterials will be discussed based on these principles. An integral part of this course will be the criteria for selection of materials for the chemical process industry. Effective From: Fall 2004

ChE 380 - Introduction to Biotechnology (3-0-3)

Prerequisites: Chem 123 or Chem 126. Basic principles of molecular biotechnology with selected examples of applications. Effective From: Fall 2004

ChE 396 - Chemical Engineering Laboratory I (0-5-3)
Prerequisites: ChE 370, Eng 352. Corequisite: Math 225A. In this first course in chemical engineering capstone laboratory, experiments are conducted in the areas of fluid mechanics and heat transfer. Bench and pilot-scale equipment is used. Oral and written reports are prepared by the students. Effective From: Fall 2005

ChE 402 - Applied Optics in Chemical Engineering (3-0-3)
Prerequisites: Junior or senior standing in chemical engineering. Combined laboratory and lecture course emphasizing photonics and laser applications in chemical engineering.

ChE 411 - Work Experience III (3 additive)
Prerequisites: ChE 311. Continuation of ChE 311. Cannot be used for degree credit. Effective From: Fall 2009

ChE 427 - Biotransport (3-0-3)
Prerequisites: ChE 230 and Math 222. Introduction to basic concepts of transport phenomena as applied to biological systems. Topics include the structure and composition of the human body, the properties of the blood and its flow in the cardiovascular system, and the body as a heat source and as a series of compartments involved in the mass transfer of materials (such as those in the kidneys and lungs). Students learn to analyze solute transport in biological systems and apply it to the design of biomedical devices. Effective From: Spring 2004

ChE 444 - Introduction to Polymer Engineering (3-0-3)
Prerequisites: ChE 370. Introduction to the basic concepts of polymer engineering. Topics covered include rheology, heat transfer, and kinetics of polymerization reactors.

ChE 460 - Separation Processes II (3-0-2)
Prerequisites: ChE 360. This second course in separations examines non-traditional methods and technologies such as fixed-bed processes, membranes, crystallization, and mechanical separations. Effective From: Fall 2008

ChE 461 - Fate and Transport of Pollutants in the Environment (3-0-3)
Prerequisites: Math 222, Chem 235 or Chem 360, ChE 370 or CE 320. The overall objective of this course is to introduce students to concepts, mechanisms, and models used to describe the transport of chemicals in the environment. Two of the most important parameters in mass transport are the driving force or concentration gradient and the transport mechanism. Methods for defining these parameters are discussed during the first six weeks of the class. Concepts and models presented in the first six weeks are applied to air-water, sediment-water, and soil-air interfaces during the rest of the term. The semester ends with a group project, where students are asked to apply material from the course to resolve a comprehensive problem.

ChE 466 - Pollution Control in Chemical Processes (3-0-3)
Prerequisites: ChE 349, ChE 360. A course applying chemical engineering principles to the appropriate treatment of gaseous and liquid effluents from manufacturing and utility plants. The course will take into consideration toxicity, safety, and economic constraints. A case study approach is used to evaluate processes and pinpoint pollution sources. Quantitative designs and calculations will be required.

ChE 468 - Air Pollution Control Principles (3-0-3)
Prerequisites: ChE 360, ChE 349. A course focusing on the sources and control of air pollution. The course emphasizes design of modern air pollution control equipment and associated economics.

ChE 471 - Equilibrium Stage Processes (3-0-3)
Prerequisite: ChE 342, ChE 364. Corequisite: ChE 367. Covers the design of distillation columns, extraction columns, leaching, and other stagewise separation processes. Effective Until: Fall 2007

ChE 472 - Process and Plant Design (4-0-4)
Prerequisites: ChE 349, ChE 375, ChE 380, ChE 460, IE 492. A capstone course in the chemical engineering program. This class is divided into three- or four-person groups. Each group must complete an open-ended process design problem, including equipment specification and economics. Effective From: Fall 2005

ChE 472H* - Process and Plant Design Honors (4-0-4)
Same as ChE 472, with special projects for Honors students.

ChE 473 - Mathematical Methods in Chemical Engineering (3-0-3)
Prerequisites: Math 222, ChE 349, ChE 364, ChE 367, Chem 245. An introduction to the use of differential equations to solve chemical engineering problems.

ChE 476 - Introduction to Biochemical Engineering (3-0-3)
Prerequisites: Chem 244, ChE 349. The application of chemical engineering to biochemical processes. Topics include enzyme reactions, dynamics of microbial populations, fermentation equipment, bioreactor design, and sterilization.

ChE 477 - Process Dynamics and Control (4-0-4)
Prerequisites: ChE 349, ChE 363, ChE 364. Mathematical description of transient and steady state behavior of chemical engineering processes. Study of the open-loop response of output process variables to varying inputs. Theory and applications of chemical process control. Effective Until: Fall 2007

ChE 485 - Chemical Engineering Laboratory I (1-6-4)
Prerequisites: Chem 235A, ChE 363, ChE 364, Math 225. Engineering experimentation and data analysis. Experiments are conducted in the areas of fluid mechanics and heat transfer. Bench and pilot-scale equipment is used. Results are presented in both oral and written reports. Effective Until: Fall 2007

ChE 486 - Chemical Engineering Laboratory II (0-8-4)
Prerequisites: ChE 349, ChE 367, ChE 471, ChE 485. Corequisite: ChE 477. Engineering experimentation and data analysis. Experiments are conducted in the areas of distillation, extraction, and chemical/biochemical reactions. Bench and pilot-scale equipment is used. Results are presented in both oral and written reports. Effective Until: Fall 2007

ChE 486H - Chemical Engineering Laboratory II Honors (0-8-4)
Same as ChE 486, with special projects for Honors students. Effective Until: Fall 2007

ChE 489 - Process Dynamics and Control (2-2-3)
Prerequisites: ChE 349, ChE 365. This course is an introduction to chemical process dynamics and control. Topics include analysis of the dynamics of open-loop systems, the design of control systems, and the dynamics of closed-loop systems. Control techniques and methodologies, used by practicing chemical engineers, are emphasized. Effective From: Fall 2005

ChE 490 - Special Topics in Chemical Engineering (3-0-3)
Prerequisites: ChE 349, ChE 360. Topics of current interest in chemical engineering, such as supercritical fluid extraction, combustion research, environmental problems, biotechnology, technologies in hazardous and toxic substance management, etc. As interests develop, other topics will be considered.

ChE 491 - Research and Independent Study I (3-0-3)
Prerequisites: senior standing in chemical engineering, agreement of a department faculty advisor, and approval of the associate chairperson for undergraduate studies. Normally a GPA greater than 3.0 is required to participate in the course. Provides the student with an opportunity to work on a research project under the individual guidance of a member of the department. A written report is required for course completion.

ChE 491H - Research and Independent Study I Honors (3-0-3)
Same as ChE 491, with special projects for Honors students.

ChE 492 - Research and Independent Study II (3-0-3)
Prerequisite: ChE 491. A continuation of ChE 491.

ChE 492H - Research and Independent Study II Honors (3-0-3)
Prerequisite: ChE 491H. Same as ChE 492, with special projects for Honors students.

ChE 496 - Chemical Engineering Laboratory II (0-6-3)
Prerequisites: ChE 349, ChE 360, ChE 380, ChE 396, Chem 339, Math 225A. Corequisites: ChE 460, ChE 489. In this second course in chemical engineering capstone laboratory, experiments are conducted in the areas of mass transfer, separations, reaction engineering, and process dynamics and control. Bench and pilot-scale equipment is used. Oral and written reports are prepared by the students. Effective From: Fall 2005

GRADUATE COURSES:

ChE 501 - Fundamentals of Chemical Engineering I (6 credits)
Prerequisites: Math 222 or equivalent, Chem 231 or equivalent(see undergraduate catalog descriptions). An intensive course in basic chemical engineering science intended for students in the bridge program. Topics include material and energy balances, thermodynamics, kinetics and reactor design, and staged separation processes. May not be taken for degree credit in any chemical engineering program.

ChE 502 - Fundamentals of Chemical Engineering II (4 credits)
Prerequisites: Math 222 or equivalent (see undergraduate catalog for description), ChE 501 or equivalent. A continuation of ChE 501. An intensive course in basic chemical engineering science intended for students in the bridge program. Topics include fluid mechanics, heat transfer and diffusion-controlled processes. May not be taken for degree credit in any chemical engineering program.

ChE 503 - Introduction to Polymer Science and Engineering (3 credits)
Prerequisite: Undergraduate degree in science or engineering. The course is intended for students whose prior undergraduate degree did not include study of polymer science or engineering. The course provides introductory concepts in four main areas: fundamentals of polymeric material including structural and chemical aspects; synthesis reactions of polymers; polymer properties including an introduction to viscoelastic behavior; and polymer technology including processing and shaping methods for specific products.

ChE 551 - Principles of Mass Transfer (3 credits)
Prerequisites: undergraduate thermodynamics and integral calculus. An introductory course in basic concepts of mass transfer. Special emphasis is placed on mass transfer concepts applicable to stage and continuous operations. Topics covered include evaporation, gas absorption, and distillation. Cannot be used for degree credit in Chemical Engineering. Effective Until: Spring 2005

ChE 590 - Graduate Co-op Work Experience I (3 additive credits)
Prerequisite: permission from department and Division of Career Development Services. Cooperative education internship provides on-the-job reinforcement of the academic program by placement in major-related work situations. Work assignment developed or approved by the co-op office and evaluated by the department. Cannot be used for degree credit.

ChE 591 - Graduate Co-op Work Experience II (3 additive credits)
Prerequisite: permission from department and Division of Career Development Services.

ChE 592 - Graduate Co-op Work Experience III (3 additive credits)
Prerequisite: permission from department and Division of Career Development Services.

ChE 593 - Graduate Co-op Work Experience IV (0 credits)
Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

ChE 599 - Methods for Teaching Assistants and Graduate Assistants (3 credits)
Prerequisite: graduate standing. Required for all chemical engineering teaching assistants and graduate assistants. Covers techniques of teaching, interaction with students, and safety. Does not count as degree credit.

ChE 602 - Selected Topics in Chemical Engineering I (3 credits)
Prerequisite: graduate standing and permission of the instructor. Topics of current interest in chemical engineering.

ChE 603 - Separation Process Principles (3-0-3)
Prerequisites: ChE 342, ChE 349, ChE 363, ChE 364, ChE 367, ChE 471. The course covers the basic principles of separation with or without chemical reaction in phase equilibrium-based, external field-driven and membrane-based separation processes. Effective From: Fall 2004

ChE 604 - Membrane Separation Processes (3-0-3)
Prerequisites: ChE 342, ChE 349, ChE 363, ChE 364, ChE 367, ChE 471. This course covers the science, technology, engineering analysis and design of membrane separation processes, membrane reactors, membrane-based equilibrium separation processes and hybrid membrane processes. Effective From: Spring 2005

ChE 611 - Thermodynamics (3 credits)
Prerequisites: undergraduate courses in physical chemistry and thermodynamics, or equivalent. Principles of thermodynamics developed quantitatively to include thermodynamic functions and their application to chemical engineering processes.

ChE 612 - Kinetics of Reactions and Reactor Design (3 credits)

Prerequisite: undergraduate course in chemical engineering kinetics, or equivalent. Elements of optimum design introduced for reactor types, series and parallel reactor systems, multiple reactions, and temperature effects. Introduction to non-ideal reactor design. Study of various models for catalytic and non-catalytic solid-fluid reactions.

ChE 619 - Nano-scale Characterization of Materials (3 credits)

The course presents the basics of nanotechnology and the principles and application of advanced instrumentation for the characterization of nanostructures. Topics include atomic force microscopy; near-field optics, dielectric spectroscopy, and light scattering. The significant component of the course is laboratory work at the W. M. Keck Foundation Laboratory and research project. Effective From: Fall 2007

ChE 624 - Transport Phenomena I (3 credits)

Prerequisites: undergraduate courses in fluid mechanics, heat transfer, and mass transfer. A unified treatment of molecular and turbulent momentum, energy, and mass transport. Emphasis is on the mathematical description of physical mechanisms in momentum and energy transport.

ChE 625 - Microlevel Modeling in Particle Technology (3 credits)

Presents methodologies for analyzing the macroscopic properties of particulate systems in terms of the underlying microlevel processes. Significant components are the mathematical modeling of particulate systems at the microlevel, analytical and numerical methods for predicting macroscopic properties from microlevel models, and comparison of theoretical predictions with experimental results. Demonstrates the importance of the interaction of these three components in the scientific process. The first part concerns the flow of dry particles where any interstitial fluid can be ignored. The second part considers the flow of particles suspended in an interstitial fluid. Also includes a class project involving development of simulations. Same as ME 624.

ChE 626 - Mathematical Methods in Chemical Engineering (3 credits)

Prerequisite: undergraduate course in differential equations. The purpose of the course is to emphasize the importance of mathematics to chemical engineering practice. Applications of non-linear regression, series solution of ordinary differential equations, Sturm-Liouville problems in partial differential equations, and numerical methods. It is suggested that students take this course before taking ChE 624.

ChE 627 - Introduction to Biomedical Engineering (3 credits)

Prerequisites: undergraduate courses in thermodynamics and differential equations. Introduction to the structure and composition of the body followed by an exploration of the properties of blood and its flow in the cardiovascular system; the body as a heat source and as a series of compartments involved in mass transfer of materials (such as those in the kidneys and lungs). Design of artificial kidneys and heart-lung machines is also explored. Same as BME 627.

ChE 628 - Biochemical Engineering (3 credits)

Prerequisite: undergraduate degree in chemical engineering. The application of chemical engineering to biological processes, biochemical reaction systems, and their technological use. Special attention given to problems in momentum, energy, and mass transport, as well as chemical reaction kinetics in biological systems.

ChE 629 - Biological Engineering Analysis (3 credits)

Prerequisite: undergraduate degree in chemical engineering. Emphasis is on chemical engineering reactor design employing microbial populations. The dynamics of microbial interactions are described mathematically, as are cell attachment and reactor stability.

ChE 634 - Chemical Process Dynamics and Control (3 credits)

Prerequisite: undergraduate chemical engineering course in process dynamics and control. Mathematical principles of process dynamics and control; derivation and solution of differential equations describing the behavior of typical chemical engineering processing units; and mathematical analysis and design of control systems. Digital and sampled data control systems also discussed.

ChE 645 - Fundamentals of Rheology (3 credits)

Prerequisite: ChE 626 or permission of the instructor. Rheology of polymer melts and polymer solutions. Various types of time-dependent and time-independent non-Newtonian fluids are classified. Experimental techniques used to characterize these materials are discussed.
Effective Until: Spring 2005

ChE 654 - Corrosion (3-0-3)

Prerequisite: Undergraduate courses in Chemistry. Fundamental principles including thermodynamics and kinetics of corrosion; forms of corrosion (e. g. galvanic, crevice and stress); methods of corrosion measurement; high temperature corrosion; and special case histories. Effective From: Fall 2004

ChE 656 - Industrial Catalysis: Fundamentals & Applications (3 credits)

The class provides an introduction to catalytic phenomena as well as catalysts. It provides the background information necessary to understand industrial catalytic processes. Examples which will be discussed are hydrogen, ammonia and methanol synthesis, inorganic and organic oxidation reactions, petrochemical processes as well as pollution abatement and other important processes. The course provides insight into the theory of catalytic phenomena and also provides practical information about these processes from an industrial perspective. Effective From: Spring 2008

ChE 662 - Chemical Processing of Electronic Materials (3 credits)

Prerequisite: undergraduate degree in chemical engineering. Processes necessary for manufacturing electronic materials into semiconductor devices and systems including single crystal growth, chemical vapor deposition, ion implantation, dry etching, and other considerations.

ChE 664 - Experiments and Simulations in Particle Technology (3 credits)

Prerequisites: graduate standing and consent of the instructor. Covers particle size analysis using sieves as well as laser diffraction technique, size reduction with ball mill, measurement of powder flow properties and internal angle of friction, measurement of angle of repose, design of mass flow hoppers using Jenike direct shear tester, measurement of minimum sintering temperature of powders, particle sedimentation, powder mixing, dry particle coating, and fluidized beds. Simulations involve various dry and fluid based particle systems, focusing on particle-particle and fluid-particle interactions. Same as ME 664.

ChE 671 - Chemical Process Safety (3 credits)

Prerequisite: graduate standing. Chemical and physical principles in chemical process safety and fire and explosion hazard evaluation. Emphasis is on materials, their reactions, and effect on surroundings. Course intended for students in the master's program in occupational safety and health engineering, and may not be taken for credit by ChE graduate students. Effective Until: Spring 2005

ChE 675 - Statistical Thermodynamics (3 credits)

Prerequisite: ChE 611 or permission of instructor. Application of equilibrium statistical mechanics to chemical engineering problems. Basic postulates and relationships of statistical thermodynamics, including the ideal gas, ideal crystal, and virial equation; statistical theories of fluid mixtures and other advanced topics.

ChE 681 - Polymerization-Principles and Practice (3 credits)

Prerequisite: Undergraduate courses in physical or organic chemistry or ChE 503 or equivalent. The course focuses on the structural and synthetic aspects of polymers and examines in detail a number of bench and industrial scale polymerization methods. In addition to kinetics and mechanisms of commercially important polymerization systems, the course examines reactive modification of synthetic and natural polymers and provides an introduction to applicable characterization methods.

ChE 682 - Polymer Structures and Properties (3 credits)

Prerequisite: Undergraduate physical chemistry, a materials related course or ChE 503 or equivalent. The course provides an overview of polymer structures and properties and their relationships from the molecular viewpoint to phenomenological descriptions. Topics include thermodynamics of a single molecule, dynamic theory and viscoelasticity of polymers, polymer solids and mechanical properties, rubbers, polymer blends and composites, biological polymers, and special applications. New areas and innovative applications of polymers will be introduced.

ChE 683 - Polymer Processing (3 credits)

Prerequisite: Undergraduate courses in transport phenomena, fluid flow, or heat transfer or approval of graduate advisor. The course provides a systematic approach to the physical phenomena occurring in polymer processing machinery. The synthesis of the elementary steps of polymer processing are shown in relation to the development of extrusion die flow and extrusion products and injection mold flows and molded products. Structural and residual stresses are examined.

ChE 684 - Materials and Process Selection for Polymer Product Design (3 credits)

Prerequisites or corequisites: ChE 681, ChE 682, ChE 683 or approval of graduate advisor. The course provides methodologies for designing polymer-based products by considering materials and processing methods. Methods for selecting homopolymers, polymer blends and composites for specific appilcations will be presented in terms of properties, processability, manufacturing methods and economics. Process/structure/property correlations are presented as well as approaches to product design including CAD, prototyping, and strength and failure criteria. Case studies from biomedical, packaging and other applications are discussed.

ChE 685 - Industrial Waste Control I (3 credits)

Prerequisite: undergraduate degree in chemical engineering or permission of the instructor. Physical/chemical treatment of industrial wastewaters: ionic equilibria; surface characterization; thermodynamic applications; transport phenomena; and sludge treatment.

ChE 686 - Industrial Waste Control II (3 credits)

Prerequisite: undergraduate degree in chemical engineering or permission of the instructor. Biological treatment of industrial wastewaters: biological mechanisms; kinetics; vapor-liquid equilibria; and settling phenomena.

ChE 687 - Industrial Gas Cleaning (3 credits)

Prerequisite: undergraduate degree in chemical engineering, or permission of the instructor. Review of available tools for cleaning atmospheric effluents from manufacturing facilities and power plants; use of a systems approach to minimize gas cleaning costs; alternatives involving combinations of process modification and effluent clean-up; methods for estimating key design parameters for cyclones, baghouses, electrostatic precipitators and scrubbers. Applications of design parameters through the solution of extensive problem-sets.

ChE 701 - Master's Thesis (6 credits)
Prerequisite: matriculation for the master's degree in chemical engineering. Approval of thesis advisor is necessary for registration. Original research under the guidance of a departmental advisor. The final product must be a written thesis approved by at least three faculty members: the primary advisor, another from the department, and one other faculty member. A student must continue to register for at least 3 credits per semester until at least 6 credits have been completed and a written thesis is approved. Only a total of 6 credits will count toward the degree.

ChE 702 - Selected Topics in Chemical Engineering II (3 credits)
Prerequisite: graduate standing and permission of the instructor. Topics of current interest in chemical engineering.

ChE 705 - Independent Study (3 credits)
Prerequisites: permission from the graduate advisor (not dissertation advisor) in chemical engineering, as well as courses prescribed by a supervising faculty member (who is not the student's dissertation advisor). This special course covers areas of study in which one or more students may be interested, but which isn't of sufficiently broad interest to warrant a regular course offering. Students may not register for this course more than once with the same supervising faculty member.

ChE 711 - Phase Equilibrium (3 credits)
Prerequisite: ChE 611 or equivalent. Low-pressure and high-pressure vapor-liquid equilibrium and liquid-liquid equilibrium. Among the topics covered are experimental methods, consistency tests of the data, expressions for the dependence of the activity coefficient on composition and temperature, and prediction of multicomponent vapor-liquid and liquid-liquid equilibrium from binary data. Prediction methods of vapor and liquid phase nonidealities, based on equations of state and solution theories, are discussed.

ChE 721 - Combustion Reaction Engineering (3-0-3)
Prerequisites: Undergraduate degree in Chemical or Mechanical Engineering. Topics related to the engineering of combustion systems will be discussed. These include laminar flames, turbulent combustion, ideal reactor modeling of complex combustion systems, combustion chemistry, heterogeneous combustion and incineration. Effective From: Fall 2004

ChE 725 - Transport Phenomena II (3 credits)
Prerequisite: ChE 624 or equivalent. Transport in laminar and turbulent flow: in solids, between phases, and macroscopic transport in flow systems.

ChE 740 - Biological Treatment of Hazardous Chemical Wastes (3 credits)
Prerequisite: ChE 686 or the permission of the instructor. A doctoral level seminar on the limitations of biological treatment for hazardous wastes that looks at the fundamental processes taking place.

ChE 790 - Doctoral Dissertation (Credits as designated)
Required of all students for the degree of Doctor of Philosophy. A minimum of 36 credits is required. Approval of dissertation advisor is necessary for registration. Students must register for at least 6 credits of dissertation per semester until 36 credits are reached and then for 3 credits each semester thereafter until a written dissertation is approved.

ChE 791 - Graduate Seminar (Non-credit)
Required of all chemical engineering students receiving departmental or research-based awards and all doctoral students. The student must register each semester until completion of the degree. Outside speakers and department members present their research for general discussion.

ChE 792 - Pre-Doctoral Research (3 credits)
Prerequisite: Permission of Associate Chairperson for Graduate Studies. For students admitted to the Doctor of Philosophy Program in Chemical Engineering who have not yet passed the qualifying examination. Research is carried out under the supervision of designated chemical engineering faculty. If the student's research activity culminates in doctoral research in the same area, up to a maximum of 6 credits may be applied to the 36 credits required under ChE 790. Effective From: Fall 2007

ChE 794 - Professional Presentations for Ph.D. Students (0 credits)
Intended to help students make better technical presentations. Each student is required to make a presentation on a research topic; guest lectures will occur during the semester. Effective From: Fall 2007

Chemistry: Offered by the Department of Chemistry and Environmental Science

UNDERGRADUATE COURSES:

Chem 105 - Applied Chemical Principles (3-2-4)

Prerequisite: high school algebra or equivalent. The fundamentals and relation of chemistry to living in today's society. Suitable laboratory experiments illustrate the course material. Not open to engineering or science students, or students who have completed a college level chemistry course.

Chem 108 - College Chemistry I (3-1-3)

Prerequisites: a one-year college prep high school chemistry course, high school math including algebra and trigonometry. Delivered as a telecourse, the course provides the first of a two-semester sequence of college chemistry for high school students and other distance learners seeking college credit and/or preparation for the AP Examination. Matriculated undergraduates may not receive credit for this course.

Chem 109 - College Chemistry II (3-1-3)

Prerequisite: Chem 108. A continuation of Chem 108.

Chem 121 - Fundamentals of Chemistry I (3-0-3)

Prerequisites: high school math including algebra and trigonometry; chemistry placement examination required. The first semester of a three-semester sequence in chemistry, designed for underprepared students. Introduces the basic concepts of chemistry, including chemical reactions, electronic structure, gases and thermochemistry. Enrollment in Chem 121, 122, 123 is determined by a placement exam prior to initial registration. This sequence takes the place of Chem 125, 126. However, 3 credits of Chem 121, 122, 123 are additive only. The remaining 6 credits count toward degree requirements.

Chem 122 - Fundamentals of Chemistry II (3-0-3)

Prerequisite: Chem 121. Continuation of the Chem 121 sequence. This course introduces the student to the basic concepts of chemistry, including molecular structure, solutions and solids, and equilibrium.

Chem 123 - Fundamentals of Chemistry III (3-0-3)

Prerequisite: Chem 122. Continuation of the Chem 121 sequence. Introduces the student to the basic concepts of chemistry, including equilibrium in solution, kinetics and thermo-dynamics. Students should also register for Chem 124.

Chem 124 - General Chemistry Laboratory (0-2-1)

Corequisite: Chem 123 or Chem 126. Chemical principles studied in the Chem 125 and 126 or Chem 121, 122 and 123 sequence are illustrated and reinforced by performance of laboratory experiments.

Chem 124H - General Chemistry II Honors Laboratory (0-2-1)

Corequisite: Chem 126H. The laboratory consists of special research projects and other developmental labs.

Chem 125 - General Chemistry I (3-0-3)

Prerequisites: high school math including algebra and trigonometry; chemistry placement examination required. The first semester of a two-semester sequence in chemistry. Introduces the basic concepts of chemistry, including chemical reactions and bonding, electronic and molecular structure, gases and thermochemistry.

Chem 125H - General Chemistry I Honors (3-0-3)

Admission is by invitation only. An honors chemistry course which parallels Chem 125 but is more comprehensive and rigorous. Field trips, molecular model building, laboratory projects, journal reading assignments and reports, and supplementary problems are required -aspects of the program.

Chem 126 - General Chemistry II (3-0-3)
Prerequisite: Chem 125 or equivalent. The second semester of a two-semester sequence in chemistry. Introduces the basic concepts of chemistry, including equilibrium, chemical kinetics, thermodynamics, and electrochemistry. Students should also register for Chem 124.

Chem 126H - General Chemistry II Honors (3-0-3)
Prerequisite: Chem 125H. A continuation of Chem 125H, which parallels the course content of Chem 126. An individual research project is completed. Chem 124H must be taken concurrently.

Chem 221 - Analytical Chemical Methods (0-4-2)
Prerequisite: Chem 123 or Chem 126, Chem 124. Laboratory introducing quantitative chemical analyses by gravimetry, titration, spectroscopy, chromatography, and potentiometry.

Chem 222 - Analytical Chemistry (3-0-3)
Prerequisite: Chem 123 or Chem 126, Chem 124. Lecture course introducing concepts of chemical analyses by gravimetry, titration, spectroscopy, chromatography, and potentiometry.

Chem 231 - Physical Chemistry I (3-0-3)
Prerequisites: Chem 123 or Chem126, Phys 111. Corequisite: Math 211. The topics covered include the properties of ideal and non-ideal gases and liquids, solutions, thermochemistry, thermodynamics, the phase rule, and phase equilibria.

Chem 235 - Physical Chemistry II (3-0-3)
Prerequisite: Chem 231. A continuation of Chem 231. The topics include homogeneous and heterogeneous chemical equilibria, ionic equilibria, electrochemistry, kinetic theory of gases, transport phenomena, kinetics, and irreversible processes.

Chem 235A - Physical Chemistry II Laboratory (0-4-2)
Prerequisite: Chem 221, Chem 235. Corequisite: Math 225 (special section for chemical engineering and chemistry majors). Laboratory experiments apply and extend the basic knowledge of physical chemistry acquired in the lecture. Reports and presentations are an essential part of the course.

Chem 236 - Physical Chemistry for Chemical Engineers (4-1-4)
Prerequisites: Chem 126 General Chemistry Laboratory, ChE 230 Chemical Engineering Thermodynamics or ChE 232. This course will introduce the chemical engineering students to the concepts of order, disorder, chemical equilibrium and phase equilibrium. Credit for this course will not be given if credit for Chem 235 has been given. Effective From: Fall 2005

Chem 238 - Analytical/Organic Chem Lab for Chemical Engineers (0-4-2)
Prerequisite: Chem 124 and Chem 245. This course will offer the ChE students experience in organic and analytical laboratory experiments. These experiments will reinforce concepts learned in the organic chemistry lecture classes. This laboratory course will also provide exposure to analytical and other techniques useful in the chemistry and chemical engineering laboratories. Effective From: Spring 2008

Chem 243 - Organic Chemistry I (3-0-3)
Prerequisite: Chem 123 or Chem 126. The preparation and properties of the various classes of organic compounds are discussed, with attention given to industrial sources such as coal and petroleum. Also covers the commercial utilization of these materials in the synthesis of useful products used in areas such as foods, cosmetics, textiles, plastics, and pharmaceuticals.

Chem 244 - Organic Chemistry II (3-0-3)
Prerequisite: Chem 243. A continuation of Chem 243.

Chem 244A - Organic Chemistry II Laboratory (0-4-2)
Prerequisite: Chem 124. Corequisite: Chem 244. Synthesis and characterization of organic compounds are performed in a unique multi-scale manner: micro, macro and a kilo scale.

Chem 245 - Organic Chemistry for Chemical Engineers (4-1-4)
Prerequisite: Chem 126. This course is a one-semester course(opposed to classic two-semester sequence) to provide chemical engineering students with a basic understanding of organic compounds and their reactions. Effective From: Fall 2005

Chem 301 - Chemical Technology (2-2-3)
Prerequisites: high school algebra and trigonometry or equivalent. Designed for engineering technology majors. Not open to students who have completed a college level chemistry course. Covers principles of chemistry, with a focus on chemical energetics and chemistry of materials. Suitable laboratory experiments illus-trate the course material.

Chem 310 - Co-op Work Experience I (3 additive credits)
Prerequisites: completion of the sophomore year, approval of the department, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the co-op office. Mandatory participation in seminars and completion of a report. Cannot be used for degree credit.

Chem 311 - Co-op Work Experience II (3 additive credits)
Prerequisites: ChE 310. Continuation of ChE 310. Cannot be used for degree credit.

Chem 336 - Physical Chemistry III (3-0-3)
Prerequisite: Chem 235. An introduction to quantum mechanics, statistical mechanics, spectroscopy, and solid state.

Chem 337 - Physical Chemistry for Biological Science (3-0-3)
Prerequisites: Chem 123 or Chem 126. The course covers fundamental principles of physical chemistry related to biochemical processes such as metabolism and other biochemistry. Descriptions and example applications use DNA, proteins, amino acids, including properties of hydrophobic interactions. Thermochemistry of biochemical systems including chemical energy (enthalpy of reaction) along with chemical activities and non-ideal behavior are illustrated. The importance of entropy in control of biochemical reactions is also covered. Ionic systems and redox reactions and acids and bases in biological systems are presented. The course also illustrates a number of biochemical analytical methods. Effective From: Spring 2003

Chem 338 - Analytical/Organic Chem Lab for Chemical Engineers (0-4-2)
Prerequisite: Chem 124 and Chem 245. This course will offer the ChE students experience in organic and analytical laboratory experiments. These experiments will reinforce concepts learned in the organic chemistry lecture classes. This laboratory course will also provide exposure to analytical and other techniques useful in the chemistry and chemical engineering laboratories. Effective From: Fall 2005 Until: Spring 2007

Chem 339 - Analytical/Physical Chem Lab for Chemical Engineers (0-4-2)
Prerequisites: Chem 245, Chem 236, Chem 338 or equivalent. Co-requisite: Math 225A. This course will offer students an introduction to physical and analytical chemistry laboratory techniques. The application of principles learned in lecture will be reinforced by the experiments done in this lab. They will also provide exposure to analytical and other techniques used in chemistry and chemical engineering. Effective From: Fall 2005

Chem 340 - Chemistry and Engineering of Materials (3-0-3)
Prerequistes: Chem 235, Chem 244. Emphasizes processing/property relationships for a variety of engineering materials, including polymers, metals, ceramics, composites, semiconductors, optical fibers, and biomaterials. Introduces concepts of chemical structure, bonding and crystallinity. Covers important chemical, physical, electrical, and mechanical properties and corrosion and materials degradation. Also includes materials selection in the chemical process industries.

Chem 350 - Industrial Chemistry (3-0-3)
Prerequisite: Chem 244. Applications of chemistry to the development of products from basic research and development through scale-up and marketing. Covers inorganic and organic processes, environmental considerations, industrial catalysis, and cost calculations.

Chem 360 - Environmental Chemistry I (3-0-3)
Prerequisites: Chem 126 and 124 or equivalent. Chemistry of the environment is covered with emphasis on water chemistry. The course includes treatment of chemical bonding, basic thermodynamics, chemical equilibrium, kinetics, and the chemistry of ideal and non-ideal solutions. Water chemistry is covered, including acid/base equilibria, alkalinity, buffers, precipitation, and the sources of fates of water pollutants. Effective From: Spring 2006

Chem 361 - Environmental Chemistry II (3-0-3)
Prerequisites: Chem 126 and 124 or equivalent. Chemistry of the environment is covered with emphasis on atmospheric and geo-chemistry. Organic and biochemical processes in the environment are treated. The applications of chemical principles to industrial ecology, green chemistry, pollution prevention and sustainability are discussed. Effective From: Spring 2006

Chem 365 - Environmental Organic Chemistry (3-0-3)
Prerequisites: Chem 122 or Chem 126. An introduction to organic chemistry intended for students studying environmental science or environmental engineering. Covers the traditional functional groups, but focuses on their environmental impact and industrial synthesis. Not open to students who have taken organic chemistry.

Chem 391 - Research and Independent Study (3-0-3)

Provides an opportunity to work on a reserch project under the individual guidance of a member of the department. Effective From: Fall 2008

Chem 412 - Inorganic Chemistry (3-0-3)
Prerequisite: Chem 231. A lecture-recitation-laboratory course in practical inorganic chemistry. Covers the chemistry of most of the elements and their compounds. Preparation in the laboratory is followed by purification and characterization.

Chem 440 - Fundamentals of Polymers (3-0-3)
Prerequisites: Chem 235, Chem 244. An introduction to the important fundamental aspects of polymers including preparation, structure, physical states and transitions, molecular weight distributions, viscous flow, and mechanical properties.

Chem 443 - Introductory Polymer Laboratory (1-4-3)
Prerequisite: Chem 440. Practical methods useful in the preparation and characterization of macromolecules, including radical, ionic, emulsion, and condensation polymerization. Various methods useful in characterizing polymers, such as solution and bulk viscosity, light scattering, osmometry, thermal analysis, and various spectroscopic techniques. Melt spinning and extrusion of polymers along with mechan-ical properties.

Chem 448 - Preparation and Analysis of Organic Compounds (0-4-2)
Prerequisites: Chem 244 and Chem 244A. The application of laboratory techniques learned in Chem 344A laboratory to the synthesis and characterization of organic compounds.

Chem 473 - Biochemistry (3-0-3)
Prerequisite: Chem 244 or Chem 245. Covers the fundamentals of biochemistry including buffers, blood, proteins, enzymes, carbohydrates, fats, and nucleic acids. Emphasis on the relationship of biochemistry to biotechnology and medicine.

Chem 475 - Biochemistry Lab I (0-4-2)
Prerequisites: Chem 244 or Chem 473. This course will offer the chemistry and related (chemical engineering, biology, bioinformatics, bioengineering)students fundamental laboratory approaches for biochemistry and biotechnology. These experiments will reinforce concepts learned in biochemistry lecture classes. Effective From: Spring 2006

Chem 480 - Instrumental Analysis (0-4-2)
Prerequisite: Chem 221, Chem 222 or equivalent. Laboratory exploring the principles of operation of modern instruments for chemical analysis. Ultra-violet and infrared spectroscopy, mass spectrometry, gas chromatography, high performance liquid chromatography, voltametry, and potentiometry are among the instruments utilized. Apply calibration methods, statistical data treatment, and sample preparation techniques are applied.

Chem 484 - Modern Analytical Chemistry (1-4-3)
Prerequisites: Chem 235 and Chem 222. Basic principles and techniques of quantitative analysis, with emphasis on application of modern analytical instrumentation. Atomic and molecular spectroscopy, chromatography, and electrochemical methods are studied and applied in the laboratory. Calibration, sampling methodology and sample preparation are also treated.

Chem 490 - Special Topics in Chemistry (3-0-3)
Prerequisite: depends upon the nature of the course given. Course is offered in specific areas as interest develops.

Chem 491 - Research and Independent Study I (3-0-3)
Prerequisite: senior standing in chemistry or chemical engineering. Provides an opportunity to work on a research project under the individual guidance of a member of the department.

Chem 491H - Honors Research and Independent Study I (3-0-3)
Same as Chem 491, with special projects for Honors students.

Chem 492 - Research and Independent Study II (3-0-3)
Prerequisite: Chem 491. A continuation of Chem 491.

Chem 492H - Research and Independent Study II ? Honors (3-0-3)
Prerequisite: Chem 491H. Same as Chem 492, with special projects for Honors students.

R160:108 - Organic Biochemistry (3)
For more details go to Rutgers Catalog.

R160:207 - Structure And Bonding (3)

For more details go to Rutgers Catalog.

R160:227 - Experimental Analytical Chemistry (3)
For more details go to Rutgers Catalog.

R160:333 - Organic Chemistry Laboratory (2)
For more details go to Rutgers Catalog.

R160:345/346 - Physical Chemistry (3,3)
For more details go to Rutgers Catalog.

R160:413 - Inorganic Chemistry (3)
For more details go to Rutgers Catalog.

GRADUATE COURSES:

Chem 552 - Laser Chemistry and Technology (3 credits)
Prerequisites: one year of chemistry, one year of physics, and calculus. An introduction to the underlying chemical and physical principles of lasers, their operation and uses and the related optoelectronic technology. Analysis of classes of laser; pumping mechanisms; detection of light; absorption and emission of radiation and current industrial and state-of-the-art uses.

Chem 593 - Graduate Co-op Work Experience IV (0 credits)
Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

Chem 599 - Methods for Teaching Assistants and Graduate Assistants (3 credits)
Prerequisite: graduate standing. Required for all chemistry teaching assistants and graduate assistants. Covers techniques of teaching, interaction with students, and safety. Does not count as degree credit.

Chem 601 - Special Topics in Chemistry I (3 credits)
Prerequisite: graduate standing and permission of the instructor. Topics of current interest in chemistry.

Chem 602 - Advanced Organic Chemistry II: Reactions (3 credits)
Prerequisite: undergraduate organic chemistry. The study of organic syntheses including principles underlying chemical reactions; chemical thermodynamics, structural theory, rates of reaction, mechanisms and stereochemistry; IR, UV, and NMR spectroscopy; organic synthesis; formation of aliphatic carbon-carbon bonds; pericyclic reactions; carbon-nitrogen bonds; electrophilic and nucleophilic aromatic substitution, molecular rearrangements; photochemical and free-radical reactions; oxidation and reduction; and organometallic reagents containing phosphorous, boron, sulfur, and silicon.

Chem 603 - Advanced Organic Chemistry Laboratory (3 credits)
Prerequisite: undergraduate organic chemistry. More advanced syntheses than those normally carried out in the undergraduate laboratory are emphasized including current analytical techniques and methods of separation. Both small and large scale preparations are assigned.

Chem 605 - Advanced Organic Chemistry I: Structure (3 credits)
Prerequisite: undergraduate organic chemistry. Structure of organic molecules. Topics include atomic and molecular structure, stereochemistry, reactive intermediates (cations, anions, radicals, and carbenes), orbital symmetry, and spectroscopy.

Chem 606 - Physical Organic Chemistry (3 credits)
Prerequisite: Chem 502 or equivalent. Emphasis is placed on the physical aspects of the subject. Determination of reaction mechanisms, equilibria, and kinetics using simple molecular orbital theory and absolute reaction rate theory.

Chem 610 - Advanced Inorganic Chemistry (3 credits)
Prerequisite: undergraduate physical chemistry or permission of the instructor. Theories of observed chemical and physical properties of the elements and their compounds; prediction of reactivity and properties of proposed new compounds.

Chem 611 - Solid-State Inorganic Chemistry (3 credits)
Prerequisite: undergraduate physical chemistry or physics. Structure, physical and chemical properties of solid-state materials, and their formation.

Chem 617 - Mass Spectrometry and Interpretation of Mass Spectra (3 credits)
Prerequisite: CHEM125 and CHEM126 or equivalent. Historical background, fundamentals and mechanics of operation for components incorporated into modern Mass Spectrometers: vacuum system, ion sources, mass filter, ion detection, plus computer operation and data collection. Explanation and interpretation of mass spectra and fragmentation patterns are a fundamental theme throughout the course. Lecture material includes principles of operation and appropriate applications for modern types of mass spectrometers: magnetic sector, quadrupole, time of flight, ion trap, FT-ICR. Theory and applications of electron impact, chemical, electrospray, and other ionization techniques including atmospheric sampling are covered. High resolution analysis using magnetic sector and FT - ion cyclotron instruments. Analytical applications in environmental, petroleum and biochemical analysis and applications and coupling of mass spectrometry with other instruments (GC, LC, AES,) are illustrated.

Chem 626 - Chemistry of Contemporary Materials (3 credits)
Prerequisite: one year of general chemistry. An introduction to the structure and chemical, electrical, and mechanical properties of metallic, ceramic, and polymeric materials and their use in science and engineering.

Chem 629 - Heterogeneous Catalysis (3 credits)
Prerequisites: Undergraduate course in Organic Chemistry or Physical Chemistry or the equivalent. Basic principles of catalysis, catalyst preparation, and catalyst action; mechanisms and applications. Methods of catalyst preparation; effect on absorption, transport phenomenon, and reaction mechanisms and review of industrial examples.

Chem 640 - Polymer Chemistry (3 credits)
Prerequisites: undergraduate organic and physical chemistry. Kinetics of polymerization; properties of polymer solutions; characterization of molecular size and shape.

Chem 641 - Polymer Properties (3 credits)
Prerequisite: undergraduate organic and physical chemistry. Forces between polymer molecules and their relation to crystal structure; fundamentals of rheology and viscoelastic properties of polymers; polymer crosslinking, reinforcement, and aging from a chemical viewpoint.

Chem 643 - Polymer Laboratory I (3 credits)
Prerequisites: Chem 440

Chem 644 - Fundamentals of Adhesion (3 credits)
Prerequisite: Undergraduate organic and physical chemistry. Adhesion phenomena; intermolecular and interatomic forces; surface chemistry; absorption of polymers on surfaces; mechanisms of adhesion; bulk properties of adhesives; and rheology of polymers used as adhesives.

Chem 645 - Polymer Laboratory II (3 credits)
Prerequisite: Chem 643. Experiments illustrating contemporary methods of polymer characterization including osmometry, viscometry, laser light scattering, vapor pressure osmometry, differential thermal analysis, dilatometry, x-ray diffraction, birefrigence, polymer factionation/gel permeation chromatography, extrusion, swelling crosslinking, molding, viscoelasticity, and infrared, ultraviolet, and NMR spectroscopy.

Chem 654 - Corrosion (3 credits)
Prerequisite: one year of general chemistry. Fundamental principles including thermodynamics and kinetics of corrosion; forms of corrosion (e. g., galvanic crevice and stress); methods of corrosion measurement; high temperature corrosion; and special case histories.

Chem 655 - Electrochemistry: Principles and Applications (3 credits)
Prerequisites: one year of general chemistry and a course in physical chemistry or equivalent. Principles governing electrochemical methods such as conductance, emf, polarography, cyclic voltammetry, chronopotentiometry, coulometry, and their application to electric energy storage and conversion, corrosion, electroplating, pollution monitoring, electrochemical sensors, and electrochemical synthesis.

Chem 658 - Advanced Physical Chemistry (3 credits)
Prerequisite: one year of undergraduate physical chemistry. Principles and applications of quantum chemistry; the wave equation, its properties and mathematics; the Schrodinger equation and wave functions; the harmonic oscillator; variational and perturbational methods; atomic theory, structure, and properties; simple molecules, LCAO and valence bond theories; semi-empirical methods; time dependence, and introduction to electronic and vibration-rotation spectroscopy.

Chem 659 - Atomic and Molecular Structure (3 credits)
Prerequisite: Chem 658 or equivalent. Application of quantum chemistry and molecular structure; techniques for calculation of physical properties of molecules; and use of state-of-the-art computer graphics.

Chem 661 - Instrumental Analysis Laboratory (3 credits)

Prerequisites: one year of undergraduate physical chemistry. Instruments for chemical analysis are discussed in class and used in the laboratory; basic theory; sample preparation; use of instruments and interpretation of data are covered for spectroscopy including UV0VIS, FTIR, AA, and NMR; HPLC, GC, ion chromatography, mass spectrometry. Applications to food science, pharmaceuticals, polymers, and other chemical areas. 1 hr. lecture, 3 hrs. lab.

Chem 662 - Air Pollution Analysis (3 credits)
Prerequisite: undergraduate physical chemistry. Chemical and physical principles of gaseous species and trace level measurement techniques for airborne vapors and particulates. Emphasis on analyzing real air samples at the parts-per-billion level, meteorological dispersion and life times of pollutants are covered. Laboratory work in air pollution sampling methods for vapor and particulate species. Determination of primary air pollutants using wet chemical and instrumental techniques.

Chem 664 - Advanced Analytical Chemistry (3 credits)
Prerequisite: undergraduate physical chemistry. The principles of chemical analysis as they apply to chromatography, electrochemistry, and spectroscopy. Sampling considerations, separations, and sample preparation steps. This course is a useful adjunct to Chem 661, where these analytical techniques are considered in a more practical way. Effective From: Spring 2009

Chem 670 - Environmental Toxicology for Engineers and Scientists (3 credits)
Prerequisite: Chem 673 or equivalent. Toxicology at the molecular level, including methods of evaluation and quantification, as well as mechanisms of absorption, distribution, metabolism, and excretion of toxicants. Discussions of systemic toxicology (e.g., liver, kidneys, nervous system) and survey of toxic agents. Particular emphasis placed on environmental toxicology including air, water and soil pollutants, food additives, and contaminants.

Chem 671 - Industrial Toxicology Workshop (3 credits)
Prerequisite: Chem 670 or equivalent. A case study approach that applies basic theory and methods of toxicology to real-life problems related to hazardous materials transport, toxic commercial products and by-products, chemical industrial fires, unsafe landfills and illegal dumping.

Chem 673 - Biochemistry (3 credits)
Prerequisites: undergraduate organic and physical chemistry, or suitable background in these subjects. Fundamentals of biochemistry related to physical organic chemistry for students who have an interest in biomedical engineering, chemistry, chemical engineering, or environmental science.

Chem 677 - Introduction to Medicinal Chemistry (3-0-3)
The course introduces Medicinal Chemistry with mechanisms of drug action and the classification of drugs into the various categories of activity from a pharmaceutical viewpoint that encompasses chemical, biological and pharmacological parameters. Course includes material on: Chemistry, Structure Activity, Structure-Activity Relationships, Synthetic Pathways and Metabolic Pathways. Effective From: Fall 2004 Until: Fall 2008

Chem 700 - Master's Project (3 credits)
Prerequisite: matriculation for the master's degree. An extensive report involving an experimental, theoretical, or literature investigation is required. The literature investigation should result in a critical review of a specific area. Approval to register for the master's project must be obtained from the project advisor. Students must continue to register for at least 3 credits each semester until the project is completed and a written report is accepted. Only a total of 3 credits will count toward the degree.

Chem 701 - Master's Thesis (6 credits)
Prerequisite: matriculation for the master's degree in applied chemistry. Approval of thesis advisor is necessary for registration. Original research under the guidance of a departmental advisor. The final product must be a written thesis approved by at least three faculty members: the primary advisor, another from the department, and one other faculty member. Once registration for thesis has begun, a student must continue to register for a minimum of 3 credits per semester until at least 6 credits have been completed and a written thesis is approved. Only a total of 6 credits will count toward the degree.

Chem 702 - Special Topics in Chemistry II (3 credits)
Prerequisite: Graduate standing. Topics of current interest in chemistry.

Chem 714 - Pharmaceutical Analysis (3 credits)
The objective of this course is to provide an overview of instrumental techniques used in the analysis of different pharmaceutical products. Many different types of analysis are carried out in the pharmaceutical industry pertaining to active ingredients, formulations as well as impurities and dgradants. The focus will be on instrumentation such as chromatography, mass spectroscopy, different types of spectroscopy, quality assurance and GMP. Effective From: Spring 2009

Chem 717 - Mass Spectrometry and Mass Spectral Interpretation (3 credits)
Prerequisites: CHEM125 and CHEM126 or equivalent. Chem 717 and Evsc 617 are comprised of Chem/Evsc 617 plus a research project:

Research projects usually comprise experimental and mass spectrometry interpretation studies. These can be performed at NJIT or in the students corporate mass spectrometry facility. Projects may also include theory, data interpretation or literature reviews pertinent to a current active area in mass spectrometry research. Projects should be approved or in consult with the instructors.

Chem 725 - Independent Study I (3 credits)

Prerequisites: permission from the graduate advisor (not thesis advisor) in chemistry, as well as courses prescribed by a supervising faculty member (who is not the student's thesis advisor). This special course covers areas of study in which one or more students may be interested, but which isn't of sufficiently broad interest to warrant a regular course offering. Students may not register for this course more than once with the same supervising faculty member.

Chem 726 - Independent Study II (3 credits)

Prerequisite: written permission from the Associate Chairperson for Environmental Science plus courses prescribed by the supervising faculty member (who is not the student's thesis advisor). This special course covers areas of study in which one or more students may be interested, but which are not sufficiently broad to warrant a regular course offering. Students may not register for this course more than once with the same supervising faculty member.

Chem 727 - Independent Study III (3 credits)

Prerequisite: written permission from the Associate Chairperson for Environmental Science plus courses prescribed by the supervising faculty member (who is not the student's thesis advisor). This special course covers areas of study in which one or more students may be interested, but which are not sufficiently broad to warrant a regular course offering. Students may not register for this course more than once with the same supervising faculty member.

Chem 734 - Thermochemical Kinetics-Detailed Mechanistic Modeling (3 credits)

Prerequisite: graduate level course in either kinetics or reactor design, or permission of instructor. Quantitative estimation of thermochemical data and chemical reactions in the vapor phase, and to some extent in the liquid phase; theories of transition state, RRKM, and Quantum RRK; and detailed chemical modeling concepts for reactor design. Applied computer project is required.

Chem 735 - Combustion (3 credits)

Prerequisite: thermodynamics and kinetics or equivalent, or permission of instructor. Thermodynamic properties of stable molecules and free radical species in combustion and oxidation of aliphatic hydrocarbons; reactions occurring in high temperature combustion systems; and related kinetic principles.

Chem 736 - Inorganic Biological Chemistry (3-0-3)

This class introduces fundamental aspects of metals' roles at the interface of inorganic/organic and biological worlds. Both the "why" and "how" questions of the role of metals in materials and biological sciences will be answered based on the concept of symmetry and its consequences. Special attention will be paid to understanding the electronic structure, spectroscopic signatures and reactivity of metal ions in coordination environments related to chemical and biological catalysis. Effective From: Fall 2008

Chem 737 - Applications of Computational Chemistry and Molecular Modeling (3-1-3)

Students are exposed to hands-on applications and fundamental aspects of computational chemistry and molecular modeling in organic, inorganic, bio- and physical chemistry. The course provides methods to determine the thermochemistry of a reaction, and strength (energy)of interactions by organic drug-like molecules with proteins. The course teaches the student to evaluate relative energy of different structures plus chemical species stability, reactivity and equilibrium ratios in chemical environments. Effective From: Spring 2009

Chem 748 - Nanomaterials (3)

Prerequisites: New feature of the 700 level course will be hands-on small projects carried out by groups of two students in Professor Iqbal's laboratories during the second half of the semester. The projects will be selected from the topics covered in the course. A second feature will involve a lecture on a specialized nanomaterial topic given by an invited outside lecturer. This 3 credit interdisciplinary course is designed to teach and provide hands-on project experience to M.S. and Ph.D. graduate students in chemistry, physics/materials science, and chemical/biomedical/ electrical engineering on the fundamentals, synthesis, characterization and applications of nanomaterials. 75% of the course will comprise of lectures-one or two of which will be given by invited outside lecturers. 25% of the course will involve small projects based on the syllabus and conducted in the research laboratories of the instructor. Effective From: Spring 2009

Chem 777 - Principles of Medicinal Chemistry (3)

Teaches about drug design, and the molecular mechanisms by which drugs act in the body. Covers pharmacodynamics, pharmacokinetics, molecular targets used by drugs, the interaction of a drug with a target, and the consequences of this interaction. Covers strategies used in discovering and designing new drugs, and surveys the "tools of the trade" involved, e.g., QSAR, combichem and computer aided design. Covers special topics like chlorinergics, analgesics, opiates, antibacterials, antivirals, and antiulcer agents. Effective From: Spring 2009

Chem 791 - Graduate Seminar (Non-credit)

Required of all chemistry graduate students receiving departmental or research-based awards and all doctoral students. The student must register each semester until completion of the degree. Outside speakers and department members present their research for general discussion.

Civil Engineering : Offered by the Department of Civil and Environmental Engineering

UNDERGRADUATE COURSES:

CE 200 - Surveying (3-0-3)

Prerequisite: Math 111. Angle and distance measurement; leveling; topographic mapping; traverse and area computations; horizontal and vertical curves; cross sections; triangulation; state plane coordinates; global positioning system. Emphasis on the use of the computer for solving typical field and office problems. Lab should be taken concurrently.

CE 200A - Surveying Laboratory (0-3-1)

Corequisite: CE 200. Field exercises in conjunction with the classroom exercises in CE 200 utilizing classical and electronic instruments and COGO/ CAD software.

CE 200B - Surveying Laboratory (0-3-1)

For geoscience engineering majors. Field exercises using survey instruments including tapes, levels, theodolites, and total stations. Covers principles of topographic mapping, traverses, triangulation, and computer data reduction.

CE 210 - Construction Materials and Procedures (3-0-3)

Prerequisites: HSS 101. Introduction to construction management organization, contracts, construction safety, engineering economics, and engineering ethics. Studies current practices of heavy construction including soil and rock excavation productivity, and building construction materials and procedures. Field trips to construction sites provide opportunities to directly view many of the practices.

CE 260 - Civil Engineering Methods (3-0-3)

Prerequisite: HSS 101 and FED 101. Provides students with in-depth experience in computer applications in civil engineering and with written and oral communication.

CE 307 - Geometric Design for Highways (3-0-3)

Prerequisite: CE 200, CE 200A. Highway design based on a study of traffic distribution, volume, and speed with consideration for the predictable future. Analysis of elements of at-grade intersections and interchanges and the geometrics of highway design and intersection layout with advanced curve work including compound and transition curves.

CE 311 - Co-op Work Experience I (3)

Prerequisites: completion of the sophomore year, approval of the department, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the co-op office. Mandatory participation in seminars and completion of a -report.

CE 320 - Fluid Mechanics (4-0-4)

Prerequisites: Mech 235. Corequisite: Mech 236. This course is designed to present the fundamental laws relating to the static and dynamic behavior of fluids. The emphasis is placed on applications dealing with the flow of water and other incompressible fluids. These include flow in pipe systems and natural channels.

CE 320A - Hydraulics Laboratory (0-3-1)

Prerequisite or corequisite: CE 320. Explores the principles of fluid mechanics through laboratory experiments. Investigates various hydraulic phenomena with both physical and computer models. Demonstrates basic civil engineering design principles for pipe networks, open channel systems, and ground water regimes.

CE 321 - Water Resources Engineering (3-0-3)

Prerequisite: CE 200, CE 200A, Math 225. Training in methods of developing water supplies and the means to treat supplies for consumptive use. Covers hydrologic techniques such as surface and ground water yield, hydrograph and routing analyses, and probabilistic methods related to hydrologic studies.

CE 322 - Hydraulic Engineering (3-0-3)
Prerequisites: CE 320, CE 321. The objective is to provide the tools required to design water distribution systems, storm drains, and sanitary sewers. Examines related hydrologic and hydraulic techniques.

CE 332 - Structural Analysis (3-0-3)
Prerequisites: Mech 237. A working knowledge of free body diagrams, equilibrium conditions for force systems and moments. The primary objective is an understanding of the various methods of analyzing determinate and indeterminate beams, frames, and trusses encountered in practice.

CE 333 - Reinforced Concrete Design (3-0-3)
Prerequisites: CE 332. The student must have a working knowledge of structural analysis including determinate and indeterminate beams and frames. Primary objectives include the following: to acquaint the student with the properties of concrete and steel and with the behavior of reinforced concrete as a structural material; also, to develop methods for the design of reinforced concrete structural members such as beams, slabs, footings, and columns. Both ultimate strength design and working stress method will be studied.

CE 341 - Soil Mechanics (3-0-3)
Prerequisite: Mech 237 or equivalent. Corequisite: CE341A. A study of soil types and properties is made with the objective of developing a basic understanding of soil behavior. The methods of subsurface investigation and compaction are presented. Fundamentals pertaining to permeability, seepage, consolidation, and shear strength are introduced. Settlement analysis is also presented. Lab must be taken concurrently.

CE 341A - Soil Mechanics Laboratory (0-3-1)
Corequisite: CE 341. Students perform basic experiments in soil mechanics.

CE 342 - Geology (3-0-3)
Prerequisite: consult the advisor. Studies science of geology with emphasis on physical geological processes. Stresses the principle of uniformity of process in the context of rock and soil formation, transformation, deformation, and mass movement. Includes aspects of historical geology and geomorphology.

CE 343 - Geology with Laboratory (3-3-4)
Covers the material given in CE 342 with the addition of a laboratory component. It provides a more in-depth understanding of geology through rock and mineral identification, laboratory experiments, field trips, and selected case studies.

CE 350 - Transportation Engineering (3-0-3)
Prerequisite: CE 200, CE 200A. A study of the principal modes of transportation, with emphasis on the planning, design and construction of facilities for modern transportation systems.

CE 406 - Remote Sensing (3-0-3)
Prerequisite: Phys 234. Principles of remote sensing are covered including general concepts, data acquisition procedures, data analysis and role of remote sensing in terrain investigations for civil engineering practices.

CE 410 - Construction Scheduling and Estimating (3-0-3)
Prerequisites: CE 210. Quantity take off, cost estimate and CPM computer analysis of typical building or highway projects. A study is made of construction project organization, contract requirements and management control techniques with an introduction to computer applications.

CE 412 - Construction Codes and Specifications (3-0-3)
Prerequisite: CE 210. Code and specification aspects of engineered construction. Topics include professional ethics, contracts, specifications, bidding procedures, building codes such as B.O.C.A. and New Jersey Uniform Construction Code, Energy Code Provisions, construction safety, and the impact of the EPA on construction.

CE 413 - Co-op Work Experience II (3)
Prerequisites: CE 311 or equivalent, approval of the department, and permission of the Office of Cooperative Education and Internships. Provides major-related work experience. Mandatory participation in seminars and completion of requirements including a report and/or project.

CE 414 - Engineered Construction (3-0-3)
Prerequisites: CE 210, CE 332, CE 341. Design, erection, and maintenance of temporary structures and procedures used to construct an engineering project. Business practices, codes, design philosophies, construction methods, hardware, inspection, safety, and cost as they pertain to engineered construction projects.

CE 431 - Construction Materials Lab (0-3-1)

Prerequisites: Mech 237, CE 210. This course provides an understanding of the basic properties of construction materials, and presents current field and laboratory standards and testing requirements for these materials. Students select a material or component assembly for testing, design a testing procedure, and present their results.

CE 432 - Steel Design (3-0-3)

Prerequisites: CE 332. A working knowledge of structural analysis including determinate and indeterminate beams and frames is essential. The development of current design procedures for structural steel elements and their use in multistory buildings, bridges, and industrial buildings.

CE 443 - Foundation Design (3-0-3)

Prerequisites: CE 341, CE 341A. Site investigation, selection of foundation types and basis for design, allowable loads, and permissible settlements of shallow and deep foundations. Computations of earth pressure and design of retaining walls.

CE 450 - Urban Planning (3-0-3)

Prerequisite: junior engineering standing. Introduction to urban planning, its principles, techniques, and use. Topics include development of cities, planning of new towns, redevelopment of central cities, and land use and transportation planning.

CE 461 - Professional Practice in CEE (3-0-3)

Develop an understanding of the process to become a licensed professional engineer and familiarize the students with the professional practice of engineering including codes of ethics and professional business practices and to provide an adequate background for the Fundamentals of Engineering. Effective From: Fall 2006

CE 490 - Civil Engineering Projects (3-0-3)

Prerequisites: senior standing in civil engineering and approval of the department. Work on an individually selected project, guided by the department faculty advisor. The project may include planning, research (library or laboratory), engineering reports, statistical or analytical investigations, and designs. Any of these may follow class-inspired direction or the student may select his or her own topic. The project must be completed and professionally presented by assigned due dates for appropriate review and recording of accomplishment.

CE 490H - Honors Civil Engineering Projects (3-0-3)

Prerequisites: senior standing, enrolled in Honors College, and approval of the department. Same as CE 490.

CE 491H - Honors Research Experience in Civil Engineering (3-0-3)

Prerequisites: Junior standing, agreement of a department faculty advisor, and approval of the associate chairperson for undergraduate studies. This course provides the student with an opportunity to work on a research project under the individual guidance of a member of the department. A written report is required for course completion. Open to students with a GPA of 3.0 or higher.

CE 494 - Civil Engineering Design I (3-0-3)

Prerequisite: senior standing in civil engineering. Simulates the submission and acceptance process normally associated with the initial design phases for a civil engineering project. Familiarizes students with the preparation of sketch plats, preliminary engineering design, and a related environmental assessment. Requirements include written submittals and oral presentations in defense of the project.

CE 494H - Honors Civil Engineering Design I (3-0-3)

Prerequisites: senior standing, enrolled in Honors College. Same as CE 494.

CE 495 - Civil Engineering Design II (3-0-3)

Prerequisite: senior standing in civil engineering. Provides students with the type of design experience they would receive if engaged in civil and environmental engineering design practice. Course will focus on one or more of these design areas: structural, geotechnical, transportation and planning, and sanitary and environmental engineering.

CE 495H - Honors Civil Engineering Design II (3-0-3)

Prerequisites: senior standing, enrolled in Honors College. Same as CE 495.

GRADUATE COURSES:

CE 501 - Introduction to Soil Behavior (3 credits)

Prerequisites: CE 320, Mech 235 and Mech 236 (see undergraduate catalog for descriptions). Open only to the students in bridge program. Permission from CEE department graduate advisor is required. Covers the necessary concepts in strength of materials, geology and soil mechanics required for the bridge program in M.S. in Environmental Engineering and Geoenvironmental Engineering option.

CE 506 - Remote Sensing of Environment (3 credits)

Prerequisite: Phys 234 (see undergraduate catalog for description). Covers the principles of remote sensing, general concepts, data acquisition procedures, data analysis and role of remote sensing in terrain investigations for civil engineering practices. Data collection from airborne and satellite platforms will be emphasized. Photographic and non-photographic sensing methodologies will be covered as well as manual and computer assisted data analysis techniques for site investigations and examination of ground conditions.

CE 531 - Design of Masonry and Timber Structures (3 credits)

Prerequisite: CE 332 (see undergraduate catalog for description). Study of basic properties of clay and concrete masonry units and wood. The masonry segment includes discussion of unreinforced bearing walls subjected to concentric as well as eccentric loads. Lateral-force resistance of unreinforced and reinforced masonry systems are introduced and new developments to strengthen and retrofit unreinforced masonry walls are discussed. The timber design portion includes design and behavior of wood fasteners, beams, columns, and beam-columns as well as introduction to plywood and glued laminated members.

CE 545 - Rock Mechanics I (3 credits)

Prerequisite: approved undergraduate course in soil mechanics within last five years or permission of instructor. Rock mechanics including geological aspects, mechanical properties, testing, and in-situ measurements of rock properties, and a brief introduction to design of structures in rock.

CE 552 - Geometric Design of Transportation Facilities (3 credits)

Prerequisite: CE 350 or equivalent (see undergraduate catalog for description). Design principles and criteria related to highways and railroads resulting from requirements of safety, vehicle performance, driver behavior, topography, traffic, design speed, and levels of service. Elements of the horizontal and vertical alignments and facility cross-section, and their coordination in the design. Computer-aided design procedures including COGO, CADAM, Digital Terrain Modeling. Same as Tran 552.

CE 553 - Design and Construction of Asphalt Pavements (3 credits)

Importance of designing proper asphalt pavements. Topics include the origin of crude, refining crude, types of asphalts, desired properties of asphalt cement, specification and tests for asphalt cement, aggregates for asphalt mixtures, aggregate analysis, gradation and blending, hot-mix asphalt (HMA) mix design, manufacture of HMA and HMA-paving, hot and cold recycling. Same as Tran 553.

CE 590 - Graduate Co-op Work Experience I (3 additive credits)

Prerequisites: permission from the civil engineering department and the Division of Career Development Services. Cooperative education/ internship providing on-the-job reinforcement of academic programs in civil engineering. Work assignments and projects are developed by the co-op office in consultation with the civil engineering department; and evaluated by civil engineering faculty co-op advisors.

CE 591 - Graduate Co-op Work Experience II (3 additive credits)

Prerequisites: permission from the civil engineering department and the Division of Career Development Services.

CE 592 - Graduate Co-op Work Experience III (3 additive credits)

Prerequisites: permission from the civil engineering department and the Division of Career Development Services.

CE 593 - Graduate Co-op Work Experience IV (0 credits)

Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

CE 601 - Advanced Remote Sensing (3 credits)

Prerequisite: a first course in remote sensing. Principles of computer processing of satellite and aircraft remote sensing data as well as image enhancement, image transformation and image classification techniques using advanced image analysis system ERDAS in the interactive mode. Multiple applications on land use/land cover, water quality assessment and terrain evaluation will be emphasized. During final weeks of the semester students will apply the acquired techniques to specific projects.

CE 602 - Geographic Information System (3 credits)

Prerequisite: course or working knowledge of CADD or permission of instructor. Geographical/Land Information System (GIS/LIS) is a computerized system capable of storing, manipulating and using spatial data describing location and significant properties of the earth's surface. GIS is an interdisciplinary technology used for studying and managing land uses, land resource assessment, environmental monitoring and hazard/

toxic waste control. Introduces this emerging technology and its applications. Same as MIP 652 and Tran 602.

CE 603 - Introduction to Urban Transportation Planning (3 credits)
Urban travel patterns and trends; community and land activity related to transportation study techniques including survey methods, network analysis, assignment and distribution techniques. Case studies of statewide and urban areas are examined. Same as Tran 603.

CE 604 - Environmental Modeling in Remote Sensing (3 credits)
Prerequisites: CE 602 and CE 605. Advanced course consisting of three main components: review of current research and literature dealing with environmental RS/GIS, applied and computer modeling of land and oceans; case studies in RS/GIS applications, emphasizing real world environmental problems presented by outside experts; and presentation of student projects.

CE 605 - Research Methods in Remote Sensing (3 credits)
Prerequisites: CE 601 and Math 661. Major components of RS data acquisition systems, overview of image processing techniques with emphasis on neural network and traditional pattern recognition, principal component transformations, and data reduction. Emphasizes geometric and mapping aspects of RS/GIS techniques for linking RS images with spatial data, sources of error, and accuracy assessment techniques. Hands-on experience with existing hardware/software (ERDAS & GENESIS).

CE 606 - Geospatial Data Applications (3 credits)
Prerequisite: CE 602. The course focuses on geospatial data processing, information extraction and analysis tools. It provides visualization and decision support applications using desktop GIS software. Examples of the student projects include: Applications of integrated geospatial date in environmental, infrastructure, urban planning and homeland security. Effective From: Spring 2010

CE 610 - Construction Management (3 credits)
Prerequisite: B.S. degree in CE, technology, architecture, or related field. Managerial aspects of contracting. Study of an individual firm in relation to the entire construction industry. Topics include contractor organization and management, legal aspects of construction, and financial planning.

CE 611 - Project Planning and Control (3 credits)
Prerequisite: CE 610. Management tools as related to construction projects are analyzed and applied to individual projects. Emphasis is on network scheduling techniques, time-cost analysis, resource allocation and leveling, cost estimating, bidding strategy, and risk analysis.

CE 614 - Underground Construction (3 credits)
Prerequisite: undergraduate course in soil mechanics. Various aspects of underground construction, including rock and soft ground tunneling; open cut construction; underpinning; control of water; drilling and blasting rock; instrumentation; and estimating underground construction costs. Case studies and a field trip to an underground construction site will be included.

CE 615 - Infrastructure and Facilities Remediation (3 credits)
Prerequisites: graduate standing in civil engineering and basic knowledge of structures, and material science. Examines the methodology of inspection, field testing, evaluation and remediation of existing infrastructure and facilities, which include pipelines, tunnels, bridges, roadways, dams, and buildings. Typical materials distress and failure scenarios will be covered with remediation options through the use of case studies.

CE 616 - Construction Cost Estimating (3 credits)
Prerequisite: CE 610. Full range of construction cost-estimating methods including final bid estimates for domestic building and heavy/highway projects; computerized takeoff and estimating techniques; international construction; financial and cost reporting; databases; indices; risk; competition; performance; and profit factors.

CE 618 - Applied Hydrogeology (3 credits)
Prerequisites: undergraduate courses in earth science/geology, fluid mechanics, and calculus or permission of instructor. Examines ground water and contaminant movement through the subsurface environment. A basic understanding of the aquifer geology is emphasized. Hydrogeologic applications including well design, pumping tests, and computer modeling of subsurface flow, and methods to monitor and remediate contaminated groundwater are introduced.

CE 620 - Open Channel Flow (3 credits)
Prerequisite: undergraduate fluid mechanics. The principles developed in fluid mechanics are applied to flow in open channels. Steady and unsteady flow, channel controls, and transitions are considered. Application is made to natural rivers and estuaries.

CE 621 - Hydrology (3 credits)
Prerequisite: undergraduate fluid mechanics. The statistical nature of precipitation and runoff data is considered with emphasis on floods and droughts. The flow of groundwater is analyzed for various aquifers and conditions. Flood routing, watershed yield, and drainage problems are considered.

CE 622 - Coastal Engineering (3 credits)
Prerequisites: fluid mechanics and calculus. An introductory course covering basic wave theory, sediment transport and ocean circulation. The application of these principles to various coastal engineering problems will be discussed, including beach erosion, pollution transport in coastal waters, and the design of shore protection structures.

CE 623 - Groundwater Hydrology (3 credits)
Prerequisites: undergraduate fluid mechanics and computer programming, or consent of instructor. Basic principles of groundwater hydraulics; Darcian analysis of various aquifer systems; unsaturated flow into porous mediums; transport of contaminants in soil media; and mathematical models for fluid and contaminant transport.

CE 625 - Public Transportation Operations and Technology (3 credits)
Prerequisite: graduate standing in a cross-listed department or instructor approval. Presentation of the technological and engineering aspects of public transportation systems. Historical development of public transportation technologies. Vehicle and right-of-way characteristics, capacity and operating strategies. Public transportation system performance. Advanced public transportation systems. Same as Tran 625.

CE 626 - Sediment Transport (3 credits)
Prerequisites: CE 341or CE 501; CE 620 or consent of the instructor. Unified treatment of sediment transport over a wide range of conditions; basic theory and application to engineering problems. Sediment transport problems associated with the analysis and design aspects of hydraulic and environmental structures, including channel stability, scouring, dredging, reservoir sedimentation, and wastewater solids are presented.

CE 631 - Advanced Reinforced Concrete Design (3 credits)
Prerequisite: an undergraduate course in theory and design of reinforced concrete. A review of basic concepts of elastic and ultimate strength theories and a study of the present design codes. Topics include: design of concrete building frames, two-way slabs, flat slabs, deep beams, and other structural elements using the above two theories.

CE 632 - Prestressed Concrete Design (3 credits)
Prerequisite: undergraduate course in theory and design of reinforced concrete. Analysis and design of pre-tensioned and post-tensioned prestressed concrete elements for both determinate and indeterminate structures will be studied. Examples of prestressed elements used in buildings and bridges will be discussed, as well as the source and magnitude of prestress losses.

CE 634 - Structural Dynamics (3 credits)
Prerequisite: undergraduate course in structural analysis. Dynamic analysis of beams, frames, and other types of structures. Practical methods developed are applied to problems such as the analysis of the effects of earthquakes on buildings and moving loads on bridges.

CE 635 - Fracture Mechanics of Engineering Materials (3 credits)
Prerequisites: graduate standing in civil and/or mechanical engineering and basic knowledge of structures and mechanics of materials. Basic principles of fracture mechanics to increase understanding of cracking and fracture behavior of materials and structures. Emphasis on practical applications of fracture mechanics.

CE 636 - Stability of Structures (3 credits)
Prerequisite: undergraduate course in theory of structural analysis. Topics include structural design concept; stability criteria; elastic and inelastic buckling; column buckling; lateral buckling of beams; stability of frames; stability of plates and shell; local buckling and post-buckling.

CE 637 - Short Span Bridge Design (3 credits)
Prerequisite: undergraduate courses in steel design and concrete design, and some knowledge of prestressed concrete fundamentals. Design and performance of highway and railroad bridges, particularly steel and prestressed concrete structures since they are most common in the northeast; and computer applications including bridge geometry, abutment design and composite beam design.

CE 638 - Nondestructive Testing Methods in Civil Engineering (3 credits)
Familiarizes the civil engineering student with nondestructive testing (NDT) techniques currently employed for evaluation and condition monitoring of civil structures and construction materials. Major emphasis in the application of NDT methodologies to steel, concrete, and timber as the construction material. Covers theories, principles, and testing methodologies associated with individual technologies from specific material point of view. Discusses advantages and limitations pertaining to the application of individual NDT technologies to construction materials.

CE 639 - Applied Finite Element Methods (3 credits)
Prerequisites: CE 332 and CIS 101. Introduction to application of finite element method to problems of structural analysis and design. Review of matrix algebra and the stiffness method of structural analysis. Applications include trusses, frames, plates, shells, and problems of plane stress/strain. Application of finite element method to design.

CE 641 - Engineering Properties of Soils (3 credits)
Prerequisite: approved undergraduate course in soil mechanics within last five years. An in-depth study of physical and mechanical properties of soils. Topics include clay mineralogy, shear behavior and compressibility of fine and coarse grained soil; and in-situ measuring techniques such as vane shear, core penetration and pressure meter. Laboratory work includes consolidation test and triaxial test, with emphasis on analysis, interpretation and application of data to design problems.

CE 642 - Foundation Engineering (3 credits)
Prerequisites: approved undergraduate courses in soil mechanics and foundation engineering. The salient aspects of shallow foundation design such as bearing capacity and settlement analyses. Topics are relevant to the deep foundation, selection of the type and the determi-nation of load bearing capacity from soil properties, load tests, and driving characteristics utilizing wave equation analyses. Earth pressure theory and retaining wall design.

CE 643 - Advanced Foundation Engineering (3 credits)
Prerequisite: CE 642. Lateral and earth pressure computations for the design of retaining walls, bulkheads, cellular cofferdams, and sheetpiles. Also considers the design of internal bracing systems and anchors, soil nailing and reinforced earth. Slope stability of embankments and dams.

CE 644 - Geology in Engineering (3 credits)
Prerequisites: undergraduate course in geology or permission of instructor. Geology has a significant influence on how we plan, design, and construct engineering works. This course examines how the geologic formations underlying a locale will ultimately determine land use, control structure design, and affect construction material availability. Included is a study of the various rock-forming processes and geologic agents that have shaped Earth's surface. The course also explores the role of geologic factors in assessing environmental impacts and natural hazards such as earthquakes, subsiding soils, and landslides. Case study applications and a field trip are included. Effective From: Fall 2005

CE 645 - Rock Mechanics II (3 credits)
Prerequisite: CE 545 or equivalent, or permission of instructor. Applications of design problems in underground structures, subways, stability of rock slopes, blasting, and seismic effects. A design project is a course requirement.

CE 646 - Geosynthetics and Soil Improvement (3 credits)
Prerequisite: CE 341 (see undergraduate catalog for description). Includes engineering properties of geosynthetics and their application in civil engineering, such as filtration, seepage, and erosion control; subgrade and slope stabilization. Soil improvement topics include preloading, electrokinetic stabilization, soil modification, admixtures and grouting.

CE 647 - Geotechnical Aspects of Solid Waste (3 credits)
Prerequisites: CE 341, CE 341A or equivalents (see undergraduate catalog for descriptions). Geotechnical aspects of solid waste such as municipal landfill, dredged materials, coal and incinerator ashes, identification and classification of waste materials, geological criteria for siting, laboratory and field testing, design for impoundment and isolation of waste, methods of stability analyses of landfill sites, techniques for stabilizing waste sites, leachate and gas collection and venting systems. Primary emphasis is on municipal wastes.

CE 648 - Flow Through Soils (3 credits)
Prerequisite: CE 641. Explains the fundamentals of fluid flow through saturated and unsaturated soils and the use of computer programs for the solution of boundary value fluid flow problems in soils. The first two-thirds of the course are devoted to flow through saturated soils. The topics are mathematical description of flow through soils, solutions for steady state and transient state fluid flow and geotechnical applications. The last one-third is devoted to flow through unsaturated soils. Topics include steady state of transient state fluid flow and a presentation of how these concepts are applied to geoenvironmental problems.

CE 650 - Urban Systems Engineering (3 credits)
Prerequisites:B.S. degree in engineering or in the physical or social with some computer programming background. Identifies the various urban problems subject to engineering analysis, and modern techinques for their solution, including inductive and deductive mathematical models, mathematical modeling and simulation, and decision making under uncertainty. Same as Tran 650.

CE 653 - Traffic Safety (3 credits)
Prerequisite: CE 660. System behavioral principles are applied to safety aspects of highway operation and design, and improvements of existing facilities. Solutions are evaluated on the basis of cost effectiveness. Same as Tran 653.

CE 655 - Land Use Planning (3 credits)
Spatial relations of human behavior patterns to land use; methods of employment and population studies are evaluated; location and spatial requirements are related to land use plans; and concepts of urban renewal and recreational planning are investigated by case studies. Same as MIP 655 and Tran 655.

CE 659 - Flexible and Rigid Pavements (3 credits)
Prerequisite: CE 341 or equivalent (see undergraduate catalog for description). Types of rigid (Portland cement) and flexible (bituminous) pavements. Properties of materials, including mineral aggregates. Design methods as functions of traffic load and expected life. Importance and consequences of construction methods. Maintenance and rehabilitation of deteriorated pavements. Same as Tran 659.

CE 660 - Traffic Studies and Capacity (3 credits)
Prerequisite: elementary probability and statistics. Presentation of the characteristics of the traffic stream, road users, and of vehicles, and a review of traffic flow relationships. Students are exposed to the principal methodologies followed by transportation practices to perform volume, speed, travel time, delay, accident, parking, pedestrian, transit and goods movement studies. Presentation of the principal methodologies used to perform transportation facility capacity analyses for: basic freeway sections, weaving areas, ramps and ramp junctions, multi-lane and two lane roadways, signalized and unsignalized intersections. Students get hands on experience using the highway capacity software (HCS) and SIDRA. Same as Tran 615.

CE 661 - Analysis and Design of Shell Structures (3 credits)
Prerequisite: undergraduate course in structural analysis. Methods of analysis and design of shell structures for building. Topics include: domes, hyperbolic paraboloids, folded plates, and cylindrical shells. Materials considered include reinforced and prestressed concrete.

CE 671 - Performance and Risk Analysis of Infrastructure Systems (3 credits)
This course presents a comprehensive systems approach to infrastructure asset management across areas of public and private infrastructure. Topics include the framework of integrated asset management illustrated in transportation, water and wastewater systems, the economic evaluation of infrastructure options, using life cycle cost analysis (LCCA) and cost-benefit analysis (CBA). The elements of performance measurement and modeling, including condition assessment and information management, failure and impact analysis are covered. Decision and risk analysis are covered to enable students to develop a holistic economic, performance and risk analysis approach to infrastructure management illustrated in a term project. Effective From: Fall 2007

CE 672 - Security Management of Critical Infrastructure (3 credits)
This course focuses on the areas of vulnerability assessment and security management of critical infrastructure systems. A review of techniques for facility and network modeling and performance simulation, leads to sector-specific approaches to vulnerability analysis and critical infrastructure protection strategies using a Model-Based Vulnerability Analysis (MBVA). Covered critical infrastructure systems include water supply/environmental, transportation, power and energy systems, SCADA systems, cyber-infrastructure and telecommunications. The course ends with a review of the combined use of multi-criteria analysis techniques, expert heuristic response to scenarios and network analysis techniques in a general framework for vulnerability and security management of infrastructure systems in its key aspects: prevention, warning/detection and event mitigation and response planning and execution. Effective From: Spring 2008

CE 700 - Civil Engineering Project (3 credits)
Prerequisite: student must have sufficient experience and/or graduate courses in major field to work on the project. Subject matter to be approved by the department. Permission to register must be obtained from the project advisor. Extensive investigation, analysis, or design of civil engineering problems not covered by regular graduate course work is required. A student with an exceptional project in CE 700 may, upon his/her own initiative and with the approval of his/her advisor, substitute the work of this course as the equivalent of the first 3 credits for CE 701 Master's Thesis. Students must register for 3 credits every semester until the project is completed.

CE 701 - Master's Thesis (6 credits)
The thesis is to be prepared on a subject in the student's major field approved by the department. Approval to register for thesis must be obtained from the thesis advisor. A student must register for a minimum of 3 credits per semester until completion and submittal of an approved document. Credit will be limited, however, to the 6 credits indicated for the thesis.

CE 702 - Special Topics in Civil Engineering (3 credits)
Prerequisite: advisor's approval. Topics of special current interest in civil engineering.

CE 705 - Mass Transportation Systems (3 credits)
Prerequisites: CE 625 and Tran 610 or IE 610. An investigation of bus, rapid transit, commuter railroad, and airplane transportation systems. Existing equipment, economics, capacity, and terminal characteristics are discussed, as well as new systems and concepts. Long- and short-range transportation systems are compared. Same as Tran 705.

CE 710 - Systems in Building Construction (3 credits)
Requirements and benefits of various building construction systems. Preliminary examination of the interrelation between design and construction. Topics include lift slab and tilt-up construction, slipforming, precasting, joist systems, modular construction, and mechanical and electrical systems.

CE 711 - Methods Improvement in Construction (3 credits)
Prerequisite: CE 610. Improved methods in construction; various techniques of work sampling and productivity measurement; and current innovations in the construction industry for increasing efficiency.

CE 720 - Water Resource Systems (3 credits)
Prerequisites: CE 620, CE 621. A system methodology is applied to the analysis of water resource development and operation. Topics include operational hydrology, water quality criteria, streamflow requirements, resource allocation, and economics. Mathematical models are developed and employed in the evaluation of a case study.

CE 725 - Independent Study I (3 credits)
Prerequisites: written permission from department chairperson plus courses to be prescribed by the supervising faculty member. Covers areas of study in which one or more students may be interested but which is not of sufficiently broad interest to warrant a regular course offering.

CE 726 - Independent Study II (3 credits)
Prerequisites: written permission from department chairperson plus courses to be prescribed by the supervising faculty member. Covers areas of study in which one or more students may be interested but which is not of sufficiently broad interest to warrant a regular course offering.

CE 727 - Independent Study III (3 credits)
Prerequisites: written permission from department chairperson plus courses to be prescribed by the supervising faculty member. Covers areas of study in which one or more students may be interested but which is not of sufficiently broad interest to warrant a regular course offering.

CE 730 - Plastic Analysis and Design (3 credits)
Prerequisite: CE 639. Theory of plasticity applied to structural design. Study of methods of predicting strength and deformation of single and multi-story steel frames in the plastic range. Comparison of plastic and prestressed concrete.

CE 733 - Design of Metal Structures (3 credits)
Prerequisites: CE 639 and CE 636. Methods of design of metal structural systems. Topics include combined action of unsymmetrical sections, torsion of open and closed sections, buckling of columns and plates with various end conditions, and design of curved and boxed girders.

CE 734 - Design of Tall Buildings and Space Structures (3 credits)
Prerequisites: CE 639 and CE 636. Design of tall buildings and space structures emphasizing framing systems, and recent developments and current research related to the design of such structures.

CE 736 - Finite Element Methods in Structural and Continuum Mechanics (3 credits)
Prerequisites: a working knowledge of computer programming, and Mech 630 and CE 630. Finite element approaches for analysis of plane stress problems, plates in flexure, shells, and three-dimensional solids; and choice of interpolation functions, convergence, and the capabilities of the methods.

CE 737 - Earthquake Engineering (3 credits)
Prerequisite: CE 634. Practical design solutions for resisting the damaging effects of earthquake ground motions and other severe dynamic excitations. Factors which control dynamic response in elastic and inelastic ranges, and the nature of severe dynamic excitations. Theories of structural analysis and dynamics, and modern design methodologies on the behavior of structures.

CE 738 - Advanced Matrix Analysis of Structures (3 credits)
Prerequisite: CE 639. Advanced topics from structural analysis, including nonlinear analysis of trusses, frames and membrane finite elements, collapse by buckling, analysis and design of fabric structures.

CE 739 - Structural Optimization (3 credits)
Prerequisite: CE 639. Application of methods of mathematical programming to problems of optimal structural design. Optimal criteria methods, discrete and continuous systems, and code design will be covered.

CE 741 - Theoretical Soil Mechanics (3 credits)
Prerequisite: CE 641. An advanced graduate course for Ph.D. students and interested M.S. students in Civil Engineering. Explains the fundamentals of constitutive models for soils and their use in the solution of boundary value problems. Covers the theory of elasticity and theory of plasticity as tools in developing constitutive models for soils. Introduces critical state concept for soils. The triaxial experimental behavior of soils is discussed to introduce the concept of soil flow and strength. Critical state concept and elastoplastic material concepts are incorporated in the constitutive models, models predictions will be compared with experimental results for sands and for clays. Constitutive models will incorporated into finite element codes to analyze boundary value problems such as stability of slopes and performance of footings.

CE 742 - Geotechnology of Earthquake Engineering (3 credits)

Prerequisite: CE 641. Explains the fundamentals of propagation of the earthquakes through soils to supporting structures and the use of computer programs in the solution of boundary value problems in soils. The first half is devoted to synthesis of earthquakes, mathematical formulation of the problem, measurement of applicable soil parameters, use of computer programs to solve 1-D wave propagation problems in soils with structures. The second half is devoted to soil liquefaction, soil-structure interaction, and design of machine foundations.

CE 743 - Contaminant Transport in Soils (3 credits)

Prerequisites: CE 618, CE 623 and CE 648. An advanced graduate course for Ph.D. students and interested M.S. students in civil, environmental, and chemical engineering. Explains the fundamental mechanisms involved in the organic chemical flow and transport in soils. Includes new concepts and recent findings associated with leaking underground storage tanks. First half deals with flow of nonaqueous phase liquids (NAPL) through a soil-water-air system. The second half discusses the sorption and dissolution of organics in the soil-water-air system, and transport of organics in the dissolved phase.

CE 751 - Transportation Design (3 credits)

Prerequisite: CE 603. Design problems for airports, terminals, and highway intersections and interchanges are undertaken. Same as Tran 751.

CE 752 - Traffic Control (3 credits)

Prerequisite: CE 660. Traffic laws and ordinances; regulatory measures; traffic control devices; markings, signs and signals; timing of isolated signals; timing and coordination of arterial signal systems; operational controls; flow, speed, parking; principles of transportation system management/administration; highway lighting; and state-of-the-art surveillance and detection devices and techniques. Hands-on experience with TRAF/NETSIM and FREESIM. Same as Tran 752.

CE 753 - Airport Design and Planning (3 credits)

Prerequisites: Tran 610 or EM 693 and CE 660. Planning of individual airports and statewide airport systems. Functional decision of air and landside facilities. Orientation, number and length of runways. Concepts of airport capacity. Passenger and freight terminal facility requirements. Airport access systems. FAA operating requirements. Financial, safety and security issues. Same as IE 753 and Tran 753.

CE 754 - Port Design and Planning (3 credits)

Prerequisites: Tran 610 or EM 693 and CE 660. Functional design of the water and landsides for general cargo, liquid and dry bulk, and container operations. Yard and storage systems. Port capacity in an intermodal network. Economic, regulatory, and environmental issues. Same as IE 754 and Tran 754.

CE 765 - Multi-modal Freight Transportation Systems Analysis (3 credits)

Prerequisites: Tran 610 or equivalent and CE 650 or EM 602 or equivalent. Quantitative methods for the analysis and planning of freight transportation services. The supply-performance-demand paradigm for freight transportation systems. Cost and performance as determined by system design and operations. Relationship of traffic and revenue to service levels and pricing. Optimal service design and redesign for transportation enterprises and operations planning. Fleet and facility investment planning. Applications to various modes. Same as EM 765 and Tran 765.

CE 790 - Doctoral Dissertation (3 credits)

Required of all candidates for the degree of Doctor of Philosophy. A minimum of 36 credits is required. Students must register for at least 6 credits of dissertation per semester until 36 credits are reached. Registration for additional credits may be permitted beyond the 6, with the approval of the advisor, to a maximum of 12 credits per semester. If the dissertation is not completed after 36 credits, registration for an additional 3 credits per semester is required thereafter. Registration for 3 credits is permitted during the summer session, hours to be arranged.

CE 791 - Graduate Seminar (Non-credit)

A seminar in which faculty or others present summaries of advanced topics suitable for research. Students and faculty discuss research procedures, thesis organization, and content. Students present their own research for discussion and criticism. Required of all doctoral students registered for CE 790 unless requirement is waived, in writing, by the dean of graduate studies.

Computer Science:

UNDERGRADUATE COURSES:

CIS 113A - Lab (0-0-0)
Lab for CIS 113. Effective Until: Summer 2006

CIS 114A - Lab (0-0-0)
Lab for CIS 114. Effective Until: Summer 2006

CS 101 - Computer Programming and Problem Solving (3-0-3)
An introductory course in computer science and programming (using MATLAB, or other languages) and its use in solving engineering and scientific problems. The emphasis is on the logical analysis of a problem and the formulation of a computer program leading to its solution. Topics include basic concepts of computer systems, algorithm design, programming languages and data abstraction. Designed for students not specializing in computer science. Effective From: Fall 2009

CS 102*** - Computer Science with Problem Solving (3-1-3)
An introductory course in computer science, with applications to engineering and technology problems. Emphasis on programming methodology using a high level language (such as FORTRAN) as the vehicle to illustrate concepts. Topics include basic concepts of computer systems, software engineering, algorithm design, programming languages and data abstraction, with applications. Effective From: Fall 2006

CS 103*** - Computer Science with Business Problems (3-1-3)
An introductory course in computer science, with applications to business and managerial decision making. Emphasis on programming methodology using the COBOL language as the vehicle to illustrate concepts. Topics include basic concepts of computer systems, software engineering, algorithm design, programming languages and abstraction, with applications. Effective From: Fall 2006

CS 104 - Computer Programming and Graphics Problems (3-0-3)
Corequisite: Math 138. An introductory course in computer science with applications in computer graphics for architecture. Emphasis on programming methodology using a high level language as the vehicle to illustrate the concepts. Topics include basic concepts of computer systems, software engineering, algorithm design, programming languages and data abstraction, with applications. Effective From: Spring 2010

CS 110 - Introduction to Computer Science IA (3-0-3)
First semester of a two course sequence, equivalent to CS 113. Introduces fundamentals of computer science, with emphasis on programming methodology and problem solving. Topics include basic concepts of computer systems, software engineering, algorithm design, programming languages and data abstraction, including the development environment, native types, expressions, objects, classes, decisions, iteration, and methods. A high level language (Java) is fully discussed and serves as the vehicle to illustrate many of the concepts. Effective From: Fall 2006

CS 110A - CS 110A Computer Science Lab for CS 111 ((0-1.5-0))
Laboratory module for the first course of the sequence equivalent to CS 113. Effective From: Fall 2006

CS 111 - Introduction to Computer Science IB (3-0-3)
Second semester of a two course sequence, equivalent to CS 113. Introduces fundamentals of computer science, with emphasis on programming methodology and problem solving. Topics include basic concepts of computer systems, software engineering, algorithm design, programming languages and data abstraction, including methods and classes, arrays, collections, inheritance and polymorphism, exceptions, recursion, testing and debugging. A high level language (Java) is fully discussed and serves as the vehicle to illustrate many of the concepts. Effective From: Fall 2006

CS 111A - CS111A Computer Science Lab for CS 111 ((0-1.5-0))

Laboratory module for the second course of the sequence equivalent to CS 113. Effective From: Fall 2006

CS 113 - Introduction to Computer Science (3-0-3)
Fundamentals of computer science are introduced, with emphasis on programming methodology and problem solving. Topics include basic concepts of computer systems, software engineering, algorithm design, programming languages and data abstraction, with applications. A high level language is fully discussed and serves as the vehicle to illustrate many of the concepts. CIS majors should enroll in CS 113. Students who receive degree credit for CS 113 may not receive degree credit for CIS 213. Effective From: Fall 2006

CS 113A - Lab (0-1.5-0)
Lab for CS 113. Effective From: Fall 2006

CS 113H - Honors Introduction to Computer Science I (3-0-3)
Prerequisite: Satisfactory performance on placement exam and/or departmental approval. A course similar to CS 113, but material is covered in greater depth. Honors students contemplating a major in computer science, or who plan to take advanced electives in computer science, should take CS 113H instead of CS 101H. Students who receive degree credit for CS 113H cannot receive degree credit for CS 213. Effective From: Fall 2006

CS 114 - Introduction to Computer Science II (3-0-3)
Prerequisites:; CS 113 or completion of a required 100 level GUR course in CIS, plus an approved CIS 105. A study of advanced programming topics with logical structures of data, their physical representation, design and analysis of computer algorithms operating on the structures, and techniques for program development and debugging. Course covers program specifications, correctness and efficiency, data abstraction, basic aspects of simple data structures, internal searching and sorting, recursion and string processing. Algorithmic analysis is also discussed. Students receiving degree credit for CS 114 cannot receive degree credit for CIS 335 or CIS 505. Effective From: Fall 2006

CS 114A - Lab (0-1.5-0)
Lab for CS 114. Effective From: Fall 2006

CS 114H - Honors Introduction to Computer Science II (3-0-3)
Prerequisites: CS 113H or department approval; A course similar to CS 114, but material is covered in greater depth. Students receiving degree credit for CS 114H cannot receive degree credit for CS 335 or CS 505. Effective Until: Fall 2006

CS 115 - Intro. to CS I in C++ (3-0-3)
Fundamentals of computer science are introduced, with emphasis on programming methodology and problem solving. Topics include basic concepts of computer systems, software engineering, algorithm design, programming languages and data abstraction, with applications. The high level language C++ is fully discussed and serves as the vehicle to illustrate many of the concepts. CIS majors should enroll in CS 113. Effective From: Fall 2006

CS 115A - Computer Science I Lab/C++ (0-1.5-0)
Laboratory for CS 115. Effective From: Fall 2006

CS 116 - Intro. to Computer Science II/C++ (3-0-3)
Prerequisites: CS 115 or completion of a required 100 level GUR course in CS, plus an approved CS 105. A study of advanced programming topics with logical structures of data, their physical representation, design and analysis of computer algorithms operating on the structures, and techniques for program development and debugging. Course covers program specifications, correctness and efficiency, data abstraction, basic aspects of simple data structures, internal searching and sorting, recursion and string processing. Algorithmic analysis is also discussed. Students receiving degree credit for CS 116 cannot receive degree credit for CS 505. Effective From: Fall 2006

CS 116A - Computer Science II Lab/C++ (0-1.5-0)
Laboratory for CS 116. Effective From: Fall 2006

CS 241 - Foundations of Computer Science I (3-0-3)
Prerequisites: CS 114, Math 112. An introduction to the foundations of computer science with emphasis on the development of techniques for the design and proof of correctness of algorithms and the analysis of their computational complexity. Reasoning techniques based on propositional and predicate logic and relational calculus operations with applications to databases will also be introduced. Auxiliary topics such as combinatorics of finite sets, functions and relations, and graph-theory definitions and graph storage alternatives will also be examined. Effective From: Fall 2006

CS 251 - Computer Organization (3-0-3)
Prerequisite: CS 113. An introduction to computer system structure and organization. Topics include representation of information, circuit analysis

and design, register-transfer level, processor architecture and input/output. Effective From: Fall 2006

CS 252 - Computer Organization and Architecture (3-0-3)
Prerequisite: CS 113. An introduction to the organization and architecture of computer systems, including the standard Von Neumann model and more recent architectural concepts. Among the topics covered are numeric data representation, assembly language organization, memory addressing, memory systems, both real and virtual, coding and compression, input/output structures treated as programmed, interrupt, and direct memory access, and functional organization of the CPU and the computer system. Effective From: Spring 2006

CS 265 - Game Architecture and Design (3-0-3)
Prerequisite: IT 201 or equivalent. Course introduces students to the core concepts and design methodologies integral to designing and developing games and other Entertainment Software. Effective From: Spring 2007

CS 266 - Game Modification Development (3-0-3)
Prerequisites: IT 102 or CS 116, or CS 114. This course introduces students to the basic concepts of game programming and development. Students will learn how to reprogram a professional game engine, or Modification (Mod) development as it is referred to in the industry. Students will work with C extensively. Students will work on their own game projects utilizing the professional game engine. Effective From: Fall 2007

CS 276 - 2D Game Development (3-0-3)
Prerequisites: CS 265 and CS 266 or IT 265 and IT 266. This course introduces students to the core concepts and skills necessary for the development of games utilizing 2D graphics. Students will learn how to set up and program their own 2D graphics based game engine. The engine will integrate 2D graphics, audio, input handling and network socket programming. Students will learn how to utilize their own custom 2D graphics and sounds into their projects. Once complete, students will have created two fully functional games. Effective From: Spring 2007

CS 280 - Programming Language Concepts (3-0-3)
Prerequisite: CS 114 or equivalent. Conceptual study of programming language syntax, semantics and implementation. Course covers language definition structure, data types and structures, control structures and data flow, run-time consideration, and interpretative languages. Effective From: Fall 2006

CS 288 - Intensive Programming Practicum (3-0-3)
Prerequisite: CS 114 or equivalent, CS 280. The objective of this course is to raise the level of students' programming maturity by a combination of discussion of fundamental concepts and intensive practice in programming intermediate software applications. Students will use a modern development environment that offers comprehensive project management capabilities, and an appropriate programming language to develop their programs using object oriented and generic programming techniques. The course will be organized around a number of programming projects of intermediate size chosen by the faculty to illustrate a spectrum of programming development requirements and techniques. At least one project will be an introduction to programming of modern GUI applications. In addition students will be introduced to standard and commercial API's, class libraries and template libraries. Effective From: Fall 2006

CS 310 - Co-op Work Experience I (3)
Prerequisites: completion of the sophomore year, approval of the department, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the Co-op office. Mandatory participation in seminars and completion of a report. Effective From: Fall 2006

CS 332 - Principles of Operating Systems (3-0-3)
Prerequisite: CS 114 or equivalent. Organization of operating systems covering structure, process management and scheduling; interaction of concurrent processes; interrupts; I/O, device handling; memory and virtual memory management and file management. Effective From: Fall 2006

CS 332H - Honors Principles of Operating Systems (3-1-3)
Prerequisite: CS 114 or equivalent. A course similar to CS 332, with a project of greater depth and scope. Effective From: Fall 2006

CS 333 - Introduction to UNIX Operating Systems (3-0-3)
Prerequisite: CS 332 or equivalent and knowledge of C language. The course covers the UNIX system kernel including initialization, scheduling, context switching, process management, memory management, device management, and the file system. The course also includes the organization of shells, editors, utilities, and programming tools of the UNIX operating system. Effective From: Fall 2006

CS 341 - Foundations of Computer Science II (3-0-3)
Prerequisites: (CS 241 or MATH 226) and CS 280. This course provides an introduction to automata theory, computability theory, and complexity theory. Theoretical models such as finite state machines, push-down stack machines, and Turing machines are developed and related to issues in programming language theory. Also, the course covers undecidability and complexity theory, including the classes P and NP. Effective

From: Fall 2006

CS 341H - Honors Introduction to Logic and Automata (3-0-3)
Prerequisites: completion of a 100-level GUR course in CS; CS 280, Math 226 or Math 326. A course similar to CS 341, with a project of greater depth and scope. Effective From: Fall 2006

CS 352 - Parallel Computers and Programming (3-1-3)
Prerequisites: CS 252, CS 332. A course introducing parallel computers and parallel programming. General structures and design techniques of parallel computers are described. Programming paradigms and algorithm design considerations for parallel processors will be discussed. Effective From: Fall 2006

CS 353 - Advanced Computer Organization (3-0-3)
Prerequisite: CS 252 or instructor approved equivalent. This course emphasizes the basic design principles of various components in a computer, as well as how the components are organized to build a computer. Topics include: design methodology, arithmetic and logic unit design, control unit design, memory hierarchy, memory system design, input and output devices, peripheral devices, and interfacing computers using software. A software simulation package is used to help the learning process. By the end of the semester, students will have built simulated computer. Effective From: Fall 2006

CS 356 - Introduction to Computer Networks (3-0-3)
This course provides an introduction to computer networks, with a special focus on the Internet architecture and protocols. Topics include layered network architectures, addressing, naming, forwarding, routing, communication reliability, the client-server model, web and email protocols. Besides the theoretical foundations, students aquire practical experience by programming reduced versions of real Internet protocols. Effective From: Spring 2009

CS 357 - Technologies for Network Security (3-0-3)
Prerequisite: CS 114,CS 356. This course offers an in depth study of network security issues, types of computer and network attacks, and effective defenses. It provides both a theoretical foundation in the area of security and hands-on experience with various attack tools, firewalls, and intrusion detection systems. Topics include: network scanning, TCP/IP stack fingerprinting, system vulnerability analysis, buffer overflows, password cracking, session hijacking, denial of service attacks, intrusion detection. Effective From: Spring 2009

CS 366 - 3D Game Development (3-0-3)
This course introduces students to the core concepts and skills necessary for the development of games utilizing 3D graphics. Students will learn how to set up and program their own 3D graphics based game engine using OpenGL. Students will learn how to load and display custom 3D models created using existing 3D modeling tools. Once complete, students will have created two fully functional 3D games and tools to work with them. Effective From: Fall 2009

CS 370 - Introduction to Artificial Intelligence (3-1-3)
Prerequisites: CS 114 and (Math 226 or CS 241). An exploration of concepts, approaches and techniques of artificial intelligence. Emphasizes both underlying theory and applications. Topics include knowledge representation, parsing language, search, logic, adduction, uncertainty, and learning. LISP and Prolog programming languages used extensively. Students are required to do programming assignments, complete a programming term project and review case studies. Effective From: Fall 2006

CS 370H - Honors Introduction to Artificial Intelligence (3-1-3)
Prerequisites: CS 114, Math 226. A course similar to CS 370, with a project of greater depth and scope. Effective From: Fall 2006

CS 371 - Logic with Applications to Computer Science (3-0-3)
Prerequisites: CS 114, Math 211 and (Math 226 or CS 241). An introduction to both the syntax and semantics (basic model theory) of first-order logic, covering one set of inference rules, sequent calculus or a tableau system and prove the completeness theorem for the proof system. You will also cover a relatively modern (and simpler) form of Incompleteness theorems and relate it to computational issues such as the halting problem, as well as issues related to automating logical reasoning. These will include Herbrand's theorem, resolution, and logic programming. Effective From: Fall 2006

CS 371H - Honors Logic with Applications to Computer Science (3-0-3)
Prerequisites: CS 114; Math 211 and 226. A course similar to CS 371, with a project of greater depth and scope. Effective From: Fall 2006

CS 375 - Application Development for WWW (3-0-3)
Prerequisite: CIS 114. A state-of-the-art computer programming language/environment, such as Java and related tools, is studied and used as a vehicle to build applications that involve graphical user-interfaces, simple graphics, multithreading, images, animation, audio, database connectivity, remote objects, and networking. Effective From: Fall 2006

CS 408 - Cryptography and Internet Security (3-0-3)
Prerequisite: Math 226 or CS 241. Covers security require-ments for telecommunication over the Internet and other communication networks, various conventional and public-key encryption protocols, digital encryption standard, RSA and ElGamal cryptographic systems, digital signature algorithm and analysis of its cryptoimmunity, and access sharing schemes. Students receiving credit for CS 408 may not enroll in CIS 608. Effective From: Fall 2006

CS 410 - Co-op Work Experience II (3 additive credits)
Prerequisites: CS 310 or its equivalent, approval of the department, and permission of the Office of Cooperative Education and Internships. Provides major-related work experience as co-op/internship. Mandatory participation in seminars and completion of requirements that include a report and/or project. Effective From: Fall 2006

CS 421 - Numerical Algorithms (3-0-3)
Prerequisite: completion of a 100-level GUR course in CIS. Corequisite: Math 222. This course deals with fundamentals of numerical methods, including discussion of errors, interpolation and approximation, linear systems of equations, solution of nonlinear equations, and numerical solution of ordinary differential equations. The algorithmic approach and the efficient use of the computer are emphasized. Effective From: Fall 2006

CS 431 - Database System Design and Management (3-0-3)
Prerequisite: CS 114 or equivalent. Database system architecture; data modeling using the entity-relationship model; storage of databases; the hierarchical, network and relational data models; formal and commercial query languages; functional dependencies and normalization for relational database design; relation decomposition; concurrency control and transactions management. Student projects involve the use of a DBMS package. Effective From: Fall 2006

CS 431H - Honors Database System Design and Management (3-0-3)
Prerequisite: CS 114 or equivalent. A course similar to CS 431, with a project of greater depth and scope. Effective From: Fall 2006

CS 432 - Advanced Operating Systems (3-0-3)
Prerequisites: CS 252, CS 332. A survey of the design and implementation of distributed operating systems, both by introducing basic concepts and considering examples of current systems. Topics include: communication, synchronization, processor allocation, and distributed file systems. Effective From: Fall 2006

CS 433 - Introduction to Linux Kernel Programming (3-0-3)
An introductory study of how the Linux operating system is built from scratch. As a hands-on course, students will perform intensive programming using Linux kernel. The contents include booting, segmentation and paging, creating and destroying processes, process switching and scheduling, handling exceptions and interrupts, software interrupts, creating system calls, creating file systems, networking with TCP/IP, device driver writing and module programming, etc. At the end of the course, students will be able to modify the Linux operating system to create their own. Effective From: Spring 2010

CS 434 - Advanced Database Systems (3-0-3)
Prerequisites: CS 431. The course covers the basic concepts of traditional files and file processing, provides a "classic" introduction to the relational data model and its languages, and discusses database design methodology and application developments. Students are expected to learn the design of database application systems through a small project and to get some practical hands-on experience with commercial database management systems (DBMS) by writing application programs using the commercial DBMS query languages. Effective From: Fall 2006

CS 434H - Honors Advanced Database Systems (3-0-3)
Prerequisites: CS 431. A course similar to CS 434, with a project of greater depth and scope. Effective From: Fall 2006

CS 435 - Advanced Data Structures and Algorithm Design (3-0-3)
Prerequisite: CS 114 and (Math 226 or CS 241). Advanced topics in data structures and algorithms, including mathematical induction, analysis and complexity of algorithms, and algorithms involving sequences, sets, and graphs such as searching, sorting, order statistics, sequence comparisons, graph traversals, etc. Optional topics include geometric, algebraic, and numeric algorithms. Effective From: Fall 2006

CS 435H - Honors Advanced Data Structures and Algorithm Design (3-0-3)
Prerequisite: CS 114 or CS 335, and Math 226 and Math 333. A course similar to CS 435, with a project of greater depth and scope. Effective From: Fall 2006

CS 438 - Interactive Computer Graphics (3-0-3)
Prerequisites: completion of a 100-level course in CIS, plus knowledge of a higher level language. This course introduces fundamental concepts of interactive graphics oriented toward computer-aided design systems. Such systems emerge in engineering, architecture, and manufacturing.

Topics include computer data structures for representation of two- and three-dimensional objects and algorithms for definition, modification, and display of these objects in applications. This course will also discuss a selection of special topics in interactive graphics. Effective From: Fall 2006

CS 439 - Image Processing and Analysis (3-0-3)
Prerequisites: CS 114 and Math 333. This course is an intensive study of the fundamentals of image processing, analysis and understanding. Topics to be covered include: a brief review of the necessary mathematical tools, human visual perception, sampling and quantization, image transformation, enhancement, restoration, compression, reconstruction, image geometric transformation, matching, segmentation, feature extraction, representation and description, recognition and interpretation. Effective From: Fall 2006

CS 440 - Computer Vision (3-0-3)
Prerequisite: Math 333. This course introduces basic concepts and methodologies of computer vision, and focuses on material that is fundamental and has a broad scope of applications. Topics include contemporary developments in all mainstream areas of computer vision e.g., Image Formation, Feature Representation, Classification and Recognition, Motion Analysis, Camera Calibration, Stereo Vision, Shape From X (shading, texture, motion, etc.), and typical applications such as Biometrics. Effective From: Fall 2006

CS 441 - Database Programming (3-0-3)
Many technologies have been developed due to the interplay between World-Wide Web Development and Databases on one hand and the growth of Database applications in E-Commerce on the other hand. Today, practically every E-Commerce application has at least a Web component and a Database Component. Many languages have been developed in order to deal with these interactions. The proposed course will focus on accessing databases through the web but also mention new developments in the field. Effective From: Fall 2006

CS 451 - Network Technologies (3-0-3)
This course provides an in-depth study of the different transmission and network technologies that make up the Internet infrastructure. Topics include: physical layer technologies, multiplexing and switching, Wired and Wireless LANS, cellular networks, ATM networks, Multimedia formats and protocols, multicasting, traffic characteristics and measurements, QoS. Effective From: Spring 2009

CS 456 - Open Systems Networking (3-0-3)
Prerequisite: CS 114. An introduction to internetworking, including an in-depth study of the architecture of network interconnections, the internet services, and the protocols needed to provide these services. Topics include: architecture of interconnected networks, internet addresses and the address resolution problem, internet protocols, the domain name system, the socket interface, the client-server model of interaction, the OSI transport and application support protocols, and the TCP/IP application protocols. Effective From: Fall 2006 Until: Fall 2008

CS 458 - Technologies-Network Security (3-0-3)
Prerequisite: CS 356 or CS 456 or IT 420. This course provides both an in depth theoretical study and a practical exposure to technologies which are critical in providing secure communication over the Internet. Topics include: remote access security, web security, wireless security, e-mail security, spam and spam filtering techniques, computer viruses and internet worms, honeypots and honeynets, security liability issues and compliance. Effective From: Spring 2009

CS 467H - Honors Efficient Algorithm Design (3-0-3)
Prerequisite: CS 435 or CS 335; Math 333. The course focuses on presenting techniques for efficient sequential and parallel algorithm design. Algorithms for numerical and combinatorial problems will be discussed. The use of randomization in the solution of algorithmic problems will be explored. Applications to be considered include string matching, polynomials and FFT algorithms, sorting networks, algebraic computations and primality testing and factoring, matrix operations, randomized algorithms for sorting and selection, and data compression. Effective From: Fall 2006

CS 478 - Software Tools for Solving Problems (3-0-3)
Prerequisites: junior or senior standing, permission of instructor. Provides students with an opportunity to interact directly with industry and solve actual problems using various -information-systems software tools. At the beginning of the semester, company representatives present actual problems they are facing, and the students work in groups to develop a solution, which they present at the end of the term. Presentation skills, working in groups, and using software tools for problem solving are stressed. Effective From: Fall 2006

CS 482 - Data Mining (3-0-3)
Prerequisite: CS 431. The course covers the concepts and principles of advanced data mining systems design; presents methods for association and dependency analysis, classification; prediction; and clustering analysis. Effective From: Fall 2006

CS 485 - Special Topics in Computer Science/Information Systems (3-0-3)
Prerequisites: junior standing and/or department approval. The study of new and/or advanced topics in an area of computer science not regularly covered in any other CIS course. The precise topics to be covered in the course, along with prerequisites, will be announced in the

semester prior to the offering of the course. A student may register for no more than two semesters of Special Topics. Effective From: Fall 2006

CS 486 - Topics in Computer Science/Information Systems (3-0-3)
Prerequisites: Same as for CS 485. A continuation of CS 485. Effective From: Fall 2006

CS 488 - Independent Study in Computer Science (3-0-3)
Prerequisites: open only to students in the Honors Program who are computer science majors and who have the prior approval of the department and the CIS faculty member who will guide the independent study. Independent studies, investigations, research, and reports on advanced topics in computer science. Students must prepare, in collaboration with their faculty mentor and in the semester prior to enrolling in this course, a detailed plan of topics and expected accomplishments for their independent study. This must have the approval of both the department and the faculty mentor. A student may register for no more than one semester of Independent Study. Effective From: Fall 2006

CS 488H - Honors Independent Study in Computer Science/Information Systems (3-0-3)
Prerequisites: honors college computer science or information systems majors who have the prior approval of the department and the CS faculty member who will guide the independent study. Independent studies, investi-gations, research, and reports on advanced topics in computer science. Students must prepare, in collaboration with their faculty mentor and in the semester prior to enrolling in this course, a detailed plan of topics and expected accomplishments for their independent study. This must have the approval of both the department and the faculty mentor. A student may register for no more than one semester of independent study Effective From: Fall 2006

CS 490 - Guided Design in Software Engineering (3-0-3)
Prerequisite: senior standing or departmental approval. This course focuses on the methodology for developing software systems. Methods and techniques for functional requirements analysis and specifications, design, coding, testing and proving, integration and maintenance are discussed. Effective From: Fall 2006

CS 491 - Senior Project (3-0-3)
Prerequisites: CS 490, senior standing and project proposal approval. An opportunity for the student to integrate the knowledge and skills gained in previous computer science work into a team-based project. The project involves investigation of current literature as well as computer implementation of either a part of a large program or the whole of a small system. Effective From: Fall 2006

CS 491H - Honors Computer Science Project (3-0-3)
Prerequisites: CS 490, senior standing in the Honors College and project proposal approval. A course similar to CS 491, with a project of greater depth and scope. Effective From: Fall 2006 (Archived Versions)

CS 493 - Computing and Business Senior Project (3-0-3)
The Computing and Business Senior Project is intended to provide a real-world project-based learning experience for seniors in the Computing and Business and Business and Information Systems BS degrees. The overall objectives of this course are to investigate the nature and techniques of a business and computing development project. Projects are either provided by industry partners or proposed by students who wish to become entrepreneurs. Effective From: Fall 2008

GRADUATE COURSES:

CS 505 - Programming, Data Structures, and Algorithms (3 credits)
Prerequisite: knowledge of at least one procedure-oriented language such as PASCAL or C. Computer science students cannot use this course for graduate degree credit. Intensive introduction to computer science principles: a procedure-oriented language such as C++; program design techniques; introductory data structures (linked lists, stacks, sets, trees, graphs); and algorithms (sorting, searching, etc.) and their analysis. Programming assignments are included. Effective From: Fall 2006

CS 506 - Foundations of Computer Science (3 credits)
Prerequisite: knowledge of C/PASCAL. Corequisite: CS 505. Cannot be used for graduate credit towards the M.S. in Computer Science. Introduction to the concepts of iteration, asymptotic performance analysis of algorithms, recursion, recurrence relations, graphs, automata and logic, and also surveys the main data models used in computer science including trees, lists, sets, and relations. Programming assignments are given. Effective From: Fall 2006

CS 510 - Assembly Language Programming and Principles (3 credits)
Prerequisite: knowledge of at least one procedure-oriented language such as PASCAL, C, or C++. Computer Science students cannot use this course for graduate degree credit. An intensive course in assembly language programming including basic machine organization, the structure of instruction sets, program linkage, macros and macro libraries. Extensive programming assignments are included. Effective From: Fall 2006 Until: Spring 2009

CS 515 - Advanced Computer Programming for Engineers (3 credits)
Prerequisite: knowledge of at least one procedure-oriented language such as PASCAL, C, or FORTRAN. Students specializing in computer science may not take this course for credit. This course is designed for engineering students who require an extensive knowledge of programming for their project or thesis work. Topics include review of basic programming techniques, treatment of algorithm design, error analysis and debugging. As time permits, problem-oriented languages are examined. Effective From: Fall 2006

CS 540 - Fundamentals of Logic and Automata (3 credits)
Prerequisite: Math 226 or equivalent (see undergraduate catalog for description). Theory of logic and automata and their influence on the design of computer systems, languages, and algorithms. Covers the application of Boolean algebra to design of finite state machines; formal systems, symbolic logic, computability, halting problem, Church's thesis, and the main ideas of the theory of computation. Effective From: Fall 2006 Until: Spring 2009

CS 590 - Graduate Co-op Work Experience I (3 additive credits)
Prerequisite: students must have the approval of the co-op advisor for the CIS department. Provides on-the-job reinforcement and application of concepts presented in the undergraduate computer science curriculum. Work assignments are identified by the co-op office and developed and approved by the CIS department in conjunction with the student and employer. Students must submit, for CIS department approval, a proposal detailing the nature of the intended work. A report at the conclusion of each semester's work experience is required. Credits for this course may not be applied toward degree requirements for either the bachelor's or master's in computer science. Effective From: Fall 2006

CS 591 - Graduate Co-op Work Experience II (3 additive credits)
Prerequisite: students must have the approval of the co-op advisor for the CIS department. Provides on-the-job reinforcement and application of concepts presented in the undergraduate computer science curriculum. Work assignments are identified by the co-op office and developed and approved by the CIS department in conjunction with the student and employer. Students must submit, for CIS department approval, a proposal detailing the nature of the intended work. A report at the conclusion of the semester work experience is required. Credits for this course may not be applied toward degree requirements for either the bachelor's or master's in computer science. Effective From: Fall 2006

CS 592 - Graduate Co-op Work Experience III (3 additive credits)
Prerequisites: graduate standing, and acceptance by the CIS department and the Division of Career Development Services. Students must have the approval of the co-op advisor for the CIS department. Provides on-the-job reinforcement and application of concepts presented in the undergraduate or graduate computer science curriculum. Work assignments are identified by the co-op office and developed and approved by the CIS department in conjunction with the student and employer. Students must submit, for CIS department approval, a proposal detailing the nature of the intended work. A report at the conclusion of the semester work experience is required. Credits for this course may not be applied toward degree requirements for either the bachelor's or master's in computer science. Effective From: Fall 2006

CS 593 - Graduate Co-op Work Experience IV (0 credits)
Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

CS 601 - Object-Oriented Programming (3 credits)
Prerequisite: basic knowledge of C++. Covers the fundamentals of object-oriented programming. Includes object-oriented concepts such as data abstractions, encapsulation, inheritance, dynamic binding, and polymorphism, and uses C++ as the vehicle for illustrating and implementing these concepts. The object-oriented paradigm is systematically employed in the design of all concepts. Effects of this methodology on software maintenance, extensibility, and reuse. Significant programming/design projects. Effective From: Fall 2006 Until: Spring 2009

CS 602 - Java Programming (3 credits)
Prerequisite: advanced Web-based programming with an emphasis on the Java language and platform. No prior knowledge of Java is required but students are expected to have a good understanding of object-oriented programming concepts such as encapsulation, inheritance, and polymorphism, experience with C++. Basic constructs and syntax and then the core advanced features. Topics include: networking and sockets, remote method invocation (RMI), database connectivity (JDBC), Java Beans, multi-threading and lighweight components (Swing). Common gateway interface (CGI) languages and browser scripting (JavaScript and VBScript) are discussed when used as a complement to the functionality of the Java language. Emphasis is on the Java Development Kit version 1.1 (JDK1.1), both deprecated methods and newly introduced features are discussed. Effective From: Fall 2006

CS 603 - Advanced Programming Environments and Tools (3 credits)
Prerequisite: CS 601. Introduction to Graphical User Interface (GUI) Programming in the X Windows System environment. Design and implementation of the GUI at various levels of abstraction using industry standard software tools. Trade-offs between flexibility and ease of use inherent in GUI building tools. Best suited for the advanced programmer. Effective From: Fall 2006 Until: Spring 2009

CS 604 - Client/Server Computing (3 credits)
Prerequisites: CS 333 and CS 432 or instructor approval (see undergraduate catalog for descriptions). Fundamentals of client/server architecture as applied to the development of software systems. Concepts of distributed systems such as open systems, middleware, software reengineering, and distributed computing environments. Components of distributed client/server technologies such as X Windows Systems, DCE, CORBA, NFS, and ODBC. Case studies are used to illustrate how client/server techniques can be used in a variety of applications. The importance of standards and their role in client/server architecture, such as Posix, DCE, and COS. Requires creation of distributed applications. Effective From: Fall 2006 Until: Spring 2009

CS 605 - Discrete Event Dynamic Systems (3 credits)
Prerequisite: Math 630 or EE 601 or MnE 603 or equivalent. Covers discrete event dynamic system theory and its applications in modeling, control, analysis, validation, simulation, and performance evaluation of computer systems, flexible manufacturing systems, robotic systems, intelligent supervisory control systems, and communication networks. Emphasis on Petri net and automation based approaches. Effective From: Fall 2006 Until: Spring 2009

CS 608 - Cryptography and Security (3-1-3)
This course involves computational methods providing secure Internet communication. Among the topics covered are: Security threats in communication systems; conventional cryptography: substitution and transposition codes; distribution of secret key over the Internet; principles of public-key cryptography; RSA and other public-key cryptographic methods; and digital signature protocol. Effective From: Fall 2006

CS 610 - Data Structures and Algorithms (3 credits)
Prerequisite: CS 505 or CIS 335 or equivalents (see undergraduate catalog for description). Intensive study of the fundamentals of data structures and algorithms. Presents the definitions, representations, processing algorithms for data structures, general design and analysis techniques for algorithms. Covers a broad variety of data structures, algorithms and their applications including linked lists, various tree organizations, hash tables, strings, storage allocation, algorithms for searching and sorting, and a selected collection of other algorithms. Programs are assigned to give students experience in algorithms, data structure design and implementation. Effective From: Fall 2006

CS 611 - Introduction to Computability and Complexity (3 credits)
Prerequisites: mathematics bridge requirements. Introduces the theoretical fundamentals of computing, and provides an understanding of both the inherent capabilities and limitations of computation. The main models of computation are deterministic and non-deterministic Turing machines. Auxiliary models include partial and total recursive functions, first order logic, recursive and recursively enumerable sets, and symbol systems. Covers the essentials of computational theory: first order logic, Russel's Paradox, completeness and consistency, Goedel's Theorem, Church's Thesis, countable and uncountable sets, simulation and computation, diagonalization, dove-tailing, decidable and undecidable problems, reduction, recursion theory, Rice's Theorem, Recursion Theorem, execution time measures, P and NP, polynomial-time reduction, NP-completeness and NP-hardness and formal correctness semantics of programs. Effective From: Fall 2006

CS 621 - Numerical Analysis I (3 credits)
Prerequisite: Math 511 (see undergraduate catalog for description) or an introductory course in numerical methods. An introduction to computational aspects of scientific and engineering problems. Time-dependent phenomena and corresponding quantitative models. Numerical stability and conditioning. Approximation of functions. Interpolation, integration. Solution of nonlinear equations. Ordinary differential equations of the first order. Finite and iterative algorithms for solution of systems of linear equations. Emphasis on computer implementation of algorithms and application to variety of engineering problems. Effective From: Fall 2006

CS 622 - Numerical Analysis II (3 credits)
Prerequisite: Math 511 (see undergraduate catalog for description) or an introductory course in numerical methods. This course covers the theory and design of computer solutions to mathematical equations. Included are iterative methods for solving systems of linear and nonlinear equations, the numerical eigenvalue-eigenvector problem, and methods for solving ordinary and partial differential equations. Emphasis is on the control of errors generated by the computer. Effective From: Fall 2006 Until: Spring 2009

CS 630 - Operating System Design (3 credits)
Prerequisites: CS 332, CS 432 (see undergraduate catalog for descriptions) and CS 505. An intensive study of computer operating system design including multiprogramming, time-sharing, real-time processing, job and task control, synchronization of concurrent processes and processors, resource scheduling, protection, and management of hierarchical storage. Effective From: Fall 2006

CS 631 - Data Management System Design (3 credits)
Prerequisites: knowledge of C and data structures. Acquaintance with fundamental notions of relational database technology. Mathematical properties and usage of database programming languages. Methods of database design and conceptual modeling. Methods of physical storage for database information. Fundamental notions of concurrency control and recovery in database systems. Effective From: Fall 2006

CS 632 - Advanced Database System Design (3 credits)

Prerequisites: CS 631 and knowledge of C++. Covers the concepts and principles of object-oriented data modeling and database systems, parallel and distributed database systems, database machines, real time (database) systems, multimedia and text databases, and imprecise information retrieval systems. Emphasis is on advanced data modeling, query optimization, indexing techniques, concurrency control, crash recovery, distributed deadlock detection, real-time scheduling, vague retrieval and system performance. Effective From: Fall 2006

CS 633 - Distributed Systems (3 credits)

Prerequisites: completion of bridge requirements. Fundamental topics concerning the design and implementation of distributed computing systems are covered, including interprocess communication, remote procedure calls, authentication, protection, distributed file systems, distributed transactions, replicated data, reliable broadcast protocols, and specifications for distributed programs. All topics will be illustrated with case studies. Optional topics may include synchronization, deadlocks, virtual time, and load balancing. Effective From: Fall 2006

CS 635 - Computer Programming Languages (3 credits)

Prerequisites: CS 505 and CS 510. The theory and design of computer language systems; the formal theory of syntax and language classification; a survey of procedure and problem-oriented computer programming languages, their syntax rules, data structures, and operations; control structures and the appropriate environments and methods of their use; a survey of translator types. Effective From: Fall 2006

CS 636 - Compiling System Design (3 credits)

Prerequisite: CS 635. Compiler organization; interaction of language and compiler design. The front end scanning, parsing, and syntax-directed translation: theory, standard approaches, and techniques; front-end tools such as Lex and Yacc. Attribute grammars. Code generation, register allocation, and scheduling; interaction with the run-time environment. Introduction to static analysis and optimization. As time permits, topics in modern compilers: compiling for object-oriented languages such as C++ or Java, memory hierarchies, pipelining, parallelism. Includes a significant programming component. Effective From: Fall 2006 Until: Spring 2009

CS 637 - Real-Time Systems (3 credits)

Prerequisites: completion of bridge requirements. Theory and principles that govern real-time systems design, and mechanisms and methodologies that enable their construction and operation. All aspects of such systems will be covered, including scheduling, device and resource management, communications, machine architecture, kernel software, language design and implementation, specification and user interfaces, and performance analysis and verification techniques. Effective From: Fall 2006 Until: Spring 2009

CS 640 - Recursive Function Theory (3 credits)

Prerequisite: CS 540 or equivalent. Review of basic computability theory. Topics include Church's thesis; unsolvability results; creative, productive, and simple sets; computational complexity; P=NP problem; and classification of solvable problems according to their complexity. Effective From: Fall 2006

CS 641 - Formal Languages and Automata (3 credits)

Prerequisite: Math 226 or equivalent (see undergraduate catalog for description). Fundamentals of automata and formal languages: hierarchy of abstract machines and languages; nondeterministic finite state machines; tape and pushdown automata; context-free and context-sensitive grammars. Effective From: Fall 2006

CS 650 - Computer Architecture (3 credits)

Prerequisites: CS 251 (see undergraduate catalog for description) and CIS 510. Exploiting instruction level parallelism (ILP) is central to designing modern computers. Presents design techniques used for such computers as IBM Power architectures, DEC Alpha, MIPS R4600, Intel P6, etc. Introduction of Instruction Set Architecture (ISA), various functional units, basic principles of pipelined computers. Modern techniques to ILP including superscalar, super-pipelining, software pipelining, loop unrolling, and VLIW. Memory hierarchy, including instruction cache, data cache, second level cache, and memory interleaving. Advanced computer architectures, including vector, array processors, interconnection technology, and ATM network of workstations. Hands-on experience designing a simple pipelined computer on screen and using CAD tools such as Cadence or ViewLogic. Effective From: Fall 2006

CS 651 - Data Communications (3 credits)

Prerequisite: Math 333 (see undergraduate catalog for description). Intensive study of the analytic tools required for the analysis and design of data communication systems. Topics include: birth-death queuing systems, Erlang's distribution, bulk-arrival and bulk-service systems, design and analysis of concentrators and multiplexers, elements of Renewal Theory, M/G/1 system, analysis of Time Division Multiplexing, priority queues, analysis of random access systems, time reversibility, open and closed queuing networks, mean value analysis, flow and congestion, control mechanisms, routing algorithms, flow models, and network topological design. Effective From: Fall 2006

CS 652 - Computer Networks-Architectures, Protocols and Standards (3 Credits)

Prerequisite: A high level programming language, Math 333 (see undergraduate catalog for description), or instructor approved equivalents. Intensive study of various network architecture and protocol standards; with emphasis on the Open Systems Interconnetion (OSI) model. Topics include: analog and digital transmission, circuit and packet switching, the Integrated Services Digital Network (ISDN), Frame Relay, Broadband ISDN, Cell Relay, SONET, Local Area Networks (CSMA/CD, Token Bus, Token Ring, switched and isochronous Ethernets), Metropolitan Area

Networks (FDDI, FDDI-II, DQDB), wireless and satellite networks, synchronization and error control, routing and congestion control, X.25 standard. Effective From: Fall 2006

CS 653 - Microcomputers and Applications (3 credits)
Prerequisite: familiarity with an assembly level and higher-level language. An investigation of the personal computer based on the WinTEl architecture. Programming and use of the various input/output devices via operating system constructs. Use of computer in stand-alone (control) applications and networked applications. Investigation of non-Intel architectures and non-Windows systems as time permits. Effective From: Fall 2006 Until: Spring 2009

CS 654 - Telecommunication Networks Performance Analysis (3 credits)
Prerequisites: CS 651, CS 652, or instructor approved equivalents. Modeling and analysis of telecommunication networks; with emphasis on Local Area Networks (LANs) and Metropolitan Area Networks (MANs). Case studies will be presented and discussed, and the need for modeling and analysis will be established. Various types of LANs, and MANs will be modeled and analyzed. Problem sets and case studies will be assigned to facilitate understanding of the covered material. Effective From: Fall 2006 Until: Spring 2009

CS 656 - Internet and Higher-Layer Protocols (3 credits)
The course introduces the protocols and standards of the TCP/IP suite that govern the functioning of the Internet. The material covered in class is a top-down approach on introduction, discussion, and analysis of protocols from the data-link layer to the application layer. Alternative protocols to the TCP/IP suite and new protocols adopted by this suite are discussed. Numerical examples related to network planning and proocol functioning are analyzed. Effective From: Spring 2010

CS 657 - Principles of Interactive Computer Graphics (3 credits)
Prerequisites: CS 505 or familiarity with the organization of at least one computer system, and knowledge of a structured programming language such as C. Graduate-level introduction to computer graphics concepts, algorithms, and systems. Includes 2-D raster graphics, algorithms, 2-D and 3-D geometric transformations, 3-D viewing, curves and surfaces. Emphasis on PC-based graphics programming projects. Principles of interactive graphics systems in terms of the hardware, software and mathematics required for interactive image production. Effective From: Fall 2006

CS 659 - Image Processing and Analysis (3 credits)
Prerequisite: CS 505. Fundamentals of image processing, analysis and understanding. Topics include image representation, image data compression, image enhancement and restoration, feature extraction and shape analysis, region analysis, image sequence analysis and computer vision. Effective From: Fall 2006

CS 660 - Digital Watermarking (3)
Digital watermarking and steganography is important to ensure data security because of widely used digital multimedia and rapid growth of the Internet. Digital watermarking is a suitable tool to identify the source, creator, owner, distributor, or authorized consumer of a document or an image. Digital steganography aims at hiding digital information into covert channels, so one can conceal the information and prevent detection. This course intends to provide students an overview on different aspects of mechanisms and techniques for digital watermarking and steganography. Effective From: Spring 2009

CS 661 - Systems Simulation (3 credits)
Prerequisites: an undergraduate or graduate course in probability theory and statistics, and working knowledge of at least one higher-level language. An introduction to the simulation of systems, with emphasis on underlying probabilistic and statistical methodologies for discrete-event simulations. Design of simulation applications, and simulation programming in a high-level language. Algorithms for the generation of pseudorandom numbers. Algorithmic methodologies for the simulation of discrete and continuous probabilistic processes. Use of statistical tools. Simulation of queuing systems. Applications of simulation to a variety of system studies. The special purpose simulation language GPSS is studied in detail. Effective From: Fall 2006

CS 662 - Model Analysis and Simulation (3 credits)
Prerequisite: introductory course in simulation. Advanced topics in simulation methodology, including design of simulation experiments, variance reduction techniques, estimation procedures, validation, and analysis of simulation results. Queueing systems. Implementing a simulation with the SIMSCRIPT language. Models of continuous systems with applications to elementary socio-economic and industrial systems. Utilization of the DYNAMO II language. Effective From: Fall 2006 Until: Spring 2009

CS 665 - Algorithmic Graph Theory (3 credits)
Prerequisite: CS 610. The elements of the theory of graphs and directed graphs with motivating examples from communication networks, data structures, etc; shortest paths, depth first search, matching algorithms, parallel algorithms, minimum spanning trees, basic complexity theory, planarity, and other topics. Programming assignments are included. Effective From: Fall 2006

CS 666 - Simulation for Finance (3 credits)
Covers the use of Monte Carlo stochastic simulation for finance applications. Topics include generation of various random variables and stochastic processes (e.g., point processes, Brownian motion, diffusions), simulation methods for estimating quantities of interest (e.g., option prices, probabilities, expected values, quantiles), input modeling, and variance-reduction techniques. Students will write computer programs in C++. Students cannot receive credit for both CS 661 and CS/Math 666. Effective From: Spring 2010

CS 667 - Design Techniques for Algorithms (3 credits)
Prerequisite: CS 610. An introduction to the principles of major design techniques in algorithms. Examples from a variety of topics and problems in computer science are used to demonstrate these design techniques and their appropriate application. Effective From: Fall 2006

CS 668 - Parallel Algorithms (3 credits)
Prerequisites: CS 610 and CS 650. This course examines a variety of parallel algorithms and architectures. Shared memory algorithms and algorithms for special architectures (tree processors, grids, systolic arrays, butterflies) are considered. The basic theory of algorithm/architecture performance will be described. Effective From: Fall 2006

CS 669 - Computational Geometry (3 credits)
Prerequisite: CS 610 or permission of the instructor. Intensive study of the fundamentals of computational geometry data structures and algorithms. Emphasis is on the design of efficient algorithms and data structures, proofs of their correctness and complexity analysis. Fundamental topics including geometric searching, convex hull computation, nearest/farthest searching, Voronoi diagrams, Euclidean minimum spanning trees, planar triangulation, planar point location, arrangement of lines. Effective From: Fall 2006 Until: Spring 2009

CS 670 - Artificial Intelligence (3 credits)
Prerequisite: CS 610 and CS 631. Fundamental concepts and general techniques in artificial intelligence. Main topics include goal tree search, logic and deduction, adduction, uncertainty, fuzzy logic, knowledge representations, machine learning, vision, and action planning. The LISP programming language is used extensively. Students are required to do programming assignments, complete a programming term project, and review case studies. Effective From: Fall 2006

CS 671 - Knowledge-Based Systems (3 credits)
Prerequisite: CS 670 or equivalent. Deals with the underlying architectures of ?classical? knowledge-based systems, i.e., systems based on a knowledge representation formalism that are built by knowledge acquisition from a domain expert; and advanced database systems, especially object-oriented and deductive databases. Effective From: Fall 2006 Until: Spring 2009

CS 672 - Expert System Methods and Design (3 credits)
Prerequisite: CS 670. Deals with expert systems, expert system shells, programming of rule-based systems, selection of shells, verification and validation of expert systems, and knowledge acquisition techniques for extracting knowledge from domain experts. Effective From: Fall 2006 Until: Spring 2009

CS 673 - Software Design and Production Methodology (3 credits)
Prerequisite: CS 631. Modern techniques and methods employed in the development of large software systems, including a study of each of the major activities occurring during the lifetime of a software system, from conception to obsolescence and replacement. Topics include cost/performance evaluation, documentation requirements, system design and production techniques, system verification techniques, automated aids to system development, and project organization and management. Effective From: Fall 2006

CS 674 - Natural Language Processing (3 credits)
Prerequisite: CS 670. Deals with techniques of natural language understanding. Topics are syntax and parsing (top down and bottom up), semantics, pragmatics and use of world knowledge in language understanding. Augmented Transition Networks will be used as programming tool set. Good knowledge of LISP or PROLOG. Effective From: Fall 2006 Until: Spring 2009

CS 680 - Linux Kernel Programming (3)
An in-depth study of how the Linux operating system is built from scratch. As a hands-on course, students will perform intensive programming using Linux Kernel. The contents include machine booting, segmentation and paging memory management, creating and destroying processes, process switching and scheduling, handling exceptions and hardware interrupts, software interrupts, creating system calls, creating file systems, networking with TCP/IP, device driver writing and module programming, etc. At the end of the course, students will be able to modify Linux operating system to create their own. Effective From: Spring 2009

CS 682 - Geometric Modeling (3 credits)
Prerequisite: CS 610. The techniques required to describe the shape of an object and to simulate dynamic processes; parametric geometry of curves, surfaces, and solids; and particular formulations for facilitating calculating geometric properties. Fundamentals of solid model construction and analysis are discussed extensively. Some applications in computer graphics, CAD, and CAM are also mentioned. Effective From:

Fall 2006 Until: Spring 2009

CS 688 - Programming for Interactive Environments (3 credits)

Prerequisite: knowledge of C++. A thorough study of the fundamental concepts and techniques of programming for modern interactive support environments, better known as graphical user interfaces (GUIs). A balanced blend of principle and practice, incorporating a general paradigm of interactive program development and numerous examples from, and projects in, the major GUI environments. Effective From: Fall 2006 Until: Spring 2009

CS 696 - Network Management and Security (3 credits)

Prerequisites: CS 652 or ECE 683, and CS 656. Thorough introduction to current network management technology and techniques, and emerging network management standards. In-depth study of the existing network security technology and the various practical techniques that have been implemented for protecting data from disclosure, for guaranteeing authenticity of messages, and for protecting systems from network-based attacks. SNMP family of standards including SNMP, SNMPv2, and RMON (Remote Monitoring), OSI systems management. Various types of security attacks (such as intruders, viruses, and worms). Conventional Encryption and Public Key Cryptology. Various security services and standards (such as Kerberos, Digital Signature Standard, Pretty Good Privacy, SNMPv2 security facility). Same as ECE 638. Effective From: Fall 2006

CS 697 - Principles of Broadband ISDN and ATM (3 credits)

Prerequisite: CS 652 or ECE 683 or equivalent. Study of the Broadband Integrated Services Digital Network (B-ISDN) architecture and services. In-depth study of the Asynchronous Transfer Mode (ATM), ATM Adaptation Layer (AAL), ATM switching architectures, SONET/SDH, ATM traffic control, broadband integrated traffic models, Operation Administration and Management (OAM) functions, TCP/IP over ATM, and ATM market. Same as ECE 639. Effective From: Fall 2006 Until: Spring 2009

CS 704 - Sequencing and Scheduling (3-0-3)

Advanced sequencing and scheduling for job shops, flow lines, and other general manufacturing and production systems are discussed in this course. Both deterministic and stochastic scheduling models are covered in detail. Heuristics and worst case analysis for "unsolvable" hard scheduling problems (NP-C problems) are introduced. Effective From: Fall 2006

CS 708 - Advanced Data Security and Privacy (3 credits)

Prerequisites: CS 608, CS 696, or instructor approval. In-depth study of the security and privacy issues associated with the massive amount of data that is collected, stored, shared and distributed in today's society. New paradigms are needed to address the security/privacy challenges when data is outsourced at untrusted servers (such as in cloud computing), when data is anonymized in order to be shared among untrusted parties, or when copyrighted data needs to be protected from unauthorized use. Effective From: Fall 2010

CS 725 - Independent Study in Computer Science I, II (3 credits)

Prerequisites: graduate standing and department consent. Effective From: Fall 2006

CS 730 - Seminar in Database Management Topics (3 credits)

Prerequisite: CS 631. A seminar in which students pursue intensive study of specialized topics in the current literature of database management. Each topic is supported by an initial reading list covering current problems in theory and practice. Students present the results of their studies in class with faculty and invited specialists participating. Topics include, but are not limited to, advanced data modeling, object oriented databases, query languages, semantic optimization, database mapping and integration, physical database architecture, database/knowledge-base integration, distributed databases, database machines, database version control, logical and deductive databases. Effective From: Fall 2006

CS 731 - Applications of Database Systems (3 credits)

Prerequisites: IS 675 and CS 631. Restricted to students who are specializing in computer and information systems management. Comparative study of different models of database management systems and their applications. Emphasis on the functions of the database administrator. Includes a survey of physical and logical organization of data, methods of accessing data, characteristics of different models of generalized database management systems, and case studies using these systems from various applications. Student teams design database systems for class projects. Effective From: Fall 2006

CS 734 - Data Mining (3 credits)

Prerequisites: Permission from instructor. Covers the concepts and principles of advanced data mining systems design. Presents methods for association and dependency analysis, classification and predication, and clustering analysis. Optional topics may include Web and scientific data mining, knowledge discovery applications, and current trends in data mining. Effective From: Fall 2006

CS 741 - Communication Network Design (3 credits)

Prerequisites: CS 651 and CS 652. Basic problems of communication network design: analyzes their complexity and provides algorithms, heuristics and other techniques for their solution. Effective From: Fall 2006 Until: Spring 2009

CS 744 - Data Mining and Management in Bioinformatics (3 credits)

Prerequisites: CS 610 or permission of the instructor. Concepts and principles of bioinformatic data mining and management with focus on efficiency and scalability. Methods for indexing and querying biological databases, biological data mining, and algorithmic development for bimolecular and phlyogenetic data analysis. Trends and advances in areas such as functional genomics and proteomics, genetic engineering, and large-scale gene expression data analysis. Effective From: Fall 2006

CS 750 - High Performance Computing (3 credits)

Prerequisite: CS 650. An in-depth study of the state of the art in high performance computing. Topics parallel computer architectures, programming paradigms, and their applications. Parallel architectures include PC clusters, shared-memory multiprocessors, distributed-memory multiprocessors, and multithreaded architectures. Parallel programming paradigms include message passing interface (MPI), its second-generation MPI-2, and multithreaded programming. Applications include computational science and high performance Web and database servers for Internet-based electronic commerce. Students program a parallel machine in class projects. First-hand experience in stable, scalable, high performance computing for Internet-based electronic commerce. Effective From: Fall 2006

CS 752 - Communication Protocol Synthesis and Analysis (3 credits)

Prerequisite: CS 652 or basic familiarity with communication protocols. An in-depth study of the state of the art of protocol engineering. Enables students to apply the techniques of protocol design to real problems in communication protocols. Effective From: Fall 2006 Until: Spring 2009

CS 755 - Security and Privacy in Wireless Networks (3 credits)

This course covers selected topics on security and privacy in wireless networks and is intended for graduate students who are interested in network security. This course can help the students learn the state of the art and open challenges in wireless network security and privacy, thus enhancing their potential to perform research or pursue a career in this emerging area. Effective From: Spring 2011

CS 756 - Mobile Computing and Sensor Networks (3 credits)

This course provides an in-depth study of mobile computing and sensor networks, which are becoming major components of the transition from today's world of desktop computers to a world where computing is ubiquitous. The main topics include: techniques to handle mobility in the Internet and ad hoc networks; operating systems, programming languages, and protocols for sensor networks; applications, middleware, programming models, and security ubiquitous computing environments. Effective From: Spring 2008

CS 759 - Advanced Image Processing and Analysis (3 credits)

Prerequisite: CS 659. Advanced study of recent research in image processing, analysis, and understanding. Topics include all image processing techniques, high-level recognition approaches, and automated expert vision systems. Effective From: Fall 2006

CS 775 - Seminar in Software Engineering (3 credits)

Prerequisite: CS 673. A seminar in which students pursue intensive study of specialized topics in the current literature of software engineering. Each topic is supported by an initial reading list on current problems in theory and practice. The results of the studies are discussed in class with students, faculty and invited specialists. Effective From: Fall 2006

CS 777 - Seminar in Software Management and Production (3 credits)

Prerequisites: Ph.D. core courses. A seminar in which students pursue intensive study of specialized topics in the current literature of software management and production. Each topic is supported by an initial reading list covering current problems in theory and practice. The results of the studies are discussed in class with students, faculty, and invited specialists participating. Topics include, but are not limited to, theory of algorithm structure, analysis of algorithms and programs, hardware technology assessment, automated tools for software production, software measurements and quality, peripheral device interfaces, data communications, computer networks, distributed processing, software verification, implementation standards, documentation standards, system security, software copyright, and project control and organization. Effective From: Fall 2006

CS 780 - Computer Vision (3 credits)

Prerequisite: CS 505. This course introduces computational models of computer vision and their implementation on computers, and focuses on material that is fundamental and has a broad scope of application. Topics include contemporary development in all mainstream areas of computer vision e.g., Image Formation, Feature Representation, Classification and Recognition , Motion Analysis, Camera Calibration, 3D Vision, Shape From X, and typical applications such as Biometrics. Effective From: Fall 2006

CS 782 - Pattern Recognition and Applications (3 credits)

Prerequisite: CS 610. Study of recent advances in development of (statistical and syntactic) pattern algorithm, approximation, and estimation techniques. Topics include statistical estimation theory, classifier design, parameter estimation and unsupervised learning, bias vs. variance, nonparametric techniques, linear discriminant functions, tree classifiers, feature extraction, and clustering. Additional topics include Support Vector machines (SVM), Bayesian Learning, Hidden Markov Models (HMM), evolutionary computation, neural networks, with applications to signal interpretation, time-series prediction, and Biometrics. Effective From: Fall 2006

CS 785 - Seminar in Computer and Information Science I (3 credits)

Prerequisites: determined by nature of topic area. Advance notice of the topics to be covered is given. These seminars examine in depth a special interest area of computer and information science. It emphasizes recent work in area selected for the offering of the course. This course is for master's students and cannot apply toward master's degree credit. Effective From: Fall 2006

CS 786 - Special Topics (3 credits)

Prerequisites: same as for CS 785. A continuation of CS 785. Effective From: Fall 2006

CS 791 - Graduate Seminar (Non-credit)

Corequisite (for doctoral students only): CIS 790. A seminar in which faculty, students, and invited speakers will present summaries of advanced topics in computer and information systems management. In the course students and faculty will discuss research procedures, dissertation organization, and content. Students engaged in research will present their own problems and research progress for discussion and criticism. Effective From: Fall 2006

CS 792 - Pre-Doctoral Research (3 credits)

Prerequisite: permission from department chairperson. For students admitted to the doctoral program in computer and information science who have passed the field exam or the qualifying examination. Research is carried out under the supervision of a designated faculty member. Students identify a research problem and prepare a plan to solve the problem. A maximum of 6 credits of CS 792 may be applied to the CIS 790 requirement. Effective From: Fall 2006

CS 794 - Computer Science/Information Systems Colloquium (Non-credit)

Prerequisite: graduate standing with major in computer science. Colloquium in which national and international experts in the various fields of computer science are invited to present and discuss the results of their recent research. Effective From: Fall 2006

Ecology and Evolution: Offered by the Department of Ecology and Evolution at Rutgers-New Brunswick

GRADUATE COURSES:

R215:533 - The Behavior of Animal Populations (3 credits)

For more details go to Rutgers Catalog.

R215:565 - Community Dynamics (4 credits)

For more details go to Rutgers Catalog.

R215:590 - Population Ecology (4 credits)

For more details go to Rutgers Catalog.

Economics: Offered by the School of Management. See Management course list for faculty.

UNDERGRADUATE COURSES:

Econ 201 - Economics (3-0-3)
The nature of a market economy. Microeconomics, demand theory, production possibilities, cost and price, equilibrium analysis, and applications to decision making in the firm. Macroeconomics, national income accounts, consumption, investment, government monetary and fiscal policy, and problems of employment and price levels. Economic analysis leading to an understanding of current developments in the United States economy and international trade and currency problems. Students who have received credit for Econ 265 or Econ 266 may not subsequently receive credit for Econ 201. Effective From: Fall 2009

Econ 265 - Microeconomics (3-0-3)
The theory of price determination and resource allocation under various market structures. The theory of demand, production, costs, factor and product pricing, income distribution, market failure, implications of government intervention in the market, and comparison of the free enterprise and alternative systems. Students who have received credit for SS 201 may not subsequently receive credit for Econ 265.

Econ 266 - Macroeconomics (3-0-3)
The theory of national income determination. The determinants of aggregate production, employment and prices, as well as money and banking, business cycles and monetary and fiscal policy. Students who have received credit for SS 201 may not subsequently receive credit for Econ 266.

Econ 485 - Special Topics in Economics (3-0-3)
The study of new and/or advanced topics in the various fields of business and their application not regularly covered in any other business course. The precise topics to be covered, along with prerequisites, are announced in the semester prior to the offering of the course. Effective From: Fall 2009

R220:102 - Introduction to Economics, Macro (3)
For more details go to Rutgers Catalog.

R220:304 - Economics of Labor (3)
For more details go to Rutgers Catalog.

R220:322 - Introduction to Econometrics (3)
For more details go to Rutgers Catalog.

R220:323 - Intermediate Microeconomic Theory (3)
For more details go to Rutgers Catalog.

R220:324 - Intermediate Macroeconomic Theory (3)
For more details go to Rutgers Catalog.

R220:339 - Economic Development (3)
For more details go to Rutgers Catalog.

R220:402 - Advanced Econometrics (3)
For more details go to Rutgers Catalog.

GRADUATE COURSES:

Econ 565 - Managerial Economics (3 credits)

Managerial decision-making for different markets: structure of industry, vertical integration, conglomerate firms, multinational firms, theory of contestable markets, entry deterrence, estimating demand and cost functions, price discrimination, agency trade, theory of regulation, market signaling and hiring, and theory of share economy.

Electrical and Computer Engineering: Offered by the Department of Electrical and Computer Engineering.

UNDERGRADUATE COURSES:

ECE 101 - Introduction to Electrical and Computer Engineering (1-0-0)
Prerequisite: None. Familiarize students with various disciplines, career opportunities and curricula in electrical and computer enginneering. Invited speakers include faculty and industrial representatives. Effective From: Fall 2003 (Archived Versions)

ECE 231 - Circuits and Systems I (3-1-3)
Prerequisites: CS 113, Phys 121, Math 112. The basic concepts of electric circuit theory and system analysis. Topics include basic circuit elements, loop and node analysis, network theorems, sinusoidal steady-state analysis, power, resonance, mutual inductance, and ideal transformers.

ECE 232 - Circuits and Systems II (3-1-3)
Prerequisite: ECE 231. Corequisite: Math 222. A continuation of circuits and systems with special emphasis on transient response. Topics include Laplace transform analysis, transfer functions, convolution, Bode diagrams, and Fourier series.

ECE 251 - Digital Design (3-1-3)
Prerequisites: FED 101 and Phys 121. The design of combinational and sequential logic circuits used in digital processing systems and computers. Basic register transfer operations are covered. Topics include Boolean algebra, minimization techniques and the design of logic circuits such as adders, comparators, decoders, multiplexers, counters, arithmetic logic units, and memory systems.

ECE 252 - Microprocessors (3-0-3)
Prerequisites: ECE 251 and CS 113. An introduction to microprocessor system organization and assembly language programming. The course covers the architecture, instruction set and assembly language of a specific microprocessor. Other topics included are memory organization, input/output interfacing, interrupt processing as well as exception processing. The problems associated with the design of a single board computer are also covered. Students receiving degree credit for CIS 453 cannot receive degree credit for ECE 352. Co-listed as CoE 252.

ECE 271 - Electronic Circuits I (3-1-3)
Prerequisite: ECE 231. Electronic circuits and devices, particularly junction diodes, bipolar transistors and field-effect transistors. Solid-state device physics is studied in sufficient detail to understand the basic models of semiconductor devices for dc and ac analysis.

ECE 291 - Electrical Engineering Laboratory I (0-3-1)
Prerequisites: ECE 231, HSS 101. Corequisites: ECE 232, ECE 251. Laboratory work in the areas covered in ECE 231, ECE 232 and ECE 251. Emphasizes the construction, testing and analysis of both digital and analog circuits. Emphasizes basic measurement techniques throughout. Introduction to the use of PSpice for solving dc, ac and transient problems on the personal computer.

ECE 310 - Co-op Work Experience I (3 additive credits)
Prerequisites: completion of the sophomore year, approval of the department, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the co-op office. Mandatory participation in seminars and completion of a report.

ECE 321 - Random Signals and Noise (3-0-3)
Prerequisite: ECE 232 and ECE 333. Random processes occurring in electrical engineering. An introduction to probability and random variables is followed by stochastic processes and noise. Topics include auto- and cross-correlation functions, power spectral density, response of linear systems to random signals, and noise figure calculations.

ECE 333 - Signals and Systems (3-0-3)
Prerequisites: ECE 232, Math 222. A continuation of circuits and systems. Topics include signal models, system representations and properties, convolution, Fourier transform, sampling, z-transform, and an introduction to IIR and FIR filter design.

ECE 341 - Energy Conversion (3-0-3)
Prerequisite: ECE 231. Magnetic materials and their applications including the design of singly- and multiply-excited magnetic circuits and transformers, and the steady-state performance of dc and ac electromechanical energy converters.

ECE 353 - Computer Organization and Architecture (3-0-3)
Prerequisites: ECE 252. Emphasizes the hardware design of computer systems. Topics include register transfer logic, central processing unit design, microprogramming, ALU design, pipelining, vector processing, micro-coded arithmetic algorithms, I/O organization, memory organization and multiprocessing. Effective From: Fall 2003

ECE 354 - Digital Test (2-0-2)
Prerequisites: ECE 251 or equivalent, Math 333 or equivalent. Covers theory and practice related to test technology. Topics include fault modeling, test generation, fault simulation, design for testability, fault diagnosis, built-in self-test, scan design, and many others. Surveys several industrial design for testability structures. Effective From: Fall 2003

ECE 361 - Electromagnetic Fields I (3-0-3)
Prerequisites: ECE 231, Math 213, Phys 234. Vector analysis and calculus, static electric and magnetic fields, capacitance and inductance, electric currents, resistance, time dependent fields and introduction to Maxwell's equations. Effective From: Spring 2006

ECE 362 - Electromagnetic Fields II (3-0-3)
Prerequisites: ECE 361. Maxwell's equations solutions, reflection and refraction of plane waves in dielectric and conducting media, transmission lines; transients and frequency domain solutions in lossy and lossless lines, Smith chart and its applications, parallel plate and rectangular waveguides.

ECE 368 - Signal Transmission (2-0-2)
Prerequisites: ECE 232, ECE 251. Familiarization with signal transmission both within and between digital systems. Topics include the telegrapher's equations, wave propagation, lattice diagrams, transients in digital systems, crosstalk, proper termination for high-speed logic, and the transmission characteristics of various interconnecting geometries. Effective From: Fall 2003

ECE 372 - Electronic Circuits II (3-0-3)
Prerequisites: ECE 232, ECE 271. Principles of FET and BJT small signal amplifiers: Q point design, input and output impedance, gain, and signal range limitations for the six different single stage configurations. Design of analog integrated circuits including current sources, differential amplifiers, noise sources, active loads, and CMOS circuits. Transistor high frequency models, Miller effect, and frequency response of multistage amplifiers. Feedback with multistage amplifiers and two-port network theory.

ECE 373 - Electronic Circuits III (3-0-3)
Prerequisites: ECE 372. Topics include operational amplifier fundamentals, linear op-amp circuits, instrumentation amplifiers, feedback theory, active filters, practical op-amp limitations, Schmitt triggers, oscillators, multivibrators, timers, and waveform generators.

ECE 374 - Electronic Device I (3-0-3)
Prerequisite: ECE 372. This course addresses electronic devices on a fundamental level. Topics include semiconductors, Structure and properties of p/n junction, Schottky barrier, BJT, MOS, MOS FET, semiconductor optoelectronics. Effective From: Fall 2006

ECE 392 - Electrical Engineering Laboratory II (1-2-2)
Prerequisite: ECE 291, ECE 333, and ECE 372. Laboratory work in some of the areas covered in ECE 251, ECE 333 and ECE 372. Covers the practical design and testing of electrical and electronic circuits. Introduces engineering design, manufacturing and measurement concepts by the use of selected design projects. Design, construct and test electronic circuits using own components.

ECE 394 - Digital Systems Lab (0-3-1)
Prerequisites: ECE 251, ECE 271 and ECE 291. Experiments emphasize digital design from basic electronic circuits to complex logic. Topics include switching speed, operational amplifier circuits, basic sequential circuits, the arithmetic/logic unit, and computer memories. Effective From: Fall 2003

ECE 395 - Microprocessor Laboratory (0-4-2)
Prerequisites: ECE 291, ECE 252. In this laboratory the students are expected to learn to apply their theoretical knowledge of both the hardware and software aspects of microprocessors. To attain this objective the students are required to construct a microprocessor based single board computer (SBC), with adequate interfacing capabilities to be able to perform some useful control tasks. Programming of the device is done in assembly language. Some of the experiments that follow the construction project deal with software while others deal with the problems of interfacing of microprocessors.

ECE 405 - Electrical Engineering Principles (3-0-3)

Prerequisites: Phys 121. (No credit for ECE students.) For non-electrical engineering majors. Topics include basic dc and ac circuits, basic electronics, an introduction to electromechanical energy conversion and control theory.

ECE 410 - Co-op Work Experience II (3 credits)

Prerequisites: ECE 310, approval of the department, and permission of the Office of Cooperative Education and Internships. Provides major-related work experience. Mandatory participation in seminars and completion of requirements that include a report and/or project. May count as EE or approved elective.

ECE 413 - Introduction to Electrical Engineering Practice (1-0-1)

Prerequisite: senior standing or permission of the instructor. Planning and execution of engineering projects. Intellectual property: publications and proprietary documents, invention disclosures and patents. Safety: the role of engineering codes and standards. Engineering ethics. Professional organizations. Professional registration. Preparation of a technical proposal for a senior project and its approval required. Effective Until: Summer 2005

ECE 414 - Electrical and Computer Engineering Project I (1-0-1)

Prerequisite: Senior standing or permission of instructor. Computer Engineering students will develop a project proposal for the senior design project. Inivited faculty and industrial speakers will present project ideas and real examples. Effective From: Fall 2005

ECE 415 - Electrical Engineering Project (1-2-2)

Prerequisites: ECE 373, ECE 413, ECE 494. A synthesis and focusing of previous experience, in and out of college, upon one or more electrical engineering projects selected by the student. Involves library research, design, cost analysis, construction and testing. Projects are shared in final project presentations. Effective Until: Summer 2005

ECE 416 - Electrical and Computer Engineering Project II (3-0-3)

Prerequisites: ECE 414. Projects must involve the design and execution of both hardware and software or firmware, and include library research, cost estimation and time budgeting. An oral pres-entation and demonstration of the project must be given. A final written report must be submitted. Effective From: Fall 2007

ECE 417 - Independent Study (3-0-3)

Prerequisites: ECE 414. Students work on various individually selected projects guided by the department faculty. The project(s) of each student must be completed and professionally presented by assigned due dates for appropriate review and recording of accomplishment. An oral presentation will be made at a meeting of all students and faculty advisors involved in the course. A formal written report will be presented to the faculty advisor at the end of the course. Effective From: Fall 2007 (Archived Versions)

ECE 421 - Digital Data Communications (3-0-3)

Prerequisites: ECE 232, Math 333, or ECE 321. Covers communications basics and some topics in digital communications most germane to data communication. Topics include signal classification, correlation, spectral analysis, energy and power spectral density, white noise, signal transmission through linear systems, sampling and quantization, and principles of digital data transmission. Effective From: Fall 2007

ECE 422 - Computer Communications Networks (3-0-3)

Prerequisites: ECE 321 or Math 333. Introduction to the fundamental concepts of computer communication networks. Topics include the OSI reference model, the physical, data link, network, and transport layers, TCP/IP, LANs (including token ring, token bus, and ethernet), ALOHA, routing and flow control. Effective From: Fall 2003

ECE 423 - Data Communications Networking Devices (3-0-3)

Prerequisites: ECE 421 or ECE 481. Provides a working knowledge of data communication networking devices, including modems, routers, multiplexers, switches, and concentrators and are used as building blocks in the implementation, modification, or optimization of data communications networks. Emphasizes device design, functionality and physical layer protocols. Effective From: Fall 2003

ECE 424 - Optical Communication Network (3-0-3)

Prerequisites: ECE 232 and either ECE 321 or Math 333. Focuses on digital optical networks, architecture, modulation techniques, and detection noise. Related topics are wireless communication, infrared link, and CATV. Computer simulations of network systems are done with commercial software packages. Effective From: Fall 2003

ECE 425 - Wireless Communication Systems (3-0-3)

Prerequisites: ECE 481 or ECE 421. Introduction to wireless system design and engineering. Develops an understanding and appreciation of the wireless engineering problems such as cellular layout design, resource allocation, mobility management, capacity and performance and signaling load calculations. Introduces physical layer building blockssuch as modulation, synchronization, coding, diversity, equalization, and spreading. Effective From: Fall 2003

ECE 429 - Computer Communications Lab (0-4-2)
Prerequisites: ECE 421. Experiments cover signals and circuits in both time and frequency domains, modulation techniques, spectral analysis, transmission technology, signal generation, measurements and detection, distortion analysis, and white noise measurements. Effective From: Fall 2007

ECE 431 - Systems and Virtual Instrumentation (3-0-3)
Prerequisites: ECE 252, ECE 333. Builds upon mathematics and electrical engineering science background to analyze and design feedback control and instrumentation systems. Emphasizes performance specifications, stability and modeling. The computer is used as an essential design and analysis tool. Effective From: Fall 2003

ECE 432 - Control Systems Elective (3-0-3)
Prerequisites: ECE 431. A continuation of the study of automatic control systems with emphasis on computer-aided design and problem solving. Topics covered include state feedback control, observers, industrial regulators, linear quadratic regulators, and the analysis of various common system nonlinearities. Implementation techniques on both analog and digital platforms will be addressed. Effective From: Fall 2003

ECE 435 - Medical Imaging Instrumentation & Data Acquisition Systems (3-0-3)
Prerequisites: ECE 231, ECE 252 and ECE 333. Three-Dimensional medical imaging modalities including X-ray Computer Tomography, Magnetic Resonance Imaging, Single Photon Emission Computer Tomography, Positron Emission Tomography, and Ultrasound utilizes advanced highly integrated electronic sensors, fast processor-based computers, and advanced signal proessing and reconstruction methods. Effective From: Fall 2007

ECE 436 - Bio Control Systems (3-0-3)
Prerequisite: ECE 431. This course provides an introduction to dynamic and control in biological systems, with particular emphasis on engineering aspects of biological oscillators/waves. A combination of theoretical and simulation tools will be applied to analyze the qualitative and quantitative properties of selected biological systems. Feedback and control mechanisms in selected biological systems will be introduced. Real time signal acquisition and processing are also adressed. Effective From: Fall 2007

ECE 438 - Bio Electronic Systems Laboratory (0-4-2)
This laboratory provides the laboratory experience for students interested in medical applications from the perspective of electrical and computer engineering. It consists of 3 modules: Bio-electronics, Bio-control and Bio-imaging. Effective From: Fall 2006

ECE 439 - Control Systems Laboratory (0-4-2)
Prerequisites: ECE 431. Laboratory work in the design and synthesis of control systems, closely coordinated with the control systems elective. Effective From: Fall 2007

ECE 441 - Power Electronics (3-0-3)
Prerequisites: ECE 373. Electronic devices and circuits used to energize various apparatus and systems. Topics include circuits, freewheeling diodes, thyristors, firing and commutation of silicon-controlled rectifiers, converters, dc choppers, and power supplies. Effective From: Fall 2003

ECE 442 - Power Systems Elective (3-0-3)
Prerequisite: ECE 341. Introduction to power plants and power networks. Topics include transmission line parameters, system modeling, economic operations of power systems, load flow studies, short circuit analysis, and power system stability. Effective From: Fall 2003

ECE 443 - Renewable Energy Systems (3-0-3)
Prerequisites: ECE 231 and ECE 271. This course presents the various sources of renewable energy including wind, solar, and biomass as potential sources of energy and investigates the contribution they can make to the energy profile of the nation. The technology used to harness these resources will be presented. Discussions of economic,environment, politics and social policy are integral components of the course. Effective From: Fall 2009

ECE 449 - Power Systems Laboratory (0-4-2)
Prerequisites: ECE 494. Corequisite: ECE 442. Laboratory work in the design and synthesis of power systems, closely coordinated with the power systems elective. Effective From: Fall 2007

ECE 451 - Advanced Computer Architecture (3-0-3)
Prerequisites: ECE 353. Focues on dvanced concepts in computer systems design, and the interaction between hardware and software components at various levels (i.e., hardware/_software codesign). Introduces common performance measures used by hardware and software designers to facilitate comparative analysis. Main topics are: advanced pipelining, good instruction sets, CISC and RISC microprocessors, introduction to

parallel computing, and a brief historical survey of computer designs. Effective From: Fall 2003 (Archived Versions)

ECE 452 - Advanced Computer Architecture II (3-0-3)
Prerequisite: ECE 451. Topics include memory allocation, single-instruction stream parallelism, parallelism by message passing, shared-resource systems, protection and security, stack-oriented systems, systolic array systems, and data-flow systems. Discusses the relationships between software and hardware levels of system implementation and -operation. Effective From: Fall 2003 (Archived Versions)

ECE 453 - Introduction to Discrete Event Systems (3-0-3)
Prerequisites: ECE 251 or CIS 251 or equivalent, and Math 333 or ECE 321 or equivalent. Introduces logical models, timed models, and stochastic timed models of discrete event systems. Applies petri net methodology to the modeling of computer systems, flexible manufacturing systems, communication networks, and robotics. Contrasts the approaches of _simulation, elementary queueing theory, and Markov processes. Effective From: Fall 2003 (Archived Versions)

ECE 457 - Digital Image Processing (3-0-3)
Prerequisites: ECE 333. An introduction to the fundamental techniques for digital image processing. Covers human visual sstems, image sensing and acquisition, image sampling and quantization, 1-D and 2-D systems, image enhancement, image restoration, image degradation, features extraction, and image segmentation. Effective From: Fall 2007 (Archived Versions)

ECE 459 - Advanced Computer Systems Design Lab (0-4-2)
Prerequisites: ECE 451, ECE 495. Corequisite: ECE 452. Design laboratory component of the advanced computer systems technical track offered to CoE majors in the senior year. Experiments emphasize advanced CPU design concepts, such as RISC approaches and exception handling, multiprocessor and systolic array computers, and FPGAs. Develop software programs to test the capabilities of these hardware designs. Effective From: Fall 2007 (Archived Versions)

ECE 461 - Microwave and Integrated Optics (3-0-3)
Prerequisite: ECE 362. The analysis and design of microwave transistor amplifiers and oscillators using scattering parameter techniques. Topics include transmission line theory, scattering parameters, matching networks, signal flow graphs, amplifier design considerations (power gain stability, noise and band width), and negative resistance oscillator design. Effective From: Fall 2007

ECE 462 - RF/Fiber Optics Systems Elective (3-0-3)
Prerequisite: ECE 362. Topics include dielectric waveguides and optical fibers, semiconductor optical sources and detectors; rf/microwave modulation and demodulation of an optical carrier; design concepts in optical transmitters and receivers; and usage of CAD software tools for rf/microwave simulations. Effective From: Fall 2003

ECE 463 - Optoelectronics (3-0-3)
Prerequisite: ECE 374. The course addresses electronic and optoelectronics device concepts. Topics include optical materials, semiconductor materials,light propagination in waveguide, solar cell, LED and modulation of light. Effective From: Fall 2007

ECE 469 - RF/Microwave and Fiber Optics Systems Laboratory (0-4-2)
Corequisite: ECE 462. Laboratory work in characterization of RF/microwave transmission structures and optical fibers, sources and detectors, spectral and time domain (OTDR) measurements in micro-waves and optics. Experiments in microwave and fiber optic links. Usage of CAD software tools for RF/microwave simulations. Effective From: Fall 2003

ECE 471 - Active Network Design (3-0-3)
Prerequisite: ECE 373. Topics include the basic theorems of network synthesis; the design of LC and RC networks; the design of second-order active RC low-pass, high-pass, band-pass and notch filters; and the design of high-order filters with Butterworth, Chebyshev, Elliptic, and Bessel response. Also, switched-capacitor circuit designs and other selected topics. Effective From: Fall 2003

ECE 472 - Pulse Techniques (3-0-3)
Prerequisite: ECE 373. Topics in electronics including linear and non-linear operational-amplifier circuits, the frequency compensation of operational-amplifiers, higher-order active filters including switched-capacitor designs, waveform generators, multi-vibrators, timers, waveshapers, converters, and other selected topics. Effective From: Fall 2003

ECE 475 - VLSI Circuits (3-0-3)
Prerequisite: ECE 372. Topics include MOSFETs, their characteristics and use in analog and digital circuit design, static and dynamic circuits; memory cells; differential stages; symbolic layout of NMOS and CMOS circuits; fundamentals of silicon processing technology and associated design rules and methodology; calculation of chip performance including power, speed and area; logic arrays.

ECE 476 - Electronic Device II (3-0-3)

Prerequisite: ECE 374. Thorough study of basic principles of semiconductor electrical behavior (particularly as applied to junction, the MOS field effect, and optoelectronic devices) in order to understand their operation and characteristics. Devices include Schottky barrier and PN junction diodes, bipolar and FET transistors, solar cells, photoconductive and photovoltaic detectors, LEDs, and semiconductor lasers. Emphasis on characteristics important for circuit design, e.g., dynamic switching behavior. Effective From: Fall 2007

ECE 477 - Semiconductor Sensors and Bio Electronics (3-0-3)

Prerequisite: ECE 374. The course outlines electronic systems geared for bio-sensors from fabrication to realization point of view. Topics include MEMS, device fabrication, BioMEMS and detection methods, Signal Conditioning Circuits, Signal Amplification, Microarrays & Nanoscale Arrays, Nanotechnology. Effective From: Fall 2007

ECE 478 - VLSI Circuits (3-0-3)

Prerequisite: ECE 372. Topics include MOSFETs, their characteristics and use in analog and digital circuit design, static and dynamic circuits; memory cells; differential stages; symbolic layout of NMOS and CMOS circuits; fundamentals of silicon processing technology and associated design rules and methodology; calculation of chip performance including power, speed and area; logic arrays. Effective Until: Summer 2003

ECE 479 - Optoelectronics and Electronic Laboratory (0-4-2)

Co-requisites: ECE 463 and ECE 476. The Laboratory course outlines experiments on electronic and optoelectronics device concepts. Topics include Optical waveguide, Solar Cell, LED Modulation of Light, capacitance-voltage of MOS structure. Effective From: Fall 2007

ECE 481 - Communications Systems (3-0-3)

Prerequisites: ECE 321, ECE 333, ECE 373. An introduction to communications systems and modulation theory. Topics are AM and FM systems, including methods of generation and detection, signal spectra, and bandwidth requirements; thermal noise, calculation of signal-to-noise ratios and the effect of noise on the communications system analyzed; pulse code modulation systems with consideration given to bandwidth requirements, quantization noise and the effects of transmission errors.

ECE 482 - Communications Systems Elective (3-0-3)

Prerequisites: ECE 481. A continuation of the study of communications systems with selected topics from different areas of communications theory such as sampled-data communications, information theory and noise. Effective From: Fall 2003

ECE 489 - Communications Systems Laboratory (0-4-2)

Prerequisites: ECE 481. Corequisite: ECE 482. Laboratory work in the design and synthesis of communications systems, closely coordinated with the communications systems elective. Effective From: Fall 2003

ECE 494 - Electrical Engineering Laboratory III (1-2-2)

Prerequisites: ECE 341, ECE 373, ECE 392. A continuation of laboratory work into the areas covered in ECE 341, ECE 352 and ECE 373.

ECE 495 - Computer Engineering Design Lab (1-4-3)

Prerequisites: ECE 353, ECE 394. Preparation for putting into practice the concepts learned in ECE 353. Emphasizes hardware design and debugging. Topics include combinational and sequential logic design using CAD tools, design based upon PLA/PLD devices, computer interface design using hardware and software, and an open-ended design project such as a central processing unit design. Effective From: Fall 2003 (Archived Versions)

ECE 497 - Computer Systems Laboratory (0-4-2)

Prerequisite: ECE 494. Corequisite: ECE 487. Laboratory work in the design and synthesis of computer systems, closely coordinated with the computer systems elective.

ECE 498 - Special Topics in Electrical and Computer Engineering (3-0-3)

The study of new and/or advanced topics in an area of electrical and computer engineering not regularly covered in any other ECE course. The precise topics to be covered in the course, along with prerequisites, will be announced in the semester prior to the offering of the course. Effective From: Fall 2007

GRADUATE COURSES:

ECE 501 - Linear Systems and Random Signals (3 credits)
This course, serving as a bridge course for non-electrical and computer engineering department graduate students, provides fundamental coverage of signal and system analysis, including probabilistic methods. Topics include signal models, system properties, Fourier Transform, introduction to probability, random variables, random processes, correlation functions, and spectral density.

ECE 550 - Circuit Analysis (3 credits)
Introduction to analysis of linear circuits and systems. Techniques used include mesh and nodal analysis, network theorems, steady-state and transient methods, analogs, Fourier series and transforms, and LaPlace transforms. Pole-zero diagrams are developed as an aid in the study of low-order systems. Credits for this course may not be used to fulfill any electrical engineering degree requirement. Effective Until: Fall 2004

ECE 590 - Graduate Co-op Work Experience I (3 credits)
Prerequisites: permission from Department of Electrical and Computer Engineering and Division of Career Development Services. Cooperative education/internship providing on-the-job reinforcement of academic programs in electrical and computer engineering. Assignments and projects are developed by the co-op office in consultation with the electrical and computer engineering department. Work assignments are related to student's major and are evaluated by faculty coordinators in the ECE department. Credits for this course may not be used to fulfill any electrical or computer engineering degree requirement.

ECE 591 - Graduate Co-op Work Experience II (3 additive credits)
Prerequisites: ECE 590 and permission from Department of Electrical and Computer Engineering and Division of Career Development Services. See ECE 590 course description. Credits for this course may not be used to fulfill any electrical or computer engineering degree requirement.

ECE 592 - Graduate Co-op Work Experience III (3 additive credits)
Prerequisites: graduate standing and permission from Department of Electrical and Computer Engineering and Division of Career Development Services. See ECE 590 course description. Credits for this course may not be used to fulfill any electrical or computer engineering degree requirement.

ECE 593 - Graduate Co-op Work Experience IV (0 credits)
Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

ECE 599 - Electrical Engineering Laboratory (3 credits)
Prerequisites: B.S. in engineering or science, and permission from ECE department. Workshop on fundamental measurements involving instrumentation commonly used in testing electronic and power circuits. Credits for this course may not be used to fulfill any electrical engineering degree requirement.

ECE 601 - Linear Systems (3 credits)
Methods of linear-system analysis, in both time and frequency domains, are studied. Techniques used in the study of continuous and discrete systems include state-variable representation, matrices, Fourier transforms, LaPlace transforms, inversion theorems, sampling theory, discrete and fast Fourier transforms, and Z-transforms. Computer simulation of linear systems is used, and, where feasible, computer solutions are obtained.

ECE 605 - Discrete Event Dynamic Systems (3 credits)
Corequisite: Math 630 or ECE 601 or MnE 603 or equivalent. Covers the theory of discrete event dynamic systems with applications in modeling, control, analysis, validation, simulation, and performance evaluation of computer systems, flexible manufacturing systems, robotic systems, intelligent supervisory control systems, and communication networks. Emphasis on Petri net and automation based approaches.

ECE 609 - Artificial Neural Networks (3 credits)
Prerequisites: ECE 601 and ECE 673 or consent of instructor. Artificial Neural Networks (ANN) are networks consisting of massively parallel connected simple processing elements arranged in various topology, usually in layers. Various ANN models, learning paradigms, and applications are covered. The course evolves from a simple single-neuron structure to more complex networks.

ECE 610 - Power System Steady-State Analysis (3 credits)
Prerequisite: B.S. in EE or ME. Steady-state analysis of power system networks, particularly real and reactive power flows under normal conditions and current flows under faulty conditions. Symmetrical components and digital solutions are emphasized.

ECE 611 - Transients in Power Systems (3 credits)
Prerequisite: ECE 610. Transient performance of power systems with lumped properties, interruption of arcs, restriking voltage, re-ignition inertia effects, switching of rotational systems, magnetic saturation in stationary networks, harmonic oscillations, saturated systems, transient performance of synchronous machines.

ECE 612 - Computer Methods Applied to Power Systems (3 credits)
Prerequisite: undergraduate computer programming. Digital computer techniques proven successful in the solution of power system problems, particularly in the electric utility industry. Emphasis on short-circuit, load flow, and transient stability problems. Matrix sparsity is considered.

ECE 613 - Protection of Power Systems (3 credits)
Prerequisite: ECE 610 or equivalent Coils, condensers, and resistors as protective devices; fundamental principles of protective relaying; relay operating characteristics; power and current directional relays; differential relays; distance and wire pilot relays; heating and harmonic effects; and Computer-based protective device coordination. Effective From: Fall 2009

ECE 614 - Dynamics of Electromechanical Energy Conversion (3 credits)
Prerequisites: ECE 620 and undergraduate electric machines. Dynamic behavior of lumped parameter systems; study of a continuum electromechanics, such as magnetic diffusion and the stress tensor; and dynamics of electromechanical continua in two- and three-dimensional systems. Effective Until: Fall 2004

ECE 615 - Advanced Electromechanical Energy Conversion I (3 credits)
Prerequisite: undergraduate electric machines. Steady-state performance of synchronous machines; time constants, sudden reactive loading; sudden short-circuit conditions; dynamic behavior of synchronous machines; speed torque-current control of induction machines; magnetic noise and voltage ripples; and Kron generalized machine theory. Effective Until: Fall 2000

ECE 616 - Power Electronics (3 credits)
Prerequisite: B.S. in electrical engineering. Principles of thyristor devices, dynamic characteristics of choppers, commutation, protection, voltage-fed and current-fed inverter drives, cycloconverters, pulse width modulation, phase control, and microcomputer control, with case studies.

ECE 617 - Economic Control of Interconnected Power Systems (3 credits)
Economic Control of Interconnected Power Systems: Advanced techniques for operating power systems in the most economic manner while meeting various network constraints; economic dispatch, penalty factors, optimal power flow, short-term electricity markets and locational marginal prices will be studied. Effective From: Fall 2009

ECE 618 - Renewable Energy Systems (3 credits)
This course introduces renewable energy systems. It covers the fundamental concepts of energy and radiation with specific solar energy applications and photovoltaics, electrical energy storage systems, and thermal energy and storage. The second part covers the basic science of wind energy systems and their electrical sytem designs. The third part covers the bioenergy systems from resources to final products and conversion technologies. It finally introduces other promising energy sources. Effective From: Spring 2009

ECE 620 - Electromagnetic Field Theory (3 credits)
Prerequisite: undergraduate electromagnetic field theory or equivalent. Maxwell's equations, boundary conditions and formulation of potentials. LaPlace and Poisson equations for electrostatic and magnetostatic problems and the method of images. Dielectric and magnetic materials, force and energy concepts. Quasi-static and time varying fields, plane, cylindrical and spherical waves. Green's functions, transmission lines.

ECE 622 - Wave Propagation (3 credits)
Prerequisite: ECE 620 or equivalent. Fundamentals of electromagnetics; radiation and scattering; Green's functions; integral equations; numerical methods; ray optics and asymptotics.

ECE 623 - Fourier Optics (3 credits)
Prerequisite: EE 362 (see undergraduate catalog for description) or equivalent. Theoretical background needed to analyze various optical systems: two-dimensional Fourier transforms, vector and scalar diffractions, Fresnel and Fraunhofer approximations, the properties of lenses, coherence theory, frequency analysis of optical imaging systems, spatial filtering, optical information processing, and wavefront-reconstruction imaging.

ECE 624 - Optical Engineering (3 credits)
This course covers basic optical concepts, emphasizing those common to many optical instruments, such as light sources and their characteristics, polarization, coherence, and interferometry. The course introduces CAD tools for lenses, optical filters, and instrument design. The course also focuses on topics concerning optical systems, such as flat panel displays and micromechanical optical systems.

ECE 625 - Fiber and Integrated Optics (3 credits)
Prerequisites: undergraduate electromagnetic field theory and solid-state circuits. Planar dielectric waveguides, step and graded index fibers and dispersion in fibers. The p-n junction and heterostructures, light emitting diodes and semiconductor lasers, p-i-n and avalanche photodetectors, optical transmitter and receiver designs, optical fiber communication system design concepts.

ECE 626 - Optoelectronics (3 credits)

Prerequisites: undergraduate electromagnetic field theory and solid-state circuits. Optical propagation in anisotropic materials, polarization, birefringence and periodic media. Concepts of electro-optics and acousto-optic devices, optical modulators, switches, active filters for optical communication and optical processing.

ECE 630 - Microwave Engineering (3 credits)
Prerequisite: undergraduate course in electromagnetic field theory. Review of transmission line theory and the Smith chart; scattering matrix representation, LC and microstrip matching networks; signal flow graph analysis; micro-wave transistor amplifier design, which includes power gain, stability, noise figure circles; oscillator design.

ECE 632 - Antenna Theory (3 credits)
Prerequisite: undergraduate course in electromagnetic field theory. Fundamentals of electromagnetic field theory; far field approximation, antenna characteristics (gain, impedance, pattern, etc.); elementary antenna types (dipoles, loops, etc.), antenna array theory, wire antennas; broadband antennas.

ECE 635 - Conduction in Plasma (3 credits)
Prerequisite: undergraduate course in direct power generation. Maxwellian velocity distribution function, concentration and diffusion gradients, mean free path, methods of ionization, field intensified ionization, drift velocity, plasma temperature methods of deionization, plasma oscillations and plasma sheath, spark breakdown and mechanism of arcs.

ECE 636 - Computer Networking Laboratory (3 credits)
Prerequisites: ECE 637 or CS 656. This course provides students with hands on training regarding the design, troubleshooting, modeling and evaluation of computer networks. In this course, students are going to experiment in a real test-bed networking environment, and learn about network design and troubleshooting topics and tools such as: network addressing, Address Resolution Protocol (ARP), basic troubleshooting tools (e. g. ping, ICMP), IP routing (e,g, RIP), route discovery (e.g. traceroute), TCP and UDP, IP fragmentation and many others. Student will also be introduced to the network modeling and simulation, and they will have the opportunity to build some simple networking models using the OPNET modeling tool and perform simulations that will help them evaluate their design approaches and expected network performance.

ECE 637 - Internet and Higher-Layer Protocols (3 credits)
The course introduces the protocols and standards of the TCP/IP suite that govern the functioning of the Internet. The material covered in class is a top-down approach on introduction, discussion, and analysis of protocols from the data-link layer to the application layer. Alternative protocols to the TCP/IP suite and new protocols adopted by this suite are discussed. Numerical examples related to network planning and proocol functioning are analyzed. Effective From: Spring 2010

ECE 638 - Network Management and Security (3 credits)
Prerequisites: ECE 683 or CIS 652, and ECE 637 or CIS 656. Thorough introduction to current network management technology and techniques, and emerging network management standards. In-depth study of the existing network security technology and the various practical techniques that have been implemented for protecting data from disclosure, for guaranteeing authenticity of messages, and from protecting systems for network-based attacks. SNMP family of standards including SNMP, SNMPv2, and RMON (Remote Monitoring), OSI systems management. Various types of security attacks (such as intruders, viruses, and worms), Conventional Encryption and Public Key Cryptology. Various security services and standards (such as Kerberos, Digital Signature Standard, Pretty Good Privacy, SNMPv2 security facility). Same as CIS 696.

ECE 639 - Principles of Broadband Networks (3 credits)
Prerequisites: ECE 673, 683 or CS 652 or equivalent. This course covers fundamental concepts of broadband networks. Topics include Broadband ISDN, Switching Techniques, ATM, SONET/SDH, Congestion Control, High-Speed Switching Architectures, Traffic Modeling of Broadband Services, Admission Control, Traffic Scheduling, IP/ATM Convergence, QoS Provisioning in IP Networks, and Optical Networks.

ECE 640 - Digital Signal Processing (3 credits)
Prerequisite: ECE 601 or equivalent. The theory of digital signals and basic processing techniques: Discrete Fourier Series, Discrete Fourier Transform and FFT, Linear and Circular Convolution, Digital Filter Design Techniques, Discrete Hilbert Transforms, Discrete Random Signals, Chirp-Z and other advanced transforms. Introduction to multivariate signal processing. The typical applications of signal processing tools are discussed and connected to the theoretical foundations.

ECE 641 - Laboratory for Digital Signal Processing with Field Programmable Gate Arrays (3 credits)
This course first introduces today's FPGA technology, the design tools for the state-of-the-art DSP algorithms and systems. Then it focuses on computer arithmetic including possible number representations for DSP with FPGA like distributed arithmetic (DA) and CORDIC algorithm. Finally, there is a set of DSP implementations spanning from finite impulse response and infinite impulse response filters to wavelet processors with two-channel filter banks and others. Each student is also assigned a term project for the course. Effective From: Fall 2009

ECE 642 - Communication Systems I (3 credits)

Corequisite: ECE 673. Principles of communication theory applied to the representation and transmission of information. Topics include analysis of deterministic and random signals, amplitude modulation, angle modulation, sampling, quantization, PCM, DM, DPCM, geometric representation of signals, error probability, matched filter and correlation receivers and performance analysis of communication systems signal to noise ratio.

ECE 643 - Digital Image Processing I (3 credits)
Prerequisite: ECE 601. Introductory course in digital image processing. Topics include image models, digitization and quantization, image enhancement in spatial and frequency domains, image restoration, image segmentation and analysis.

ECE 644 - Introduction to Wireless and Personal Communications Systems (3 credits)
Prerequisite: ECE 642 or equivalent. Introduces emerging personal communications networks (PCN) and envisioned personal communication services (PCS). Discussion of recent history of underlying technologies that are being used to synthesize PCN and delineation of the alternative approaches being considered. Focuses primarily on U.S. technologies, with coverage of wireless technologies in Europe and Japan.

ECE 645 - Wireless Networks (3 credits)
Prerequisites: EE 321 or Math 333, or equivalent (see undergraduate catalog for descriptions). Introduction to wireless network design, management, and planning stages. Topics include demand modeling, radio planning, network optimization, and information handling architecture with emphasis on resource allocation and mobility management aspects. Investigation of signaling load optimizations and internetworking problems.

ECE 646 - Introduction to Data Communications (3 credits)
Prerequisites: ECE 642 and ECE 673, or equivalent. Introduces the theory and technology of data communications over voice-grade and broadband channels. Provides the analytical tools required to understand and design data communication systems. Topics include: an overview of data communication systems, channel capacity, channel coding (block codes, cyclic codes, convolutional codes), data transmission, synchronization, equalization, and an introduction to adaptive equalization.

ECE 648 - Digital Microelectronics (3 credits)
Prerequisite: undergraduate semiconductor circuits. Topics include: linear wave shaping with RC circuits, clipping and clamping circuits; theory of operation of semiconductor diode, bipolar transistor (BJT), and MOSFET; BJT and MOSFET inverters, gate circuits, and regenerative logic circuits.

ECE 649 - Compression in Multimedia Engineering (3 credits)
Prerequisite: ECE 640 or instructor's permission. Foundations of information theory, audio/speech and video compression technologies. Detailed discussion of JPEG, image compression, H.261, MPEG-1 and MPEG-2 international video compression standard algorithms. Current status and future directions of very low bit rate MPEG-4 video compression standards activities.

ECE 650 - Electronic Circuits (3 credits)
Prerequisite: senior undergraduate level semiconductor circuits. Methods of analysis and design of linear and digital semiconductor circuits are studied. Topics include low and high frequency models, passive and active biasing techniques, I-C analysis and design, op-amp circuits, and active filters.

ECE 653 - Micro/Nanotechnologies for Interacing Live Cells (3 credits)
In this course, we will study technologies and tools available for interfacing live cells from a sub-cellular, single-cell, and multi-cellular (tissue models) approach. We will introduce key concepts of the biology of cells and tissues and will explore the technologies (micro-/nanotechnologies) and tools (sensors and actuators) available for the investigation of cell and tissue biology. Same as BME 653. Effective From: Spring 2010

ECE 655 - Modeling of Biological Neural Systems (3 credits)
This course introduces biological neural networks and systems as the essential parts of the autonomous, peripheral and central nervous systems in human body to perform physiological functions and determine behavior. The difference in neural architecture and function in different nervous systems will be discussed. Approaches for modeling of neural circuits with examples of simulation of small and large neural networks in human nervous systems for pattern generation, recall and recognition are discussed and studied. Effective From: Spring 2010

ECE 657 - Semiconductor Devices (3 credits)
Fundamental principles of solid state materials necessary for understanding semiconductor devices. Topics include crystal structure; energy bands; electron and hole generation, and transport phenomena; generation and recombination processes, and high field effects. P-N junction diode, metal semiconductor contact, and bipolar and metal oxide semiconductor transistors, including switching phenomena and circuit models. Introduction to: photonic devices~light emitting diodes, semiconductor lasers, photodetectors, and solar cells; microwave devices~tunnel and IMPATT diodes, transferred electron devices, and charge-coupled capacitors.

ECE 658 - VLSI Design I (3 credits)
Prerequisite: ECE 657 or equivalent. Analysis and design of digital integrated circuits; basic building blocks and dependence on circuit parameters of propagation delay; noise margin; fan-out; fan-in; and power dissipation for circuits of different logic families, including NMOS, CMOS and

BiCMOS; subsystem designs in combinational and sequential logic; Memory Systems; HSPICE circuit simulation is used for digital characteristics evaluation. Mentor Graphics Layout design tools are used for chip design.

ECE 659 - Fabrication Principles of Electronic and Optoelectronic Devices (3 credits)

Prerequisite: ECE 657 or equivalent. Overview of all major processing steps in fabrication of integrated circuits such as crystal growth, epitaxy, oxidation, diffusion, ion implantation and etching. Formation of thin film structures along with techniques for defining submicron structures. Emphasizes silicon device technology but also includes processing of compound semiconductors such as gallium arsenide.

ECE 660 - Control Systems I (3 credits)

Prerequisites: undergraduate course equivalent to EE 333 or ME 305 (see undergraduate catalog for descriptions) and ECE 601 or equivalent or permission from instructor. Introduction to feedback control. Review of state-space analysis. Frequency-domain methods for analysis: Routh-Hurwitz stability algorithms, Root-loci; Nyquist and Bode plots; system ?type.? Controllability and observability. The separation principle and design by pole placement. Linear observers. Optimization of quadratic performance criteria. Elements of random processes. The Kalman filter as an optimum observer. Robustness considerations.

ECE 661 - Control System Components (3 credits)

Prerequisite: ECE 660. The theoretical and practical requirements for analog and digital state-of-the-art control system components are covered. Actuators, amplifiers, sensors, encoders, resolvers and other electromagnetic devices are included. A complete system is designed using current vendor catalog data. Problems affecting the system performance are analyzed using measures of functionality, reliability and cost.

ECE 662 - Large Power Control Systems (3 credits)

Prerequisites: ECE 660, ECE 614, or equivalents. Emphasis on the design and test analysis of servomechanisms and regulation systems involving large power components such as dc machines, induction motors, and alternators. Positioning and velocity servos using rotating amplifiers are covered. A velocity servo for controlling a large induction motor is designed and a typical alternator voltage regulator studied, with regard to its servo characteristics. Methods of determining motor size and gear ratio in large positioning servos are covered.

ECE 664 - Real-time Computer Control Systems (3 credits)

Prerequisite: EE 486 or equivalent (see undergraduate catalog for description). Emphasizes the practical aspects of modern computer control systems. Topics include: Architecture of digital signal processors (DSP) and microcontrollers, real-time data acquisition devices and interface, programming a DSP, review of sampling theorems and properties of discrete-time systems, introduction of control systems theory, design and implementation of parameter optimized controllers, state variable controllers, and cancellation controllers. An experimental project using a TMS320C2x DSP-based data acquisition system is an integral part of this course.

ECE 666 - Control Systems II (3 credits)

Prerequisites: ECE 601 and ECE 660. Properties of nonlinear systems and basic concepts of stability including small-signal linearization. State plane methods are introduced, with emphasis on controller design for systems that can be represented by second-order approximations. Concepts of equivalent gain, describing function, and dual-input describing function as applied to a large class of nonlinear systems. Representation of linear sampled-data systems in discrete state variable form, stability and performance of discrete-event systems. Full-state feedback, pole placement and observer design. Linear quadratic control and Kalman filtering.

ECE 667 - Bio-Control Systems (3 credits)

The course provides an introduction to dynamic and control in biological systems, with particular emphasis on engineering aspects of biological oscillators/waves which govern the basic operations of all living organisms and especially higher order life forms. A combination of theoretical and simulation tools will be applied to analyze the qualitative and quantitative properties of selected biological systems. Feedback and control mechanisms in selected biological systems will be introduced. Same as BME 667. Effective From: Spring 2010

ECE 668 - Mecial Imaging Systems (3 credits)

This course provides a detailed introduction to medical imaging physics, instrumentation, data acquisition and image processing systems for reconstruction of multi-dimensional anatomical and functional medical images. Three-Dimensional medical imaging modalities including X-ray, Computer Tomography, Magnetic Resonance Imaging, Single Photon Emission Computer Tomography, Positron Emission Tomography, Ultrasound and optical imaging modalities are included. Same as BME 668. Effective From: Spring 2010

ECE 669 - Engineering Physiology (3 credits)

To enable students to apply basic tools in engineering analysis, mathematics, computer science, general physics and chemistry courses so that they can develop models that quantitatively predict the functioning of physiological systems in the human body. To enable students to apply engineering systems analysis to systematic physiology and employ the ideas of feedback control, signal procession, mathematical modeling and numerical simulation. Same as BME 669. Effective From: Spring 2010

ECE 673 - Random Signal Analysis I (3 credits)

Fundamentals of the theory of random variables. Introduction to the theory of random processes. Topics include functions of random variables, sequences of random variables, central limit theorem, properties of random processes, correlation, spectral analysis and linear systems with random inputs.

ECE 677 - Optimization Techniques (3 credits)

Prerequisite: undergraduate course in differential equations. Analytical and numerical methods for finding an extremum emphasizing how and when to apply them. Classical differentiation, Lagrange multipliers, the calculus of variations, penalty functions, slack variables, search techniques, and stochastic approximation are covered.

ECE 681 - High Performance Routers and Switches (3 credits)

The course introduces the different system comprising and Internet routing including the processors for networking function and protocol compliance, switching functions and packet classification for deep-layer inspection capable routers or network appliances. This course material describe the different functions that Internet routers perform and discusses the different approaches used for improving performance of high-end routers. The content includes a discussion on switch architectures. Effective From: Spring 2010

ECE 682 - Introduction to Computer Network Design: Internet Perspective (3 credits)

Explicit emphasis on design considerations. Covers the basics of computer networking and the important current network technologies including the premier local area network and wide area network technologies and services, as well as the description of the relevant protocols. Also covers explicit related design considerations and implications. Amplifies the conclusions with discussions of relevant examples and case studies.

ECE 683 - Computer Network Design and Analysis (3 credits)

Corequisite: ECE 673. Queueing models and state-transition models are introduced to model, design and analyze computer networks. The OSI model, LANS (including token ring, token bus, and Ethernet), and useful network protocols. Emphasis on the physical, data link and network layers. ALOHA, Stop-and-Wait protocol, Go-Back-N protocol, window-flow-control, and shortest-path routing.

ECE 684 - Advanced Microprocessor Systems (3 credits)

Prerequisites: undergraduate course in computer architecture and microprocessors, and some experience in assembly language programming. Architecture of advanced microprocessors; CPU architecture, memory management and protection, interrupt and exception facilities, instruction sets, systems aspects including peripheral interfaces, communications ports, and real-time systems.

ECE 685 - Network Interface Design (3 credits)

Prerequisite: ECE 683 or equivalent. Provides a working knowledge of data communications networking devices, the building blocks upon which networks are constructed. Emphasizes devices and their function in data communication networks. Covers the use of devices in the design, implementation, modification, and optimization of data communications networks.

ECE 686 - Instrumentation Systems and Microprocessors (3 credits)

Prerequisite: undergraduate course in microprocessors. Principles of instrumentation transducers and the electronic amplifiers and filters needed to process the electrical signals generated by them; types and characteristics of A/D and D/A converters and other circuits necessary for the interfacing of instrumentation data to a computer or digital data transmission system. Emphasis placed on development of stand-alone analog instrumentation systems as well as microprocessor-based systems. Tradeoffs and alternatives for both implementations are emphasized as well as cost effectiveness of each design. Hardware and software are developed as needed.

ECE 687 - Design of Medical Instrumentation (3 credits)

Prerequisite: undergraduate course in electronics. Principles and practice of medical instrumentation. Instrument components and medical instrument systems design. Examples taken from electrocardiography, clinical chemistry, medical imaging. Microprocessor-based systems emphasized.

ECE 688 - Microcontrollers in Instrumentation (3 credits)

Prerequisite: undergraduate course in microprocessors. Microcontroller as single chip computer system for diverse applications. System microcontroller real-time design concepts from architecture to interface. Assembly language programs. Real-time facilities of advanced microcontrollers are emphasized.

ECE 689 - Digital System Design for Machine Arithmetic (3 credits)

Prerequisite: undergraduate course in logic design. Data representation, integers, floating point and residue representation. Bounds on arithmetic speed, algorithms for high speed addition, multiplication, and division. Pipelined arithmetic. Hardware implementation and control issues.

ECE 690 - Computer Systems Architecture (3 credits)

Prerequisites: ECE 684 and CoE 353 (see undergraduate catalog for description) or CIS 650. Discusses advanced topics in modern computer systems architecture such as pipelined and superscalar processors, parallel computers (vector, SIMD, MIMD), multithreaded and dataflow architectures, cache and memory hierarchy, and system interconnect architectures. Also discusses relevant system software design issues such as shared memory and message-passing communication models, cache coherence and synchronization mechanisms, latency-hiding techniques, virtual memory management, program partitioning and scheduling. Examples are drawn from real systems.

ECE 692 - Embedded Computing Systems (3)
Pre-requisites: ECE 353 (CoE) or ECE 684 (EE) and CS 105 (or equivalents). Introduction of the methodology for the design and implementation of embedded computing systems, and its application to real-world problems. Topics include Embedded System Design Process, UML, ARM Instruct Set Architectures, CPU's Hardware Platforms, Software Design and Analysis, Embedded Operating Systems, Real-Time Scheduling, Hardware Accelerators, Distributed Embedded Systems, and Design Methodology and Quality Assurance. Effective From: Fall 2006

ECE 698 - Selected Topics in Electrical and Computer Engineering (3 credits)
Special area course given when suitable interest develops. Advance notice of forthcoming topics will be given.

ECE 699 - Selected Topics in Electrical and Computer Engineering II (3 credits)
See description for ECE 698 above.

ECE 700 - Master's Project (3 credits)
Prerequisite: written approval of project advisor. An extensive paper involving design, construction, and analysis, or theoretical investigation. Joint projects with industry may be acceptable. Work is carried out under the supervision of a member of the department faculty. A maximum of 3 credits may be applied to the degree.

ECE 701 - Master's Thesis (3 credits)
Prerequisite: written approval of thesis advisor. Projects involving design, construction, experimental or theoretical investigation. Joint projects with industry or governmental agencies may be acceptable. Work is carried on under the supervision of a designated member of the department faculty. Completed work in the form of a written thesis should be of a quality leading to journal publication. The completed thesis must be defended by the student in an open forum and must be approved by a committee of at least three people. A student must register for a minimum of 3 credits per semester. Only the 6 credits indicated for the thesis will be applied to the degree.

ECE 710 - Economic Control of Interconnected Power Systems (3 credits)
Prerequisite: ECE 610. Theoretical developments and computer methods in determining economic operation within the boundaries of a given steam-electric operating area. Energy accounting control and economic theories for interconnected steam and hydroelectric power systems.

ECE 711 - Power System Dynamics and Stability (3 credits)
Prerequisites: ECE 610 and undergraduate course in electric machines. Elements of the stability problem: principal factors affecting stability, ordinary simplified methods of making stability calculations, and illustrations of the application of these methods to studies of power systems, damping, and saturation.

ECE 719 - Advanced Electromechanical Energy Conversion II (3 credits)
Prerequisites: ECE 615, ECE 622. Derivation of circuit models of rotating systems, based on the cross-sectional space wave method and the study of generalized Maxwell-Lorentz equations, applied to coupled rotational bodies.

ECE 725 - Independent Study I (3 credits)
Prerequisite: departmental approval. Program of study prescribed and approved by student's faculty coordinator. This special course covers areas of study in which one or more students may be interested but is not of sufficiently broad interest to warrant a regular course offering. Master's degree students cannot count ECE 725 as degree credit but can count these credits to qualify for full-time status.

ECE 726 - Independent Study II (3 credits)
See description for ECE 725 above. This course is not available to master's students.

ECE 730 - Theory of Guided Waves (3 credits)
Prerequisite: ECE 620 or equivalent. Modes, rays and beam propagation in guiding structures. Non-uniform waveguides and transitions, excitation of waveguides and optical fibers. Coupled modes theory with applications to resonators and couplers. Wave propagation in anisotropic media.

ECE 739 - Laser Systems (3 credits)
Prerequisite: ECE 620 or permission of instructor. Optical resonators, laser radiation and oscillation. Laser characteristics: semiconductor lasers, gas and glass lasers; mode-locking, Q-switching. Quantum-well lasers, noise; modulation and detection of laser light, optical systems for communication and computation.

ECE 740 - Advanced Digital Signal Processing (3 credits)
Prerequisites: ECE 601, ECE 640 and ECE 673. Topics in stationary discrete time stochastic processes; modeling of discrete time processes,

Yule-waker equations, aspects of discrete wiener theory; principle of orthogonality, linear predictors; Levinson-Durbin recursion and algorithm, lattice predictors, method of least squares (RLS) algorithm, systolic array implementation of QRD-Ls.

ECE 742 - Communication Systems II (3 credits)

Prerequisites: ECE 642 and ECE 673 or equivalents. Principles of digital communication. Topics include fundamentals of information theory, digital modulation techniques, optimum detector receivers for digitally modulated signals, the bandlimited gaussian channel and intersymbol interference, equalization, spread spectrum, CDMA.

ECE 745 - Advanced Wireless Networks (3 credits)

Prerequisite: ECE 645. This course explores next generation wireless networks. Students are expected to conduct research on the up to the minute advances in research, development, and standards activities in wireless networks. Resource allocation and Quality of Service provisioning which include advanced queueing tools in the case of long range dependent and self-similar traffic are discussed. State of the art topics such as mobility management, routing, Mobile IP, Cellular IP, and relevant open issues are studied. New network architectures are studied in detail. These include advanced wireless data communications via ad hoc networking, wireless Internet, and multimedia service provisioning over broadband air interfaces.

ECE 746 - Adaptive Array Processing and Interference Cancellation (3 credits)

Prerequisites: ECE 642 and ECE 673. Principles of array processing, performance criteria used, and adaptive algorithms for realization of these processors; and ideas and principles of array processing in the design of contemporary radar systems.

ECE 747 - Signal Decomposition Techniques: Transforms, Sub-bands, and Wavelets (3 credits)

Prerequisites: ECE 640 and ECE 673. Multiresolution signal decomposition techniques, transforms, sub-bands, and wavelets. Time-frequency localization properties of multiresolution algorithms. Evaluation and critique of proposed decomposition strategies from compression and performance standpoints. Applications to speech and video compression, and localized feature extraction. These are basic signal processing tools used in diverse applications such as speech and image processing and storage, seismology, machine vision.

ECE 755 - Advanced Topics in Digital Communications (3 credits)

Prerequisites: ECE 642 and ECE 673 or equivalent. Advanced topics in digital communication systems in the presence of intersymbol interference, noise, and fading: modulation and demodulation in the presence of gaussian noise, efficient signaling with coded modulation, trellis decoding, Viterbi algorithm, digital transmission with intersymbol interference, and digital signaling over imperfect channels.

ECE 756 - Advanced Topics in Semiconductor Devices (3 credits)

Prerequisite: ECE 657 or permission of instructor. Builds on ECE 657. Covers photonic devices particularly semiconductor laser and photodetectors for optical systems; microwave and other high speed devices; scaled advanced MOS, FET, and bipolar transistors.

ECE 757 - Advanced Wireless Communications (3 credits)

Prerequisite: ECE 742 or equivalent. Introduction of digital cellular radio. In-depth analytical characterization of linear, time-variant systems as they apply to wireless channels. Thorough consideration of the principles of the CDMA multiuser system, together with methods for reducing multiple-access interference. Emphasis on general topics such as diversity interleaving.

ECE 758 - VLSI Design II (3 credits)

Prerequisite: ECE 658 (with ECE 657 suggested). Use of CMOS, biCMOS and bipolar semiconductor technology for VLSI design. Digital techniques are emphasized with minor coverage of analog design. Application areas for full custom, gate arrays, standard cell, and compiled designs are compared. Mentor VLSI design tools running on the HP and Sun workstations are used in the course projects for each enrollee. The course attempts to provide a design environment for projects that is similar to that encountered by VLSI designers in industry.

ECE 759 - Principles of Phase Lock and Frequency Feedback (3 credits)

Prerequisites: ECE 642 and ECE 673 or equivalents. Principles of operation and design for phase locked and frequency feedback loops, linear equivalent circuit, nonlinear effects, and optimization against noise used in a wide range of applications including low-level signal reception, tracking, phase extraction, filtering, and frequency synchronization. F.M. communication is emphasized.

ECE 760 - Solid-State Image Sensors (3 credits)

Prerequisites: ECE 657 and ECE 648 or ECE 658. Construction, operation, and performance evaluation of visible and infrared image sensors. Included are a review of the main approaches for photodetectors and readout structures, image sensor architectures, performance evaluation and trade-offs, noise considerations, modulation transfer function, techniques for control of blooming, interlacing, color-coding for visible imagers, HDTV imagers, photo-counting amplifiers, and radiometry and figures of merit for infrared imagers.

ECE 766 - Stability Theory of Nonlinear Systems (3 credits)

Prerequisite: ECE 666. Concepts of stability in dynamic systems, theory and application of Lyapunov's direct method. Use of functional analysis, and frequency response method of Popov and its extensions including their application to the investigation of stability, boundedness, and damping in a class of unforced and forced nonlinear systems.

ECE 768 - Optimal Control Theory (3 credits)
Prerequisite: ECE 677. Optimal control for classes of deterministic systems with various constraints using calculus of variations, dynamic programming and the maximum principle, state variable constraints, and application of theory to design problems.

ECE 769 - Stochastic Estimation and Control (3 credits)
Prerequisites: ECE 660 and ECE 673. Markov processes. The discrete-time Kalman filter as a minimum variance estimator. The continuous-time Kalman-Bucy filter. Relationship to the Wiener filter. Nonlinear systems: the extended Kalman filter and other generalizations. Computational difficulties and methods for avoiding them: separated-bias estimation, ?UDU? factorization. Applications in navigation and control.

ECE 773 - Random Signal Analysis II (3 credits)
Prerequisite: ECE 673. Continuation of ECE 673. Non-stationary stochastic processes, harmonic analysis, the zero crossing problem, Markov processes, the Poisson process, orthogonal expansions, non-Gaussian processes, non-linear operations.

ECE 776 - Information Theory (3 credits)
Prerequisites: ECE 642 and ECE 673 or equivalents. Classical theory of information developed from Shannon's theory. Information measure, Markov sources and extensions, the adjoint source, uniquely decodable and instantaneous codes and their construction, Shannon's first and second theorems, mutual information, and performance bounds on block and convolutional codes.

ECE 777 - Statistical Decision Theory in Communications (3 credits)
Prerequisite: ECE 642 or equivalent. Relation between detection theory and statistical hypothesis testing problem. Use of Bayes decision criteria, Neyman-Pearson, and mini-max tests; receiver operating characteristics. Representation of signals in signal space, probability of error calculations. Estimation of random and non-random signal parameters, Cramer-Rao Inequality. The general Gaussian problem and the use of covariance matrices.

ECE 778 - Algebraic Coding for Information Transmission (3 credits)
Prerequisites: ECE 642 and ECE 673. Coding for reliable digital transmission and storage, error detection and correction codes. Decoding techniques and performance evaluation of block and convolutional codes, including BCH, Reed-Solomon code and Trellis coded modulation.

ECE 782 - Advanced Data Security and Privacy (3 credits)
Prerequisites: CS 608, CS 696, or instructor approval. In-depth study of the security and privacy issues associated with the massive amount of data that is collected, stored, shared and distributed in today's society. New paradigms are needed to address the security/privacy challenges when data is outsourced at untrusted servers (such as in cloud computing), when data is anonymized in order to be shared among untrusted parties, or when copyrighted data needs to be protected from unauthorized use. Effective From: Fall 2010

ECE 783 - Computer Communication Networks (3 credits)
Prerequisites: ECE 673 and ECE 683. Data link control and communication channels. Delay models in data networks. Queueing analysis techniques are taught in detail. Multi-access communication techniques. Routing in computer communication networks.

ECE 785 - Parallel Processing Systems (3 credits)
Prerequisite: ECE 684 or equivalent. Parallel computer architectures. General purpose and specialized parallel computers. Shared-memory multiprocessors, message-passing multicomputers, and vector supercomputers. Principles of scalable performance. MPP designs. SIMD and MIMD computers. Design of parallel algorithms (merging and sorting of data, FFT, etc.) and performance evaluation. Load balancing, data decomposition, and scheduling of operations.

ECE 788 - Selected Topics in Electrical and Computer Engineering (3 credits)
Special-area course given when suitable interest develops. Advance notice of forthcoming topics will be given.

ECE 789 - Selected Topics in Electrical and Computer Engineering II (3 credits)
See description for ECE 788.

ECE 790 - Doctoral Dissertation (Credits as designated)
Required of all students working toward the Ph.D. in Computer Engineering or in Electrical Engineering. A minimum of 36 credits is required. The student must register for at least 6 credits of dissertation per semester; registration for additional credits may be permitted beyond the 6, with the approval of the advisor, up to a maximum of 12 credits per semester. If the student is still actively engaged in the research after completion of 36 credits, continued registration of 3 credits per semester is required.

ECE 791 - Graduate Seminar (0 credit)

All master's and doctoral students must register for two semesters and six semesters of ECE 791 Graduate Seminar, respectively. To receive a satisfactory grade, students must attend at least five seminars during the semester, as approved by the seminar supervisor. Effective From: Spring 2006

ECE 792 - Pre-Doctoral Research (3 credits)

Prerequisite: permission of the department. For students admitted to the program leading to the Ph.D. in Computer Engineering or Electrical Engineering. Research carried on under the supervision of a designated member of the department faculty. If the student's research activity culminates in doctoral research in the same area, up to a maximum of 6 credits may be applied toward the 36 credits required under ECE 790 after the student fulfills requirements of doctoral candidacy.

Engineering Management: Offered by the Department of Industrial and Manufacturing Engineering

GRADUATE COURSES:

EM 501 - Industrial Management (3 credits)
Prerequisite: approval from the engineering management graduate advisor or program director. Operational aspects of management techniques: organization, product design and development, distribution logistics, marketing, plant location and layout, materials handling, production planning and control, inventory control, quality control, work analysis, and incentive plans.

EM 502 - Engineering Cost Analysis (3 credits)
Prerequisite: approval from the engineering management graduate advisor or program director. Financial, engineering, economic, and cost-control aspects of industrial management; the accounting cycle; cost accounting procedure; and cost-model techniques of making cost comparisons through engineering economic studies.

EM 503 - Methods and Applications of Industrial Statistics and Probability (3 credits)
Prerequisites: approval from the engineering management graduate advisor or program director, undergraduate course in calculus. An analytical approach to basic engineering probability and statistics, with applications drawn from both manufacturing and process industries. Emphasis is placed upon the utility of statistical inference derived from engineering data.

EM 602 - Management Science (3 credits)
Prerequisites: undergraduate calculus and probability and statistics. Linear programming: formulation, methodology, and application; the transportation problem; the assignment problem; Markov chains and their applications in decision making; queueing systems; deterministic and stochastic inventory models.

EM 607 - Seminar in Contemporary Management Problems (3 credits)
Prerequisites: undergraduate courses in economics and management. Readings, discussions, field studies, and reports in areas of contemporary management, behavioral science, management science, economics, and systems planning and control. Course is designed to encourage and give direction to student research for thesis.

EM 617 - Environmental Risk Assessment (3 credits)
Prerequisites: undergraduate courses in calculus and economics. Application of management technique methodology to recognize, evaluate, and make decisions regarding expenditures for the mitigation of potentially hazardous environmental risks. Basic analytical techniques applicable to social and economic risk assessment; methodology and application to current air and water resources; and rationale for cost-benefit and trade-off analysis. Technical characteristics of materials: half-life, decomposition rates, and temperature sensitivity determining environmental probabilities and expectations.

EM 631 - Legal Aspects in Environmental Engineering (3 credits)
Control of air, water, and solid waste pollution by federal, state, and local government statutes and international law. Preparation of environmental impact statements and the right of private citizens to bring suit under federal clean air and water pollution legislation are discussed, as well as limitations on these rights.

EM 632 - Legal Aspects in Construction (3 credits)
Introduction to the legal factors affecting construction activities: contract responsibilities of contractors, engineers, and owners; subcontracts and third-party liability; construction law and code compliance; and insurance and bonds.

EM 633 - Legal Aspects of Health and Safety (3 credits)
Review of key laws and regulations pertaining to occupational health, safety, and product liability; methods to determine which codes apply in given situations and to prepare operating procedures to be used for internal compliance.

EM 634 - Legal, Ethical and Intellectual Property Issues for Engineering Managers (3 credits)

Introduction to various environmental, product liability, health and safety, and intellectual property, legal, as well as ethical, issues facing engineering managers. Current New Jersey and federal laws and pending legal actions in these fields. Case studies and advanced multimedia learning tools are used.

EM 635 - Management of Engineering Research and Development (3 credits)

Prerequisites: principles of management and statistics, or EM 501 and EM 503. A systems approach to management of resources, and tasks needed for engineering research and development. Identification, analysis, and evaluation of the operational characteristics and structure of the research laboratory and engineering office; functions of planning, organizing, staffing, direction, control, innovation, and representation; and planning and control theories, techniques, and current practices in scientific and engineering management.

EM 636 - Project Management (3 credits)

Prerequisites: IE 492 (see undergraduate catalog for description), IE 603 or equivalents. Introduction to concepts of project management and techniques for planning and controlling of resources to accomplish specific project goals. While the focus is on technically oriented projects, the principles discussed are applicable to the management of any project. Topics include time, cost considerations, cash flow forecasting, financial and performance control, documentation.

EM 637 - Project Control (3 credits)

Prerequisite: EM 636 or equivalent. Focuses on the methodology that can be employed to plan project implementation and control progress. Topics include work breakdown construction, task and schedule development budgetary control, earned value analysis, and behavioral considerations. Project management software utilization is emphasized.

EM 638 - Advanced Topics in Project Management and Cost Engineering (3 credits)

Prerequisites: EM 636, EM 637 or equivalent. Considers project management from its initial development to its successful execution from the owner and vendor's perspective. Topics emphasized include pre-proposal activities, project finance, risk control claim management, contract administration and human resource utilization and termination. Assignments include working in a team setting and, when appropriate, using relevant software.

EM 640 - Distribution Logistics (3 credits)

Prerequisite: EM 602 or Tran 650 or equivalent. Distribution logistics emphasizing systems engineering techniques used to optimize corporate profit and customer service: transportation modes; inventory policies; warehousing and order processing; and the best logistics gross margin. Same as Tran 640.

EM 641 - Engineering Procurement and Materials Management (3 credits)

Prerequisites: EM 602, EM 640, and EM 674 or equivalents. Study of the logistics life cycle, involving planning, analysis, design, testing, distribution and life cycle support. Make versus buy engineering design decision. Various tools and techniques for an effective life cycle support program. Bench-marking approach to survey available internal and external resources and competitor solutions. Constructing life cycle cost models for acquisitions. Build adequate specification. Application of the latest techniques in supplier chain quality management. Case studies and advanced multimedia learning tools are used.

EM 655 - Management Aspects of Information Systems (3 credits)

Prerequisite: computer programming experience. Information flow in an organization as an integrated system and management resource: techniques of data analysis, design, and processing; characteristics of computerized information-handling equipment; data acquisition, storage, processing, retrieval, and transmission to decision-makers; and information systems for finance, production, inventory, accounting, marketing, and distribution.

EM 660 - Financing an Industrial Enterprise (3 credits)

Prerequisites: undergraduate economics, accounting, and engineering economy. Principles of financial practice and management in modern business corporations emphasizing financial planning and control; capital project and working capital needs; internal and external financing; and finance as a major function of the management process.

EM 661 - Advanced Engineering Economics (3 credits)

Prerequisite: undergraduate engineering economics or equivalent. Economic use of a firm's capital resources. Feasibility studies of potential major capital investments likely to be considered by an enterprise. Risk assessment, cost engineering, effect of financing sources, life cycle, and technologies forecasting models. Case studies are used.

EM 674 - Benchmarking and Quality Function Deployment (3 credits)

Prerequisite: IE 673 or equivalent. Continuation of IE 673. Benchmarking surveys of competition, process analysis of engineering activities, statistical process control mathematics, Taguchi methods of process and product design, current total quality management innovations, quality functional deployment. Case studies and advanced multimedia learning tools are used.

EM 691 - Cost Estimating for Capital Projects (3 credits)

Prerequisites: EM 502 and EM 503, or equivalent. Cost estimating techniques and procedures for budgeting used in evaluation, planning, and control of capital investments. Emphasis on updating for change, escalation, and statistical and computer methods.

EM 693 - Managerial Economics (3 credits)
Prerequisite: undergraduate economics. Internal and external influences on the economic practices of business; classical and current theories of economic behavior; contemporary analytical techniques; behavior of costs, prices, and profits; demand analysis, competition and monopoly; capital expenditure planning; profit theories and business cycles; and econometric models of market strategies, competitive action, and demand behavior.

EM 695 - Public Utility Energy Management (3 credits)
Prerequisite: EM 602 or equivalent. Managing loads on electric power systems. Influence of variable rate structure and description of several projects currently in progress.

EM 696 - Nuclear Power Reactor Management (3 credits)
Prerequisites: undergraduate economics and physics. Nuclear power reactor management and power generation alternatives: optimum performance; maximum control; minimum cost; capacity planning; cost estimating; investment requirements; plant location and safety; separation technology for fuel enrichment; transportation and storage of spent fuel; reprocessing and nuclear waste storage; and regulatory aspects of nuclear power.

EM 701 - Master's Thesis (6 credits)
Prerequisites: matriculation for the M.S. degree, adequate graduate courses in the field of the proposed thesis, and the thesis advisor's approval. Thesis must contribute to the field, and preferably aid the candidate's present or potential career. While original research may not always result, the thesis should provide a new conclusion or application. A student must continuously register for a minimum of 3 credits per semester until the thesis is completed. Total credit will be limited, however, to the 6 credits indicated for the thesis.

EM 714 - Multicriteria Decision Making (3 credits)
Prerequisite: some background in operations research. Multiobjective programming and conflict analysis to evaluate alternatives in decision making, utility, assessment methodology, interactive and noninteractive multiple mathematical programming methods, and surrogate worth trade-off methods are covered.

EM 715 - Design of an Enterprise (3 credits)
Prerequisites: undergraduate economics, industrial management accounting, engineering economy, probability and statistics; 9 credits of EM courses at 600-level or above; and advisor's approval. Organization and management of an enterprise, from initial planning through production and distribution of manufactured products. Students choose the industry that they study.

EM 716 - Seminar in the Design of an Enterprise (3 credits)
Prerequisite: EM 715. Continuation of EM 715. Depending on the student's interest, report on design of the particular enterprise emphasizing either the management of research and development; the management of production; the management of distribution; or the management of manpower.

EM 725 - Independent Research (3 credits)
Prerequisite: permission from the ME department's industrial and management engineering division advisor. Program of study prescribed and approved by student's advisor. Special course covers areas of study in which one or more students may be interested, but is not of sufficiently broad interest to warrant regular course offering.

EM 740 - Management of Transportation Carriers (3 credits)
Prerequisites: Tran 610 or equivalent and Tran 650 or EM 602 or equivalent. Presents theory and practice of managing transportation carriers, including the concepts of costing, pricing, designing and marketing transportation service; the concepts of financial efficiency and resource productivity with application to the selected freight carriers in each mode of transportation. Selected case studies of carriers? operations management practices in various modes. Comparative studies of service characteristics, market share, cost structures both within a particular transportation mode and between the modes. Same as Tran 740.

EM 765 - Multi-modal Freight Transportation Systems Analysis (3 credits)
Prerequisites: Tran 610 or equivalent and Tran 650 or EM 602 or equivalent. Quantitative methods for the analysis and planning of freight transportation services. The supply-performance-demand paradigm for freight transportation systems. Cost and performance as determined by system design and operations. Relationship of traffic and revenue to service levels and pricing. Optimal service design and redesign for transportation enterprises and operations planning. Fleet and facility investment planning. Applications to various modes. Same as Tran 765 and CE 765.

EM 771 - Operations Cost and Management Control (3 credits)

Prerequisites: 6 credits of EM courses at 600-level or above. Analysis and control of cost and other operational aspects of enterprises: manufacturing, distribution and overhead budgets; cost accounting; management information systems; relevant behavioral factors; financial and other management reports. Case studies used.

English: Offered by the Department of Humanities. See Humanities course list for faculty.

UNDERGRADUATE COURSES:

Eng 095 - General Skills in English as a Second Language (4.5-1-5)

Intended for students in need of extensive practice in speaking, listening, reading, and writing in English prior to enrolling in HSS 099S.

Eng 200 - Communicating in Organizations (3-0-3)

Prerequisites: HUM 101 and two from among Hum 102, HUM 211, HUM 212 and HIST 213 or their equivalents. Allows students to understand the need for writing in an information-based corporate culture. Students write intensively in a variety of forms for a variety of audiences. Attention is given to editing, graphic design, communications ethics, and desktop publishing. At the conclusion of the course, students prepare a portfolio of their work.

Eng 301 - Advocacy and the Law (3-0-3)

Prerequisite: Eng 300, SS 300, HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Offers opportunities to explore the retrieval and use of legal and law-related materials while developing skills in oral advocacy and in writing persuasive legal documents, such as motion memoranda and briefs. Includes learning to listen to participants in the legal process as well as developing effective styles and forms of speech in the classroom. Effective Until: Fall 2004

Eng 302 - Communication Theory (3-0-3)

Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. This course will introduce students to communication theory and practice. The course begins with a review of contemporary communication theory. After covering five selected theories--semiotic, visual, cultural, social, and reception--students will be required to apply a selected theory to a computer-mediated case study. Students will also be required to perform a collaborative field study. Through the course, students will be expected to read critically, to research peer-reviewed sources thoroughly, to present effective oral briefings, and to write analytic reports. Effective From: Spring 2008

Eng 333 - Cybertext (3-0-3)

Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Through theoretical readings and electronic research, students explore and compare information structuring in print and digital media, particularly how digital technology influences the dynamics of text. Interactivity, visual communication and developments in the realm of cybernetics are addressed in the course. Materials presented in creative, technical and commercial areas were studied. Effective From: Fall 2005

Eng 336 - Advanced Composition (3-0-3)

Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212, and Hist 213 or their equivalents. Involves composing in-depth, persuasive research essays designed to address the aims of discourse (expressive, referential, literary, and persuasive), using current media tools (text, graphics, audio, animaation and video) and venues (print and electronic), in several iterations. Effective From: Fall 2006

Eng 339 - Practical Journalism (3-0-3)

Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents or permission of instructor. A descriptive and analytic survey of news systems. Assignments include practice in writing straight news items, sports writing, feature writing, science writing, interviewing, and editing?with emphasis on understanding methods. The survey of printed and broadcast news systems includes the influence of technological, economic, legal, ethical, and historical factors.

Eng 340 - Oral Presentations (3-0-3)

Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Instruction and practice in effective oral presentations. Students deliver a wide range of presentations adapted to the needs of a variety of audiences. Topics include voice and diction, presentation skills, the effective use of visual aids, reporting technical mate-rial and audience analysis.

Eng 346 - The Fourth Estate (3-0-3)

Prerequisites: Hum 101 and two from Hum 102, 211, 212, or Hist 213 or their equivalents, with a grade of C or better. Explores how the media - defined as print as well as electronic media (television, radio and online modes of communication)have influenced different events and social movements at various points in time. Topics will include the role of William Randolph Hearst's newspapers in creating support for the Spanish-American War; press coverage of the women's suffrage movement; the role of television in ending the Vietnam war. Effective From: Spring 2010

Eng 347 - Technical, Professional and Scientific Writing for Publication (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. A journalism course that prepares students to write and publish scientific or technical papers. Working with their interests and knowledge, students learn writing for popular and specialized audiences, journal conventions, publishing process, article marketing, and editing techniques. Includes editorial committees, guest speakers, and technical advisors.

Eng 348 - Literary Journalism (3-0-3)
Prerequisites: Hum 101 and two from Hum 102, 211, 213 or Hist 213 or their equivalent, with a grade of C or better. Students will read and analyze the works of literary journalists from the 18th century to the present day. Close reading and analytical writing as well as some journalistic writing. Effective From: Fall 2009

Eng 349 - Advanced Journalism Skills (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Through hands-on writing and reporting supervised by the instructor, students learn competencies needed in various journalistic specialties. Special focus on how to cover science and technology, social issues, culture and the arts, sports, business and consumer news. Particular emphasis on copy-editing. Effective From: Spring 2006

Eng 350 - The Newsroom (3-0-3)
Prerequisites: Hum 101 and two from Hum 102, 211, 212 or Hist 213 or their equivalent, with a grade of C or better. Students will work closely with the university's newspaper advisor in order to write news and feature stories, commentaries and critiques for publication in the university newspaper, The Vector. Students will finish the course with a portfolio of work that they can present to prospective employers or graduate schools. This is an advanced journalism course. Effective From: Fall 2009

Eng 351 - Online Journalism (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents or permission of instructor. A study of how news is covered on the World Wide Web, and the impact of online news on society and politics. History of news online. Differences between print, broadcast and online-what are the strengths and weaknesses inherent to each medium? Analysis of the websites of different news organizations-from the New York Times to CNN to special interest e-zines to blogs. Effective From: Spring 2006

Eng 352 - Technical Writing (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. An advanced writing course. Combines current theory with actual practice to prepare students as technical writers. Analyze complex communication situations and design appropriate responses through tasks that involve problem solving, rhetorical theory, document design, oral presentations, writing teams, audience awareness, ethical considerations, and gender equity issues.

Eng 353 - Composing Documents for Print (3-0-3)
Prerequisites: HUM 101, and two from among HUM 102, HUM 211, HUM 212 or Hist 213 or their equivalents. Explores information structuring via print and digital media; how computer technology has influenced the ways in which information is presented in modern culture. Focuses on the optimal ways to prepare and present information for technical and commercial use. Important concepts such as visual literacy and effective design are discussed and addressed. Effective From: Fall 2009

Eng 353A - Electronic Publishing Lab (0-3-2)
Prerequisites: HUM 101, and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents; Eng 352 and Eng 353. Seminar and laboratory-based course designed for PTC majors; open to others with appropriate backgrounds and interests and permission of instructor. Follow up of Eng 353, explores information structuring via digital media, and how computer technology has influenced the ways in which information is presented in contemporary culture. Through guided interactive research, present information for technical and commercial use. Projects involve use of html editors, graphical software, and NJIT networks. Effective Until: Fall 2005

Eng 354 - Composing Documents for the Web (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents and ENG 353. Seminar and laboratory-based course designed for BA/BS majors; open to others with appropriate backgrounds and interests and permission of instructor. Follow up of Eng 353, explores information structuring via digital media, and how computer technology has influenced the ways in which information is presented in contemporary culture. Through guided interactive research, presents information for technical, commercial, and artistic use. Projects involve use of HTML editors, NJIT networks, and graphical and animation software. Effective From: Spring 2009

Eng 355 - Television News Writing and Production (3-1-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. This course consists of lectures and hands-on practice with the basics of television news writing and production and a field trip to a television station. After learning the fundamentals, the class will then begin its own news production by refining the video taped "packages" and integrating them into a studio newscast they will write and produce while guided by the instructor and with technical support from the staff of Instructional Technology and Media Services. The semester culminates in a final program that can be delivered to the campus community through ITMS's cable network. Effective From: Spring 2007

Eng 356 - Technical Writing in Distributed Environments (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Prepare distance-learning students to communicate technical information in collaborative computer systems. Uses both real-time and asynchronous communication tools in tasks that involve problem solving, rhetoric, information design, writing teams, audience awareness, and ethical considerations. ENG 356 will satisfy the ENG 352 Technical Writing requirement for distance learning students whose academic majors require ENG 352. Effective From: Fall 2003 Until: Summer1 2024

Eng 360 - Collaborative Communication: Community and Global Perspectives (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. The central focus is on the challenge for cooperative communication to solve local and global problems. Examines how technological advances have altered the way we gather resources to solve problems. Today's information is too vast, too diverse, and changes too rapidly to be used to solve social dynamics problems in traditional ways. Using the resources of all available technology--e-mail, video conferencing, satellite communications, etc.--the goal is to bring all stakeholders together in order to build consensus and/or solve problems.

Eng 364 - Theory of Rhetoric (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Examines theories of rhetoric from ancient to contemporary times. Special attention is paid to Aristotle, Peter Ramus, James Kinneavy, Walter Ong, and -Jurgen Habermas. Focuses on the ways in which theories inform the practice of communication. In the course project, students design and conduct field research based on rhetorical theory.

Eng 369 - Creative Writing (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Focuses on the complexities of creating literary texts. Analyzes student writing in genres such as fiction, creative non-fiction, poetry, and drama. Considers these genres from theoretical perspectives. Topics include character development, plot, dia-logue; meter, rhyme, figurative language; audience analysis, ethos, and narrative theory. Students write, edit and critique their own work with the aim of publication.

Eng 490 - Co-op Work Experience I (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Students gain major-related work experience and reinforcement of their academic program. Work assignments are facilitated and approved by the co-op office. Requires mandatory participation in seminars and completion of a report.

Eng 491 - Co-op Work Experience II (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Students gain major-related work experience and reinforcement of their academic program. Work assignments are facilitated and approved by the co-op office. Requires mandatory participation in seminars and completion of a report.

Eng 496 - Senior Project-Communication and Media (3-0-3)
Prerequisites: HUM 101 and two from HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. For professional and technical communication majors only. Provides students with a capstone experience. Offers PTC students the opportunity to enhance their understanding of communication through their integration of skills and knowledge gained in prior courses. The resultant research thesis or field project, of substantial length and originality, represents the culmination of the undergraduate disciplinary experience. Utilizing both a seminar and workshop approach, entails intense and sustained collaboration between student and instructor, and cooperation among students.
Effective From: Fall 2009

R350:254 - Literature and Politics in the Third World (3)
For more details go to Rutgers Catalog.

GRADUATE COURSES:

Eng 500 - English for International Graduate Students I (3 credits)
Practice in listening and conversational English for students whose native language is not English. Level: Low Intermediate

Eng 502 - English for International Graduate Students II (3 credits)
Practice in writing to improve sentence structure, grammar, vocabulary, and organization. For technical writing, see Eng 541. Level: High Intermediate.

Eng 503 - Advanced English for International Teaching Assistants (3 credits)
Practice in public speaking for international TAs and other international students who want to improve their oral presentation skills. Also covers teaching techniques and pronunciation. Level: Advanced.

Eng 505 - Advanced Spoken English for International Graduate Students (3 credits)
Designed to improve English pronunciation; accent reduction. Level: Advanced.

Eng 507 - Advanced Conversation and American Culture (3 credits)
Practice in conversation in English at an advanced level. The goal is to help students gain the cultural knowledge and speaking skills to increase participation in American life. Level: Advanced.

Eng 521 - Technical Written and Oral Communication (3 credits)
Develops skill in oral and written technical communication on a professional level. Three areas are emphasized: 1) analyzing professional and technical communication situations; 2) achieving clear, effective oral and written communication; and 3) developing awareness of variations in professional communication across cultures. For some assignments, students will work on projects from courses in their own fields. The approach is practical; course format is that of a workshop. Non-native speakers of English may take this course.

Eng 598 - Special Topics in ESL: Understanding Research Articles in Information Systems (3 credits)
Develops skills in reading journal articles in Information Systems efficiently and with understanding. Includes practice in writing about journal articles. Helpful for CIS 675 and CIS 677.

Eng 599 - University Teaching Methods/Communication Skills (3 credits)
Provides ideas, strategies, and techniques to help teaching assistants with their teaching assignments and to enhance their professional communication and interpersonal skills. Includes practical information on classroom management, the culture of the American classroom, diversity issues, and leadership skills. Effective Until: Fall 2005

Eng 601 - Advanced Professional and Technical Communication (3 credits)
Provides the foundation and direction for all Professional and Technical Communication coursework. This course introduces students to the profession and the academic discipline of technical/professional communication. Modules include bibliographic research; usability analysis; working in teams; report writing; visual thinking; communicating with new technologies; and technical writing style. Effective Until: Fall 2005

Eng 603 - Cultural and Technological Change (3 credits)
Prerequisite or corequisite: ENG 601. Examines the complex ways in which technology constructs and is constructed by society, with emphasis on interrelationships between technology and communication. Discussions focus on how technological change is expressed in social and political movements, literature, art, architecture, and philosophy and how they, in turn, influence the future direction of technology. Effective Until: Fall 2005

Eng 604 - Communication Theory and Research (3 credits)
Prerequisite or corequisite: ENG 601 . Reviews the major theories of communication and provides strategies for research in the field of Professional and Technical Communication. The course focuses on these research methods: problem statement and hypothesis formulation derived from theory; research design and data generation; existing information sources and their acquisition; and analytic techniques. Students develop analytic methods necessary to create a well-considered thesis proposal. Effective Until: Fall 2005

Eng 605 - Elements of Visual Design (3 credits)
Prerequisite or corequisite: ENG 601 . Provides an understanding of and competency in the visual presentation of information. Course integrates theories of design, techniques of composition, and technologies of electronic and print publishing. Modules include both design principles and hands-on practice in visual literacy, layout and design, and graphic tools. Effective Until: Fall 2005

Eng 606 - Advanced Online Design (3 credits)
Prerequisites: Eng 605 Elements of Visual Design. This course will focus on online visual communication strategies and community building. The course will cover: multimedia, usability heuristics, navigation theory, contemporary design practices and online community building. Students will be required to create a multidimensional online community and to participate in team-building by collaborating on the MSPTC newsletter. Effective Until: Summer 2005

Eng 610 - Creating Hypertext: User and Task Analysis (3 credits)
Prerequisite: ENG 605 or equivalent . Covers the complex tasks needed to create nonlinear material: audience assessment, task analysis, scenario development, and evaluation. Students complete the life cycle of planning, implementing, testing and revising a nonlinear writing project. This is a writing intensive course that focuses on creating effective goal-oriented online products. Effective Until: Fall 2005

Eng 612 - Theory and Practice of Text Encoding (3 credits)
Prerequisite: ENG 605 or equivalent . In the beginning, IBM created "Script," a series of low-level commands that formatted text on a page. Then came Generalized Markup Language (GML) a series of macros for Script. Today we have Standard Generalized Markup Language (SGML) Hypertext Markup Language (HTML) and Extensible Markup Language (XML), all of which rely on the same basic concepts. Students will learn XHTML in order to gain a solid understanding of the theory of text encoding, while looking into the past (when technical writers wrote the code behind the text) and into the future (when VoiceXML enables unified messaging in a single interface). Each student will also create a website. Effective Until: Fall 2005

Eng 613 - Multimedia Presentations (3 credits)
Prerequisite: ENG 605 or equivalent . There are many ways to create presentations with short films, voice recordings, animations, photos, graphics, narrative, etc. The presentations can 'live' in a variety of ways - on the web, on CD, doing the email rounds, or appearing at a formal board meeting. We will experiment with as many multimedia programs as possible and during our experimentation we will uncover the bugs that go along with making multimedia presentations. We will also consider the balance between content and style - how much is TOO much? Each student will create several presentations. Effective Until: Fall 2005

Eng 620 - Proposal Writing (3 credits)
Prerequisite or corequisite: ENG 601 . Provides an understanding of and practice in proposal writing for corporations, foundations, and government agencies. Students build skills to create a range of persuasive documents including proposals for research grants, responses to requests for proposal, and government proposals. Effective Until: Fall 2005

Eng 622 - Working in Teams (3 credits)
Prerequisite or corequisite: ENG 601 . Uses case studies and simulations to provide both the theoretical foundations and the hands-on practice needed to work effectively in and among heterogeneous corporate groups. Includes collaborative writing, interviewing, and conflict resolution, and computer-mediated group work. Effective Until: Fall 2005

Eng 624 - Professional and Technical Editing (3 credits)
Prerequisite or corequisite: ENG 601 . Presents the theory and practice of editing professional and technical writing. Topics include correctness and conciseness, hard copy and on-line editing, editing graphics, document management, editor-author relationships, and ethical considerations in editing. Students edit writing samples from a variety of technical fields. Effective Until: Fall 2005

Eng 626 - Hypertext Design Studio (3 credits)
Prerequisite: ENG 605 or equivalent. Integrates language, image, linking and thinking in a studio approach to advanced HTML projects. Students work in computer laboratory with instructor on designing individual projects using current audio and video design applications. Effective Until: Fall 2005

Eng 631 - Communication and Environmental Problem Solving (3 credits)
Prerequisite or corequisite: ENG 601. Develops critical thinking on ecological issues for problem solving by integrating technical information, human values, and communication with environmental change. Students combine theory, research and models, case studies, visual thinking, and scientific inquiry for application in individual decision-making course project. Effective Until: Fall 2005

Eng 632 - Content Management, Manuals and On-Line Help (3 credits)
Prerequisite or Corequisite: ENG 601. The three skills that technical writers most often need are an ability to elicit information from recalcitrant SMEs (Subject Matter Experts), the ability to put this information on paper(user manuals) and the ability to put it online in a Help system. This class will focus on the development of skills and abilities that will enable Help system developers to gather, translate and manage information for end users. Students will use theory and practical applications such as RoboHelp and Forehelp to develop an on-line Help module in this course. Effective Until: Fall 2005

Eng 640 - Health Communication (3-0-3)
This course will focus on the use of communication strategies to inform and influence individual and community decisions regarding health. The course will cover: the multidimensional nature of health communication, research in health communication, behavioral theories in health communication, rhetorical theories in health communication, legal and ethical concerns in health communication, the communication of risk and uncertainty, and the design of health campaigns. Students will be required to (a) research and prepare a health communication strategy for use in a specific context and (b) to design an accompanying print or hypertext document to be used in that context. Effective Until: Fall 2005

Eng 642 - Corporate Communication (3 credits)

Prerequisite or corequisite: ENG 601 . Develops communication skills for modern global corporate and business markets. Business documents may include mission/vision statements, business plans, financial statements/plans, marketing plans, and corporate policies and procedures. Effective Until: Fall 2005

Eng 650 - Web Based Training Design (3 credits)

Prerequisite or corequisite: ENG 601 and ENG 605 . Web-based Training (WBT) is at the forefront of the recent 'e-learning' boom. However, while WBT use is on the rise, specific skills and tools are required to ensure a successful WBT implementation. Based on proven instructional design concepts, this course provides the student with the skills necessary to create effective web-based training programs. Effective Until: Fall 2005

Eng 698 - Selected Topics in Professional and Technical Communication (3 credits)

Prerequisite or corequisite: ENG 601 Effective Until: Fall 2005

Eng 700 - Project in Professional and Technical Communication (3 credits)

Prerequisites: approval of graduate advisor, and completion of core courses. Demonstrates ability to conceive and execute an extended writing project with professional graphics and to make an oral and visual presentation of the work. Based on experiential research (internship, co-op, work experience) student submits a proposal, develops a project (e.g., guidebook, manual, online documentation, website, video, CD-ROM) and completes a paper describing the theory and methodology supporting the project application. With graduate advisor, student selects a faculty advisor, faculty reviewer, and external reviewer. Effective Until: Fall 2005

Eng 701 - Thesis in Professional and Technical Communication (6 credits)

Prerequisites: approval of graduate advisor; completion of core courses. Demonstrates ability to conceive and execute an extended writing project with professional graphics and to make an oral and visual presentation of the work. The completed written thesis should warrant publication in a technical journal. Thesis Committee consists of program-approved faculty advisor, one other faculty member, and external reviewer. A student must register continuously for a minimum of 3 credits per semester until thesis in completed. Total will be limited to 6 credits. Effective Until: Fall 2005

Eng 725 - Independent Study in Professional and Technical Communication (3 credits)

Prerequisite: approval of graduate advisor and supervising faculty.Allows development of areas of specialization for Master's Project or for areas of study in communication in which one or more students may be interested but which are not of sufficiently broad interest to warrant a regular course offering. Effective Until: Fall 2005

Enviromental Engineering: Offered by the Department of Civil and Environmental Engineering. See Civil Engineering course list for faculty.

UNDERGRADUATE COURSES:

EnE 262 - Introduction to Environmental Engineering (3-1-3)

Prerequisites: Chem 126, Math 112, and Phys 121. To introduce students to the integrated science, engineering, design and management concepts of engineered environmental systems. The course will cover environmental regulations and standards, environmental parameters, mass balance and natural systems, water quality management, water and wastewater treatment, air pollution control, noise pollution, and solid and hazardous waste management. Background material and laboratories in the environmental sciences and management areas will be covered. Group term papers and presentations will be required. Effective From: Fall 2006

EnE 360 - Water and Waste Water Engineering (3-0-3)

Prerequisites: EnE 262 and junior standing. Training in the methods used for water pollution control. Topics include the chemical, physical, and biological processes that occur in waste treatment design and in receiving waters; modeling schemes to determine allowable loadings in various bodies of water; and waste treatment processes used for water pollution control.

EnE 361 - Solid and Hazardous Waste Engineering (3-0-3)

Prerequisites: EnE 262 and junior standing. Exposure to the area of air pollution control, solid waste disposal, and radioactive waste disposal. Topics include the chemistry of contaminated atmospheres; the influence on meteorological conditions of dispersion of pollutants; abatement processes used in the control of emissions; classification and nature of solid waste, and solid waste disposal techniques; sources and methods for the disposal of radioactive contaminants; and related health effects.

EnE 491H - Honors Research Experience in Environmental Engineering (3-0-3)

Prerequisites: Junior standing, agreement of a department faculty advisor, and approval of the associate chairperson for undergraduate studies. This course provides the student with an opportunity to work on a research project under the individual guidance of a member of the department. A written report is required for course completion. Open to students with a GPA of 3.0 or higher.

GRADUATE COURSES:

EnE 593 - Graduate Co-op Work Experience IV (0 credits)

Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

EnE 610 - Hazardous Site Operations (3 credits)

Course consists of overview of OSHA regulations and NIOSH standards concerning toxicological hazards and medical surveillance requirements, and recognition and monitoring of site hazards. Site layout, design of engineering control to minimize exposure, risk assessment, and modeling will also be presented. Students will receive a certification for the 40-hour OSHA Hazardous Waste Operation training.

EnE 620 - Environmental Chemodynamics (3 credits)

The overall objective of this course is to introduce students to concepts, mechanisms, and models used to describe the transport of chemicals in the environment. Concepts and models presented in the first six weeks are applied to the air-water, sediment-water, and soil-air interfaces during the rest of the term. Effective Until: Fall 2004

EnE 660 - Introduction to Solid and Hazardous Waste Problems (3 credits)

Prerequisite: EnE 663. (May be taken concurrently.) Introduction to solid waste disposal. Industrial and urban sources of solid waste and conventional methods of waste disposal. Application of engineering principles related to these topics.

EnE 661 - Microbiology for Environmental Engineers (3 credits)

Prerequisite: EnE 663. (May be taken concurrently.) Biological and microbiological principles applied to environmental and sanitary engineering. Bacteriological examinations in the laboratory of water and wastewater.

EnE 662 - Site Remediation (3 credits)

Prerequisite: EM 631. Can be taken concurrently with EM 631. Examines site remediation from start to finish. Includes regulations, cleanup standards, remedial investigations, feasibility studies, risk assessment, and safety. Examines established and innovative cleanup technologies such as incineration, containment, bioremediation, vapor extraction and ground water recovery.

EnE 663 - Water Chemistry (3 credits)

Prerequisite: undergraduate general chemistry. The ability to analyze and solve a wide range of chemical equilibrium problems in water chemistry is developed.

EnE 664 - Physical and Chemical Treatment (3 credits)

Prerequisite: EnE 663. Physical and chemical operations and processes employed in the treatment of water and wastewater. Topics include gas transfer, coagulation, flocculation, solid-liquid separation, filtration, and disinfection.

EnE 665 - Biological Treatment (3 credits)

Prerequisites: EnE 663, EnE 661. (May be taken concurrently.) Principles of evaluation and control of water pollution that describe aerobic treatment processes: oxidation ponds, trickling filters, and activated sludge. Anaerobic digestion and sludge handling and disposal as well as biodegradability study techniques for various wastes.

EnE 666 - Analysis of Receiving Waters (3 credits)

Prerequisites or corequisites: EnE 663 and EnE 661. Ecological responses of various types of receiving waters to municipal and industrial waste loadings. Mathematical models for water quality prediction and planning.

EnE 667 - Solid Waste Disposal Systems (3 credits)

Prerequisite: EnE 663. Review and evaluation of design criteria, methods, and equipment employed in handling and disposal of industrial and municipal solid wastes. Emphasis is on hazardous toxic waste, resource recovery, and regulatory constraints.

EnE 668 - Air Pollution Control (3 credits)

Prerequisite: EnE 663 or physical chemistry. The nature of air pollution, its effect on the public, and legal and engineering remedies.

EnE 669 - Water and Wastewater Analysis (3 credits)

Prerequisite: EnE 663. (May be taken concurrently.) Measurement of parameters of interest in water and wastewater quality studies is performed in the laboratory. Specific project requiring analysis, interpretation, and recommendations will be a major part of the work.

EnE 670 - Advanced Processes in Water Pollution Control (3 credits)

Prerequisite: EnE 669. Detailed laboratory experiments using unit operations of sedimentation, coagulation and flocculation; chlorination, filtration, aeration, sludge treatment and digestion. Aspects of pilot plant design and layout are considered. Design parameters discussed in prerequisite courses are developed by advanced bench-scale laboratory procedures. Advanced design and synthesis are considered.

EnE 671 - Environmental Impact Analysis (3 credits)

Prerequisite or corequisite: EnE 663. A graduate course dealing with physical aspects of the environment. Overview of environmental problems, federal and state standards, methodology for developing impact statements, case studies based on recent experience, basis for assessment and decision making.

EnE 672 - Stormwater Management (3 credits)

This course provides a comprehensive study of stormwater management with emphasis on design practices. Topics include regulatory framework, an overview of structural and non-structural BMPs, groundwater recharge analysis, estimate of runoff, and design of detention basin and drainage systems. Effective From: Spring 2006

EnE 673 - Sustainability and Life Cycle Analysis (3-0-3)

The course provides a systematic foundation for the connection between evolving technology and human activity impacts on natural systems by emphasizing the sources of environmental degradation and energy use and strategies to reduce risk and promote sustainability. The course provides hands-on experience with life cycle assessment computer tools and approaches. The course emphasizes relationships between industrial activities and regional and global natural systems-physical, chemical and biological-focusing on the importance of sustainability goals and practices. Effective From: Spring 2009

EnE 700 - Environmental Engineering Project (3 credits)

Prerequisite: student must have sufficient experience and/or graduate courses in major field to work on the project. Subject matter to be approved by the department. Permission to register must be obtained from the project advisor. Extensive investigation, analysis, or design of environmental engineering problems not covered by regular graduate course work is required. A student with an exceptional project in EnE may, upon his/her own initiative and with the approval of his/her advisor, substitute the work of this course as the equivalent of the first 3 credits for EnE 701 Master's Thesis.

EnE 701 - Master's Thesis (6 credits)

The thesis is to be prepared on a subject in the student's major field approved by the department. Approval to register for thesis must be obtained from the thesis advisor. A student must register for a minimum of 3 credits per semester. Credit will be limited, however, to the 6 credits indicated for the thesis.

EnE 702 - Special Topics in Environmental Engineering (3 credits)

Prerequisite: advisor's approval. Topics of special current interest in environmental engineering.

EnE 720 - Environmental Chemodynamics (3)

Introduction to concepts, mechanisms and models used to describe the transport of chemicals in the environment. Concepts and models are applied to air-water, sediment-water and soil-air interfaces. Effective From: Spring 2005

EnE 725 - Independent Study I (3 credits)

Prerequisite: written permission from department chairperson plus courses to be prescribed by the supervising faculty member. Covers areas of study in which one or more students may be interested but which is not of sufficiently broad interest to warrant a regular course offering.

EnE 726 - Independent Study II (3 credits)

Prerequisite: written permission from department chairperson plus courses to be prescribed by the supervising faculty member. Covers areas of study in which one or more students may be interested but which is not of sufficiently broad interest to warrant a regular course offering.

EnE 727 - Independent Study III (3 credits)

Prerequisite: written permission from department chairperson plus courses to be prescribed by the supervising faculty member. Covers areas of study in which one or more students may be interested but which is not of sufficiently broad interest to warrant a regular course offering.

EnE 760 - Applied Environmental Soil Chemistry (3 credits)

Prerequisites: EnE 663, Math 651 or equivalent. Understanding of physical and chemical processes occurring in soils as well as the chemical and physical properties of subsurface soil environments. Emphasizes current research on the subsurface environment.

EnE 790 - Doctoral Dissertation (Credits as designated)

Required of all students working toward the doctoral degree. A minimum of 36 credits is required. The student must register for at least 6 credits of dissertation per semester until 36 credits are reached; registration for additional credits may be permitted beyond the 6, with the approval of the advisor, up to a maximum of 12 credits per semester. If the student has not completed the dissertation after completion of 36 credits, continued registration of 3 credits per semester is required.

EnE 791 - Graduate Seminar (3 credits)

Seminar in which faculty or others present summaries of advanced topics suitable for research. Students and faculty discuss research procedures, thesis organization, and content. Students present their own research for discussion and criticism. Required of all doctoral students registered for EnE 790 unless requirement is waived, in writing, by the dean of graduate studies.

Environmental Policy Studies: Offered by the Department of Chemistry and Environmental Science

UNDERGRADUATE COURSES:

EPS 202 - Society, Technology, and the Environment (3-0-3)

Prerequisite: HSS 101. Uses case studies to examine the relationships between the creation and use of technologies, the human and natural environment, and the development of social and cultural institutions. Its central theme is the manner in which human society structures the environment in which it lives: nature and culture, city and country, civilization and development. This course satisfies 3 credits of the Basic Social Sciences GUR. Honors Note: See HSS 101. Effective From: Spring 2007

EPS 312 - Technology and Policy in Contemporary America (3-0-3)

Prerequisites: HSS 101, HSS 202 or their equivalents; two from HSS 211, HSS 212, Hist 213 or their equivalents. A study of technology and politics in recent America. Focuses on the role of the federal government in shaping technology, especially through funding technological innovations and applications. Topics will include the origins of technology policy in World War II, the influence of the Cold War, the science and technology policy advisory system, and political and cultural influences on technology policy. Honors Note: See HSS 101. Effective From: Fall 2008

EPS 313 - Environmental History and Policy (3-0-3)

Prerequisites: HSS 101, HSS 202 or their equivalents; two from HSS 211, HSS 212, Hist 213 or their equivalents. Covers the rise of the modern environmental debate, and examines its current priorities and values, politics and economics, and impacts on industry and society. Students review the role of regulatory agencies, private industry, public interest groups, and the media. Current major issues in New Jersey are considered, as well as environmental debate on a national and global level. Honors Note: See HSS 101. Effective From: Fall 2008

EPS 360 - Ethics and the Environment (3-0-3)

Prerequisites: HSS 101, HSS 202 or their equivalents; two from HSS 211, HSS 212, Hist 213 or their equivalents. An examination of contemporary environmental problems from the perspective of ethics or moral philosophy. An analysis of the ethical presuppositions and value principles underlying environmental policy. The study of ethical theories and their application to the environmental crisis. Honors Note: See HSS 101. Effective From: Fall 2008

EPS 362 - Environmental Economics (3-0-3)

Prerequisites: HSS 101, HSS 202, SS 201 or their equivalents. Presents a detailed overview of the relationship between political economy and the environment. Draws on diverse case studies including global warming, harvesting of minerals on the ocean's floor, destruction of old growth forests, and contamination of the -nation's water, air, and soils. Explores the economic remedies to the fast-changing relationship between society and nature. Honors Note: See HSS 101. Effective From: Fall 2008

EPS 380 - Policy Issues in the Coastal Environment (3-0-3)

Prerequisites: HSS 101, HSS 202 or their equivalents; two from HSS 211, HSS 212, Hist 213 or their equivalents. An examination of coastal environments from the standpoint of the scientist, the engineer, and the resource manager. Topics include beach and shoreline characteristics, technological innovations to address coastal erosion problems, and current debates in coastal policy and resource management. Case studies are used to illustrate coastal management practices and the scientific, technical, and social constraint to policy formulation. Effective From: Fall 2008

EPS 381 - Field Techniques and Research (3-0-3)

Prerequisites: HSS 101, HSS 202 or their equivalents; two from HSS 211, HSS 212, Hist 213 or their equivalents.; STS 307. An introduction to research methods. The objectives of the course are to provide opportunity to pursue specialized, in-depth research in a subfield of science, technology and society of the student's choice; to develop skills in problem identification, research design and problem solving; to increase familiarity with methods of data analysis; to strengthen library research skills; to provide an opportunity to gather original field data in a team-oriented environment; and to improve oral and written communication skills. Effective From: Fall 2008

GRADUATE COURSES:

EPS 601 - Research Design for the Social and Policy Sciences (3 credits)

Introduces beginning graduate students to the research tools necessary for specialized study in other environmental policy studies courses. Problem identification, research design and problem solving; methods of data analysis; gathering of original field data.

EPS 602 - Research Analysis for the Social and Policy Sciences (3 credits)

Prerequisite: EPS 601. Distribution of social, political, economic and health-related data in both samples and populations using a general linear model with residuals. Test hypotheses using both the Fisher and Neyman-Pearson criteria. Use of software such as SPSS, Microsoft Excel and Resampling Stats. to develop and test models using correlation, regression and ANOV techniques.

EPS 606 - Technology Forecasting and Management Planning (3 credits)

Prerequisite: quantitative background in science, social science, or engineering. Basic forecasting techniques such as regression analysis, scenario generating, Delphi conferencing, and morphological analysis with particular case studies and problems pertaining to the forecasting of technological development. The relation of technological forecasting to the management process and the understanding of the technological development process. Demonstration of techniques and application to the contemporary fields of technological importance such as energy, communications, transportation, housing, and computers.

EPS 609 - Environmental Risk Assessment (3 credits)

Methodology to assess the social and economic risks to present-day environmental resources of air and water; cost-benefit and trade-off analysis; technical characteristics of materials such as half-life, decomposition rates, and temperature sensitivity; and probabilities of various environmental situations.

EPS 612 - Introduction to Environmental Policy Studies (3 credits)

Introduction to six areas essential to a comprehensive understanding of environmental policy: concept of environmental policy; tools (law, economics, planning, science, engineering, ethics) for environmental policy; the U.S. perspective (NEPA, clean air and water acts, CERCLA); the international perspective (Club of Rome models, 1972 UNEP, 1992 Rio); industrial perspective (pollution prevention/life cycle engineering, privatization); and the local perspective (New Jersey DEP, NGOs, local industry, shoreline.) Same as MIP 612.

EPS 613 - Environmental History and Policy (3 credits)

Explores the dialogue between humanity and the environment in the United States, as well as its global implications. Surveys fundamental themes of history and policy from an environmental perspective: colonial development, independence, western expansion, industrialization, urbanization, and the rise of a consumer society. Gives special attention to the emergence of an environmental perspective: wilderness appreciation, the conservation movement, public health, the rise of the environmental movement since the 1960s, environmental science, and the legislative and regulatory process.

EPS 614 - Environmental Economics (3 credits)

Detailed overview of the relationship between political economy and the environment drawing on diverse case studies including global warming, ocean resources, energy policies, and contamination of the nation's water, air and soils. Economic and social policies for the fast-changing relationship between society and nature.

EPS 615 - The Politics of Science (3 credits)

Geopolitical context in which scientific discovery and governmental science policy have been formulated since World War II: social construction and the constituencies that have a stake in its outcome; military influence on science policy priorities; and legislative obstacles to various science policy objectives.

EPS 616 - Global Problem Solving in Science, Technology, and the Environment (3 credits)

Developing policy for the global era. Analyses and theories on political concept of sovereign nation states; the earth as one integrated economy, technology, science, politics and ecology; multinational corporations; worldwide patterns of capital and labor migration; energy flows; technology transfer; and impact of modernization and development on ecology.

EPS 622 - Sustainable Development (3 credits)

Prerequisite: EPS 612 Challenges of sustainable development in the United States and in other countries, influence of sustainable development concepts on environmental decision-making, sustainable development as a paradigm for environmental policy-making.

EPS 630 - Technology, Engineering and Civilization (3 credits)

Technological development and technical innovation dating from the ancient world, medieval Europe, to the modern era, with emphasis on Western civilization. Comparisons of the United States, Europe, China and Japan. Major themes include the role of the military and war, proto-industrialization and industrial revolution, technology transfer, emergence of engineering as an occupational class, and the place of the United States as the world's premier technological nation.

EPS 634 - Professional Ethics (3 credits)
Professional ethics: its source, range, and limits. Ethical thought and behavior in Western tradition and culture as they apply to business, engineering, and government. By studying both theoretical arguments and practical, real-life case studies, students learn to recognize, analyze and evaluate the ethics of personal professional decisions about work, careers, and policies.

EPS 638 - Physical Geography (3)
Understanding the interaction between humans and the physical environment is important to the formulation of sound environmental policy. The course examines processes that shape the physical environment, the influence of human activities on these processes and the physical environment, and the application of this information to solving environmental problems.

EPS 642 - Urban Environmental Policy Studies (3 credits)
Critical evaluation and formulation of environmental policy as it affects urban setting. History and theory of environmental policy. How the U.S. legal structure shapes environmental regulation and its administration. Shifting environmental policy paradigms. Case study analyses focusing on urban settings.

EPS 644 - The Rhetoric of Environmental Policy (3 credits)
Introduces students to the major types of rhetorical analysis as well as assures that students can analyze and write technology policy that is informed by core rhetorical principles of that analysis.

EPS 651 - Introduction to Urban and Environmental Health (3 credits)
Health problems associated with the social and psychological factors found in urban areas and health problems stemming from contamination of air, water, food, the work place and other special environments. Policies required to promote healthful living behavior and those required to regulate negative externalities.

EPS 660 - Ethics and Environmental Policy (3 credits)
Contemporary environmental problems from the perspective of ethics or moral philosophy. Is there a moral obligation to preserve or protect the natural environment? What are the ethical presumptions and values underlying environmental policy? Are traditional theories of moral philosophy applicable to contemporary environmental problems, or is a new conception of the relationship between humanity and nature needed?

EPS 698/EPS 699 - Special Topics in Environmental Policy (3 credits each)
Prerequisite: advisor's approval. Topics of special or current interest.

EPS 701 - Master's Thesis (6 credits)
Prerequisite: matriculation for the master's degree, advisor's and departmental approval. Projects involving fieldwork, experimental, or theoretical investigation carried out under the supervision of a designated member of the departmental faculty. The completed thesis should be of a quality as to warrant publication, in whole or in part, in a professional journal. A minimum of 3 credits per semester is required until completion.

EPS 702 - Special Topics (3-0-3)
Prerequisite: Approval of graduate advisor in Environmental Science. Topics of current interest in the field of environmental policy. Doctoral level course. Effective From: Spring 2006

EPS 711 - Environmental Policy: Corporate Approach and Organization (3 credits)
Explores corporate and business advocacy approaches to influencing and responding to environmental policy and regulation from organizational, historic and strategic perspectives.

EPS 712 - Advanced Studies in Environmental Policy (3 credits)
Analysis of environmental policy development and implementation by studying current issues such as the shift from command and control to pollution prevention, brownfields, clean air from local, regional and national perspectives, and environmental policy priority setting.

EPS 714 - Environmental and Natural Resources Economics (3 credits)
Examines environmental regulation of firms and natural resource use with emphasis on the theoretical foundations required for public policy. Students focus primarily on the application of economic tools to improve environmental quality.

EPS 725 - Independent Study I (3 credits)
Prerequisite: matriculation for the master's degree, advisor's and departmental approval. Projects not within the scope of existing courses are carried out under the supervision of a designated member of the departmental faculty.

EPS 726 - Independent Study II (3 credits)
Prerequisite: matriculation for the master's degree, advisor's and departmental approval. Projects not within the scope of existing courses are carried

out under the supervision of a designated member of the departmental faculty.

EPS 761 - Ethics and Environmental Policy II (3 credits)

Presents a detailed investigation of the ethical bases of environmental policy decisions. Examines both theoretical philosophical arguments and practical case studies.

Environmetal Science : Offered by the Department of Chemical Engineering, Chemistry and Environmental Science

UNDERGRADUATE COURSES:

EvSc 375 - Environmental Biology (3-0-3)

An introductory ecological approach to understanding man's impact and dependence on the natural environment. Broad topics include ecosystems, nutrient cycles, pollution, pest management, conservation of natural resources, energy, and human population. Effective From: Spring 2006

EvSc 385 - Environmental Microbiology (3-0-3)

The main goals of this course are to present an overview of the important microbes involved in environmental microbiology, to discuss the environments where they are found, to learn how they are detected and monitored, and to describe their effects on humans. Traditional lectures and exams will be supplemented with discussions of experimental design and data interpretation by reading current research articles. Effective From: Spring 2006

EvSc 391 - Research and Independent Study (3-0-3)

Provides an opportunity to work on a research project under the individual guidance of a member of the department. Effective From: Fall 2008

EvSc 416 - Environmental Toxicology (3-0-3)

The course is intended to explore the general principles of toxicology and apply them to the assessment of acute, subacute and chronic effects of hazardous and toxic chemicals. Qualitative and quantitative measures of toxicity and testing protocols are addressed. The role of toxicology in risk assessment and risk management is discussed. Effective From: Spring 2006

EvSc 484 - Environmental Analysis (2-2-3)

The analysis of environmental samples is studied from the acquisition of representative samples, through sample handling, chain of custody, sample storage, analytical method selection, analysis, and data treatment. Effective From: Fall 2006

EvSc 492H - Honors Research and Independent Study II (3-0-3)

Provides an opportunity to work on a research project under the individual guidance of a member of the department. Effective From: Fall 2008

GRADUATE COURSES:

EvSc 592 - Graduate Work Experience (3 additive credits)

Prerequisite: permission of the associate chairperson for environmental science and the Division of Career Development Services. Provides on-the-job reinforcement of environmental science assignments. Projects are developed by the co-op office in consultation with the associate chairperson for environmental science. Cannot be used for degree credit.

EvSc 593 - Graduate Co-op Work Experience IV (0 credits)

Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

EvSc 600 - Environmental Science Seminar (Non-credit)

Prerequisite: graduate standing. Current environmental topics of interest to the environmental professional are presented. Required every semester for environmental science graduate students receiving departmental or research-based awards and for all doctoral students.

EvSc 602 - Special Topics in Environmental Science I (3 credits)

Prerequisite: approval of graduate advisor in environmental science. Topics of current interest in the environmental field.

EvSc 603 - Hazardous Waste Operations and Emergency Response (3 credits)

Explores the safe operation of hazardous waste sites as well as emergency responses to hazardous releases. Overview of OSHA regulations and NIOSH standards concerning toxicological hazards and medical surveillance requirements. Emphasis on recognition and monitoring of site hazards. A written health and safety plan, and participation in a group problem involving a simulated hazardous site entry using actual protective equipment is required. Course satisfies the regulatory compliance mandates to meet 29 CFR 1910.120 for OSHA, with certification valid for one year.

EvSc 610 - Environmental Chemical Science (3 credits)

Prerequisite: graduate standing. Principles of physical, inorganic and organic chemistry are applied to understanding the origins of environmental pollutants, their transport, distribution and decomposition pathways.

EvSc 611 - Hazardous Waste Management (3 credits)

Prerequisite: graduate standing. An overview of hazardous waste management; case histories; legislation and regulations; treatment, disposal and cleanup technologies; sampling and analysis methodology; persistence and fate in the environment; emergency response procedures.

EvSc 612 - Environmental Analysis (3 credits)

Prerequisite: graduate standing. The analysis of environmental samples is studied from the acquisition of representative samples, through sample handling, chain of custody, sample storage, analytical method selection, analysis, and data treatment.

EvSc 613 - Environmental Problem Solving (3 credits)

Prerequisite: graduate standing. This course is designed to study solutions for current environmental problems. Students are asked to respond to an imaginary Request for Proposal (RFP) in writing and before a team of technical experts at an oral presentation. Solutions proposed in student RFPs must reflect knowledge of environmental science and technology in current use.

EvSc 614 - Quantitative Environmental Risk Assessment (3 credits)

Prerequisite: graduate standing. Applications ofquantitative risk assessment concepts to the management of environmental problems.

EvSc 615 - Global Environmental Problems (3 credits)

Prerequisite: graduate standing. With an understanding that environmental problems are not restricted by geographical boundaries, relationships of the earth's temperature balance, global air circulation patterns, global energy needs, and control and remediation technologies are studied.

EvSc 616 - Toxicology for Engineers and Scientists (3 credits)

Prerequisite: graduate standing. The general principles of toxicology are presented and applied to the assessment of acute, subacute and chronic effects of hazardous and toxic chemicals. Qualitative and quantitative measures of toxicity and testing protocols are addressed. The role of toxicology in risk assessment and risk management is discussed.

EvSc 617 - Mass Spectrometry and Interpretation of Mass Spectra (3 credits)

Prerequisite: CHEM125 and CHEM126 or equivalent. Historical background, fundamentals and mechanics of operation for components incorporated into modern Mass Spectrometers: vacuum system, ion sources, mass filter, ion detection, plus computer operation and data collection. Explanation and interpretation of mass spectra and fragmentation patterns are a fundamental theme throughout the course. Lecture material includes principles of operation and appropriate applications for modern types of mass spectrometers: magnetic sector, quadrupole, time of flight, ion trap, FT-ICR. Theory and applications of electron impact, chemical, electrospray, and other ionization techniques including atmospheric sampling are covered. High resolution analysis using magnetic sector and FT - ion cyclotron instruments. Analytical applications in environmental, petroleum and biochemical analysis and applications and coupling of mass spectrometry with other instruments (GC, LC, AES,) are illustrated.

EvSc 624 - Environmental Analysis Methods and Laboratory (3 credits)

Basic theory, methods, instruments, and data interpretation for chemical analysis of environmental samples are described in lectures and used in the laboratory; sampling; sample preparation; quality assurance, chain of custody. Instrument methods and uses include: UV-VIS, FTIR, AA, HPLC, GC, Ion Chromatography, and Mass Spectrometry as applied to environmental samples.

EvSc 625 - Social Dimensions of Risk (3 credits)

Low-probability/high consequence events involving terrorism, food safety, and extreme weather offer ample evidence the prevalent approaches of economics and statistics are not able to deal with the complex ways that risk permeates modern societies. This course treats risk analysis as a broad interdisciplinary activity and draws on the full range of the social sciences to explore the multifaceted way that risk infuses itself into the fabric of contemporary affairs. Effective From: Spring 2007

EvSc 626 - Hydrogeology (3 credits)

This course covers the principles of ground water flow, advanced water cycle properties, aquifer flow and aquifer recharge. Contaminant migration and remediation methods are discussed. Basic groundwater chemistry and quality is covered. Effective From: Spring 2008

EvSc 700 - Master's Project (3 credits)
Prerequisite: graduate standing and approval of the graduate advisor in environmental science. Written report requiring experimental or theoretical research, or an extensive literature analysis. Registration must be approved by an advisor. Students must continue to register for 3 credits each semester until completion and a written report is accepted. Only a total of 3 credits will count toward the degree.

EvSc 701 - Master's Thesis (3 credits)
Prerequisite: matriculation for a master's degree in environmental science. Approval to register for the thesis must be obtained from the advisor. Original research under the supervision of a designated faculty member. The final product must be a written thesis approved by three faculty members: the student's primary advisor, another from the program and one other faculty member. Once registration for thesis has begun, a student must continue to register for a minimum 3 credits per semester until at least 6 credits have been completed and a written thesis is approved. Only a total of 6 credits will count toward the degree.

EvSc 702 - Special Topics in Environmental Science II (3 credits)
Prerequisite: approval of graduate advisor in environmental science. Topics of current interest in the environmental field.

EvSc 711 - Advanced Environmental Analysis (3 credits)
Prerequisite: EvSc 612 or equivalent. Analysis of complex environmental samples is studied, from the acquisition of representative samples, through sample handling, chain of custody, sample storage, analytical method selection, analysis and data handling. Collection and analysis of samples from air, water, soil, and biological systems will be discussed. Emphasis on the study of current literature.

EvSc 717 - Mass Spectrometry and Mass Spectral Interpretation (3 credits)
Prerequisite: CHEM125 and CHEM126 or equivalent. Chem 717 and Evsc 617 are comprised of Chem/Evsc 617 plus a research project: Research projects usually comprise experimental and mass spectrometry interpretation studies. These can be performed at NJIT or in the students corporate mass spectrometry facility. Projects may also include theory, data interpretation or literature reviews pertinent to a current active area in mass spectrometry research. Projects should be approved or in consult with the instructors.

EvSc 725 - Independent Study I (3 credits)
Prerequisite: written permission from the Associate Chairperson for Environmental Science plus courses prescribed by the supervising faculty member (who is not the student's thesis advisor). This special course covers areas of study in which one or more students may be interested, but which are not sufficiently broad to warrant a regular course offering. Students may not register for this course more than once with the same supervising faculty member.

EvSc 726 - Independent Study II (3 credits)
See description for EvSc 725.

EvSc 790 - Doctoral Dissertation (Credits as designated)
Required of all students working toward the degree of Doctor of Philosophy. A minimum of 36 credits is required. Approval of dissertation advisor is necessary for registration. Candidates must register for at least 6 credits of dissertation per semester until 36 credits are reached, and 3 credits per semester thereafter until a written dissertation is approved.

EvSc 791 - Graduate Seminar (Non-credit)
Required of all environmental science graduate students receiving departmental or research-based awards and all doctoral students. The student must register each semester until completion of the degree. Outside speakers and department members present their research for general discussion.

Epidemiology: Offered by the UMDNJ-New Jersey Medical School

GRADUATE COURSES:

EPI 615 - Introduction to Epidemiology and Control of Chronic and Infectious Diseases (3 credits)

Prerequisites: epidemiology core courses. Terminology; major causes; occurrence, distribution and dynamic behavior; epidemiologic concepts; epidemiology of selected diseases; investigation of outbreaks and epidemics; application to medicine (individual basis) and public health (community and population basis); implement levels of prevention and control.

EPI 616 - Advanced Topics in Infectious and Chronic Diseases Epidemiology (3 credits)

Prerequisites: epidemiology core courses, EPI 615. Utilizing practical and detailed examples, explores topically important issues in epide-miology to provide a framework for future self-learning and field research experiences. Applies principles to critically analyze relevant literature. Presents advanced, selected topics in depth with an emphasis on infectious disease epidemiology.

EPI 621 - Survey Research Methods/Questionnaire Design (3 credits)

Prerequisites: biostatistics, epidemiology, health information systems core courses. Introduces basics of survey research; provides skills necessary to conduct research. Conduct a one-page survey and present the results to the class as a final project.

EPI 625 - Community-Based Epidemiological Research (3 credits)

Prerequisites: epidemiology and biostatistic core courses. Investigate the epidemiology of a disease or an outbreak or risk factor(s) or any of the current public health issues. The investigation must warrant publication upon successful completion of the study; include detailed study in primary and secondary prevention of the selected topic; and requires review of relevant literature.

EPI 626 - Emerging and Re-emerging Infections (3 credits)

Covers the problem organisms and the various approaches to the problems from immunization and surveillance to attacking the societal variables that provide the setting in which these epidemics arise and flourish. Includes deliberately initiated infections (bioterrorism) and controversial partial solutions such as food irradiation.

EPI 627 - Innovations in Public Health (3 credits)

Includes some of the major historical approaches, current concepts (including control of illicit drug use, unusual community-based projects, use of large national cohorts) and potential future approaches; marketing of public health; appropriate, fiscally responsible screening; nutrition; and changes that will be created in public health innovations related to deciphering the genome.

EPI 628 - Pharmacoepidemiology (3 credits)

Prerequisites: epidemiology core courses, required track courses. Familiarization with methodological issues in pharmacoepidemiology; commonly used designs (e.g. cohort, case-referent); identification of main sources of bias in these designs; familiarization with tactics to deal with these biases. Students present for discussion proposals for pharmacoepidemiologic research.

EPI 629 - Oral Epidemiology of Chronic and Infectious Diseases (3 credits)

Provides an epidemiological overview of oral diseases. Topics include: clinical-decision analyses for the diagnosis, treatment, prevention and prognosis; research protocol; epidemiological data sources and clinical measurements; scientific papers; sampling techniques and research designs; descriptive and inferential statistics.

Financial Management: Offered by the School of Management

UNDERGRADUATE COURSES:

Fin 218 - Financial Markets and Institutions (3-0-3)

This course provides an overview of the main features of financial markets and institutions in the United States, including interest rates and rates of return and how they are determined. It also covers securities traded on the U.S. financial markets including bonds, stocks, and derivatives and discusses how financial institutions, especially commercial banks work, along with the role of government in regulating financial markets and institutions. Effective From: Fall 2009

Fin 315 - Fundamentals of Corporate Finance (3-0-3)

Prerequisites: Acct 115, Acct 116. This course focuses on how companies invest in real assets and how they raise the money to pay for those investments. Topics covered include the firm and the financial manager, time value of money, bonds, stocks, and net present value. International finance, risk management, capital structure strategy and case studies of technology-based companies will be introduced. Effective From: Fall 2008

Fin 401 - Securities in Financial Markets (3-0-3)

This course offers a quantitative approach to evaluating fixed income securities and to managing bond portfolios. Specific topics include: modern theory of bond pricing, pricing of high risk bonds, derivatives, and risk management. Effective From: Fall 2005

Fin 402 - Financial Risk Measurement and Management (3-0-3)

This course offers an in-depth analysis of the measurement and management of risk in financial markets. Topics include: assessing overall market risk, credit risk, liquidity risk, settlement risk, volatility risk, measuring portfolio risk, and extreme value risk. Effective From: Fall 2005

Fin 403 - Financial Statement Analysis (3-0-3)

This course offers comprehensive coverage of analysis of financial statements so that students can: a) evaluate the financial position of a firm; b) assess the firm's inherent value and the value of its securities; c) assess the firm's obligations and its ability to meet them; and d) analyze sources and uses of cash. Effective From: Fall 2005

Fin 404 - Financial Management Using ERP Systems (3-0-3)

Enterprise Resource Planning (ERP) systems are covered in-depth as tools for increasing a firm's profitability, reducing its costs, and for improving its competitiveness. ERP platforms from PeopleSoft and Microsoft as used throughout the course to demonstrate financial management using integrated, firm wide information systems. Effective From: Fall 2005

Fin 416 - Advanced Corporate Finance (3-0-3)

Prerequisite: Fin 315. Advanced corporate finance with an emphasis on the financial management of technology-based organizations. Case studies are used for comparative analysis. Emphasis is on organizational productivity and profitability. Effective From: Summer 2008

Fin 422 - International Finance (3-0-3)

Prerequisite: Fin 315. Introduction to the international financial management of the firm with an emphasis on technology-based organizations. Topics covered include hedging currency risk, capital budgeting internationally, raising funds internationally. Global competitiveness is addressed with comparative analysis of the financial management practices of American, European and Japanese firms.

Fin 423 - Risk Analysis (3-0-3)

Prerequisite: Fin 315. The management of risk in the business enterprise. Topics include meas-urement of risk and hedging strategies, sources of liability, property and liability insurance, and insurance administration.

Fin 430 - Options and Futures Markets (3-0-3)

Prerequisites: Fin 315 and Math 135 (or Math 138, Math 111, Math 113). This course covers options, forward contracts, futures contracts and swaps, and will give students a working knowledge of how these contracts work, how they are used, and how they are priced. Students will learn how corporations and portfolio managers can hedge different kinds of risks or alter the distribution of returns on their portfolios using various techniques. Effective From: Fall 2009

Fin 485 - Special Topics in Finance (3-0-3)

The study of new and/or advanced topics in the various fields of business and their application not regularly covered in any other business course. The precise topics to be covered, along with prerequisites, are announced in the semester prior to the offering of the course. Effective From: Fall 2009

R390:315 - Investments (3)

For more details go to Rutgers Catalog.

R390:329 - Finance (3)

For more details go to Rutgers Catalog.

R390:386 - Futures and Options (3)

For more details go to Rutgers Catalog.

GRADUATE COURSES:

Fin 516 - Principles of Financial Management (3 credits)

Fundamentals of financial management divided into two segments: investment and corporation finance.

Fin 600 - Corporate Finance I (3 credits)

This course introduces concepts and analytical tools to identify and solve Financial Management problems. After introducing the corporation, the course focuses on how firms invest in real assets (capital budgeting) and how they raise money to pay for assets (financing). Practical problems in valuing bonds, stocks and other investments will be based on the time value of money. The trade-off between risk and return will be introduced with the Capital Asset Pricing Model. Effective From: Fall 2009

Fin 610 - Global Macro Economics (3 credits)

Fin 610 is an introductory graduate course for entering master's students that will also be taking other core Master's courses such as accounting. The course introduces various concepts relating to macroenomics and the financial environment from both a theoretical and institutional perspective. Thus fiscal and monetary policy and actions are covered but are taught using a macroeconomic model that helps identify how particular actions affect the money and goods economies as well as specific financial institutions. Effective From: Spring 2010

Fin 618 - Public and Private Financing of Urban Areas (3 credits)

Ties government's budget, tax policy, allocation of resources between public and private sectors, with the structure, development, and growth needs of urban metropolitan areas. Focuses on problems of poverty, transportation, land-use, economic base, relation between central cities and suburban areas, and alternative engineering and economic solutions. Same as MIP 618 and Tran 604.

Fin 624 - Corporate Finance II (3 credits)

Fin 600 is a prerequisite. The trade-off between risk and return will be examined in the context of historical analysis, portfolio optimization, the Capital Asset Pricing Model and other alternative models. The course will begin with the understanding of the Modigliani and Miller results and introduce bankruptcy, taxes, information asymmetries and other market imperfections. Financial options, put-call parity and option pricing will be introduces. Effective From: Fall 2009

Fin 626 - Financial Investment Institutions (3 credits)

Prerequisite: Fin 516. Introduces the role of banking institutions and investment banks in the domestic and international money market and capital environment to the financial managers. Covers instruments and services of financial intermediaries that are crucial to business management. Discussions range from the financial services and facilities of regional banks to money-center banking institutions. Alternatives of project financing, lending requirements and regulations, project financing, and role of intermediaries in local and international transactions. Focuses on the private placement procedures of all types of securities in the capital market and the unique role undertaken by the investment banking firms. Provides an insight about the public offering process for existing and venture capitalized firms.

Fin 627 - International Finance (3 credits)

Prerequisite: Fin 516. Examines financing of exports and imports, managing multicurrency working capital, international aspects of capital budgeting, cost of capital and their relationship with political, economic, and financial risk. Explores financial innovations and their impact on the firm's financial strategy and performance of overall productivity. Discusses the tax consequences and principal-subsidiary relationship of the multinational enterprise. Introduces international money and capital markets, instruments, derivatives, and institutions.

Fin 630 - Applied Business Econometrics (3 credits)

Introduces methodological development of quantitative tools essential to modern managers. Includes sampling distribution, hypothesis testing, nonparametric statistics, and simultaneous regression models. Centers on application setting with statistical results providing insights into management decisions.

Fin 631 - Working Capital Management and Credit Analysis (3 credits)

Prerequisite: Fin 516. Optimal management of a firm's working capital, such as cash, marketable securities, receivables, and inventories with an emphasis on the institutional background and environmental modeling. Deals with cash flow analysis, the assessment of financial needs, and selecting the appropriate domestic and international sources for meeting a firm's credit needs.

Fin 632 - Financial Valuation of Technology-Based Companies (3 credits)

Prerequisite: Fin 516. Concentrates on techniques and procedures of assessing, managing, and forecasting value of alternative corporate and business level strategies of companies with emphasis on technology-based companies. These strategies include new product introduction, joint venture agreements, new market entries, and capital expenditures.

Fin 634 - Mergers, Acquisitions, and Restructuring (3 credits)

Prerequisite: Fin 516. Focuses on identifying and evaluating potential and international companies for mergers and acquisitions as well as structuring of deals. The financial, social and managerial implications of these changes in corporate ownership will be examined. Topics are: financing M&As, deal structuring, tax implications, valuation, broker/finder agreements, merger negotiations, and post-merger integration.

Fin 641 - Derivatives Markets (3 credits)

Prerequisites: A basic introductory coures in Finance at the undergraduate or graduate level (e.g., FIN 315 or FIN 600), one year of calculus (at the level of Math 112), probability and statistics, and permission of the instructor. This course introduces students to futures, options, and other derivative securities. Topics include option valuation models, principles of forward and futures pricing, structure of markets for derivative securities, and strategies for hedging and speculation. Effective From: Fall 2009

Fin 642 - Derivatives and Structured Finance (3 credits)

Prerequisites: Finance 641. This is a second course in the instruments created by modern financial engineering. It continues the study of derivatives from Fin 641 (Derivatives Markets), covering additional types of options and of underlying assets. The second part of the course is devoted to structured finance, including securities backed by mortgages and other types of assets. Effective From: Spring 2010

Fin 643 - Term Structure of Interest Rates (3-0-3)

Prerequisites: FIN 642(Derivatives and Structure Finance), Math 605 (Stochastic Calculus). This course provides the student with a basic understanding of models of the term-structure of interest rates and the pricing of derivatives on bonds and other interest-rate-based securities. Topics covered include arbitrage-free pricing principles, continuous-time interest-rate models, no-arbitrage term structure models, multifactor models, forward measure approach, market models and model calibration. Effective From: Spring 2010

Fin 644 - Credit Risk Modeling (3-0-3)

Prerequisites: FIN 643 (Term Structure of Interest Rates), Math 605 (Stochastic Calculus). This course covers types of credit risk, measurement of credit risk, and methods for changing exposure to credit risk using credit derivatives. Current models for pricing credit derivatives will be analyzed and applied. Effective From: Fall 2011

Fin 650 - Investment Analysis and Portfolio Theory (3 credits)

This is a basic course in the theory and practice of investing. We will study in depth why and how to form portfolios of securities. A significant amount of mathematical and statistical analysis will be used in answering these questions. Theories of asset pricing based on the relationship between risk and return will be included. We will also discuss criteria for selecting specific securities in different asset classes, such as, stocks, bonds, and derivatives. Effective From: Fall 2009

Fin 660 - Financial Planning and Decision Making (3 credits)

Prerequisite: Fin 624. This course introduces the in-depth qualitative and quantitative analysis of the short-term and long-term investment and financing decisions in an uncertain environment. The course emphasizes a quantitative analysis (simulation model) and case studies that deal with actual business decisions and challenges. Students are assigned to competing financial management teams in order to develop financial planning and decision making expertise.

Fin 700 - Seminar in Theory and Research in Financial Management (3 credits)

Prerequisites: Fin 624 or Fin 626. Only open to those students who do not do a thesis. The theory and applied tools of financial management. Presented in seminar format with several students working as a team to analyze and resolve an issue in financial management.

Fin 701 - Thesis in Financial Management (6 credits)

Prerequisites: Fin 624 or Fin 626; waived with approval of the assistant dean for graduate programs. Examines:What is research? Why do research? What are the objectives of research? Covers the need for research, criteria for good research and research design, concept of measurement, sampling design, primary data collection, experimentation and simulation, statistical and other types of analysis, and reporting of research findings.

Geology: Offered by the Department of Geological Sciences at Rutgers-Newark

UNDERGRADUATE COURSES:

R460:103 - Planet Earth (3)
For more details go to Rutgers Catalog.

R460:104 - Planet Earth Laboratory (1)
For more details go to Rutgers Catalog.

R460:106 - Environmental Geology (3-0-3)
For more details go to Rutgers Catalog.

R460:206 - Environmental Geology (3)
For more details go to Rutgers Catalog.

R460:207 - Environmental Geology Laboratory (1)
For more details go to Rutgers Catalog.

R460:309 - Geomorphology (3)
For more details go to Rutgers Catalog.

R460:311 - Geologic Field Problems (3)
For more details go to Rutgers Catalog.

R460:320 - Structural Geology (4)
For more details go to Rutgers Catalog.

R460:321 - Mineralogy (4)
For more details go to Rutgers Catalog.

R460:406 - Applied Geophysics (3)
For more details go to Rutgers Catalog.

R460:427 - Hydrogeology (3)
For more details go to Rutgers Catalog.

GRADUATE COURSES:

R460:577 - Seminar in Environmental Geology (3 credits)
For more details go to Rutgers Catalog.

History: Offered by the Federated History Department of NJIT and Rutgers-Newark

UNDERGRADUATE COURSES:

Hist 125 - Mapping Human History (3-0-3)
An introduction to the relationship of time and space in human history, using selected case studies drawn from a wide range of historical periods and places. Students learn to read and use maps, with a particular emphasis on the critical examination of evidence.

Hist 213 - The Twentieth-Century World (3-0-3)
Prerequisite: HUM 101. Uses case studies to provide an interdisciplinary view of the 20th-century world. Selected literary, philosophical, and artistic movements are discussed in the context of the major historical developments of the century. This course satisfies three credits of the GUR in Cultural History.

Hist 334 - Environmental History of North America (3-0-3)
Prerequisites: Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. The history of interactions between humans and their natural environment on the North American Continent. Considers perceptions of, use of, and alteration of the environment. Traces the cultural, intellectual, economic, political and technological transformations from early colonial times to the late 20th century. Addresses the diverse environmentalisms that have emerged the last several decades.

Hist 341 - The American Experience (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. American history from the colonies to the 20th century, with concentration on several selected themes basic to an understanding of the changing cultural patterns and social values of American civilization.

Hist 343 - African-American History I (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Introduction to African-American history from pre-colonial West Africa to emancipation in the mid-19th century. Topics include the African slave trade, the economics and politics of slavery, gender and culture in the slave community, and the free black experience in both the north and south.

Hist 344 - African-American History II (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Introduction to African-American history from the mid-19th century to the present. Covers race relations and the civil rights movement, as well as migration, black social and political thought, gender roles, and class formation.

Hist 345 - Communication through the Ages (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Modes of communication, ancient and modern, in their social and cultural context?from cave painting to computers. Topics include literacy and economic development in the West; the technological revolution in media beginning with Daguerre, Samuel Morse, and Alexander Graham Bell; the institutional development of mass media and popular culture; and contemporary trends in world communication and interaction.

Hist 351 - Ancient Greece and the Persian Empire (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. The political, institutional, and cultural developments of Ancient Greece and the Persian Empire from the Mycenaean period to the King's Peace (386 B.C.).

Hist 352 - The Hellenistic States and the Roman Republic (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. The political and cultural developments of the Hellenistic states and their influence on the Republic of Rome to 30 B.C.

Hist 359 - History of the Middle East I (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. The political, cultural, and

institutional developments in the Middle East from the Parthians to the capture of Constantinople by the Ottoman Turks. Four periods will be analyzed: the Parthian, the Sassanid Persian, the Caliphate, and the Seljuk and Ottoman Turks.

Hist 360 - History of the Middle East II (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. The political, cultural, and institutional developments in the Middle East from the capture of Constantinople by the -Ottoman Turks to the impact of the Arab-Israeli conflict on the world today.

Hist 361 - The Founding of the American Nation (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. North America in the colonial and revolutionary periods, with emphasis on patterns of cultural and institutional development from early settlement through the ratification of the Constitution.

Hist 363 - The United States as a World Power (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. American domestic and foreign policy in the 20th century. Topics include imperialism, the Progressive Era, the Depression, the New Deal, World Wars I and II, the Cold War, America and the world today.

Hist 365 - Comparative Colonial History (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. A comparative analysis of the relationship between expanding Western nations and selected regions of Africa, Asia, and South America, from 1500 to 1970. A case study approach illuminates key historical processes, with a special emphasis on economic development and cultural change in colonial settings. Topics include European perceptions of culturally different peoples, race relations in colonial societies, forms of rebellion and resistance to European rule, nationalist movements.

Hist 366 - Gender, Race and Identity in American History (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Surveys the social construction of gender in America from the s17th century to the present. Examines the changing gender roles and relations that have characterized and structured the historical experiences of different racial and ethnic groups. In a multicultural framework, covers the impact that colonization, industrialization, slavery, immigration and migration, urbanization, war, and social movements have had on the ways that women and men think of themselves in terms of gender as well as their respective roles in families and larger social networks.

Hist 367 - International Law and Diplomacy in History (3-0-3)
Prerequisites: HUM 101, and two (2) from HUM 102, HUM 211, HUM 212, Hist 213. Examines the origins, evolution, and application of diplomacy and international law from the 15th century to the present. Topics include the rise of modern diplomacy in Renaissance Italy; the emergence of international law and professionalization of diplomacy in early modern Europe; the development of international law and diplomatic theory in the 18th and 19th centuries; the codification of international law; and adaptation of international law to transnationalism and globalism in the 20th century. Effective From: Spring 2009

Hist 368 - Comparative Economic History (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. A comparative analysis of the history of economic development, with particular attention to industrialization, shifting patterns of global trade, and changing labor markets. Topics include the Industrial Revolution, the rise of the world economy, the transformation of non-Western economies, labor migration, and newly industrializing countries.

Hist 369 - Law and Society in History (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Uses historical case studies to illustrate and evaluate various approaches to the study of law and society. Topics include criminality and the rise of incarceration as a legal penalty in the 19th century; the comparative law of slavery; and the evolution of American Indian law.

Hist 370 - Legal issues in the History of Media (3-0-3)
Investigates the development and impact of media law and policy in the United States. Examines how media law and policy affect media content, industry behavior, and consumer rights. Analyzes the values and ideas, as well as political and cultural contexts, that have guided continuities and transformations in media law and policy. Topics include indecency and obscenity, copyright and intellectual property, legal protections for children, and media ownership regulation. Effective From: Fall 2008

Hist 372 - Contemporary Europe (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. European society in the 20th century, Nationalism, imperialism, totalitarianism, movements toward European unity, and prominent cultural developments.

Hist 373 - The Rise of Modern Science (3-0-3)
Prerequisites: HUM 101 and two (2) from HUM 102, HUM 211, Hum 212, Hist 213 or their equivalents. Examines the development of modern science in the western world from the origins of the Scientific Revolution to 1900. Explores how science challenged the revealed universe of Christianity, changed the curriculum in schools and universities, and altered the world view of philosophers. This course covers the achievements of Copernicus, Galileo, Newton, Darwin, Einstein, and other leading scientific innovators, but it also weaves the expansion of scientific knowledge into the larger fabric of European intellectual history. Effective From: Spring 2009

Hist 374 - Modern Russian Civilization (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Russia under the last tsars, the 1917 upheavals, rise of the Soviet state to world power under Lenin, Stalin, and others, until the collapse of the communist dictatorship.

Hist 375 - Legal Issues in Environmental History (3-0-3)
Examines the role of law in the formation of human relationships with the natural world. The course will focus on the management and regulation of the human use of natural resources in a variety of historical contexts, but particularly in the United States from colonial times to the present. Through readings and class discussion, students will explore a number of recurring themes, including the transformation from customary rules governing access to local resources to state enforced laws. Effective From: Fall 2008

Hist 377 - Cities in History (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Examines social, cultural and economic changes in urban areas. Regions and themes vary and may include urbanization in Europe, the rise of cities in Latin America, and urban change in contemporary America.

Hist 378 - Medicine and Health Law in Modern America (3-0-3)
Examines the legal and ethical aspects of medical and public health practice in the United States from 1900 to the present. Topics include the rights and responsibilities of physicians and patients, the roles of government in promoting health, the rise of health law and bioethics, the tensions between civil liberties and public health, as well as evolving notions of harm, liability, uncertainty, and proof as they relate to the history of medical and public health practice. Effective From: Fall 2008

Hist 379 - History of Medicine (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Focuses on the evolving institutions, values, concepts, and techniques through which doctors attempted to control the impact of disease and preserve the health of Americans, beginning with the shaman and colonial physician through post-World War II changes in the system of medical care.

Hist 380 - History of Public Health (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Attempts to protect the health of human populations from the Black Death in medieval Europe to recent threats from epidemics and chemical and biological terrorism. Shiftings patterns of disease and the emergence and growth of public health as a domain of expert knowledge and policy. Topics include: epidemiology and statistical modes of inquiry; the tension between civil liberties and public health; the economics of health and disease; and the relationship between medicine and public health.

Hist 381 - Germs Genes & Body: Sci. & Tech. in Modern Medicine (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Examines how science and technology came to play critical roles in the rise of modern medicine. Readings, lectures, and discussion focus on the specific innovations in ideas, practices, and technologies that helped transform Western medicine in the 19th and 20th centuries. The course also considers how medicine and the biomedical sciences both inform and reflect attitudes about the human body in Western society. Effective From: Spring 2005

Hist 382 - War and Society (3-0-3)
Prerequisites: HSS 101, HSS 202 or their equivalents; two from HSS 211, HSS 212, HSS 213 or their equivalents.The evolution of warfare and the impact of war on political, economic, cultural, and social institutions, including the two World Wars and post-1945 conflicts.

Hist 383 - The Making of Modern Thought (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. The formation of contemporary images of human nature since the mid-19th century. Emphasis on Marx, Darwin, and Freud and their legacy to 20th century thought. Theories of the family, sexuality, and the changing role of women in society are explored.

Hist 385 - Technology and Society in European and World History (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. An introduction to the social history of European and global tech-nology from the Middle Ages to the second Industrial Revolution of the late 19th century. Emphasis on such themes as the process of tech-nological innovation, the nature of technological systems, the diffusion of technology, the interaction of Western and non-

Western technology, the changing relations of science and technology, and the role of technology in broader historical movements.

Hist 386 - Technology in American History (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. Survey of the history of American technology emphasizing the social and economic environments of technological change. Topics include the transfer of technology in building canals and cities, the rise of the factory system, the emergence of the American system of manufacture, and the development of major technological systems such as the railroad, telegraph, electric light and power, and automobile production and use. Focus on the professionalization of engineering practice, the industrialization of invention, and the growing links between engineers and corporate capitalism in the 20th century.

Hist 388 - Britain in the 20th Century (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. A survey of British history from the death of Queen Victoria to 1964 with emphasis on the social and political trans-formation resulting from Britain's declining economy and world position. Topics include: the causes and impact of the two World Wars, the transition from liberal democracy to welfare state, the turn from Empire to Europe, social and economic trends as well as foreign -relations.

Hist 390 - Historical Problems of the 20th Century through Film (3-0-3)
Prerequisites: HUM 101 and two from among HUM 102, HUM 211, HUM 212 and Hist 213 or their equivalents. A study of selected problems in the 20th century using film as a ?window into history.? Such topics as the rise of Nazi Germany, America in the thirties, World War II and American society, the development of cities, and the emergence of the ?Third World? will be considered. In any one semester only two topics will be selected for study. The material for the course will include documentary films, newsreels, TV news films, and theatrical feature films as well as selected readings.

Hist 401, 402 - Independent Studies in History (1-0-1, or 2-0-2, or 3-0-3)
Prerequisites: junior or senior standing; and before registering, permission from one of the following: NJIT history department chairperson, associate chairperson or history minor advisor. Pursuit of special interests in history not covered in a regular elective course. A history faculty member provides guidance and assigns readings and papers.

Hist 489H - Senior History Honors Seminar: Readings (3-0-3)
Prerequisites: HSS 101, HSS 202 or their equivalents; two from HSS 211, HSS 212, HSS 213 or their equivalents. Limited to senior history majors who are enrolled in the Albert Dorman Honors College or who receive permission from the undergraduate history advisor. Meets with 510:489 but includes more advanced readings. Effective Until: Fall 2007

Hist 490H - Senior History Honors Seminar: Research (3-0-3)
Prerequisites: HSS 101, HSS 202 or their equivalents; two from HSS 211, HSS 212, HSS 213 or their equivalents. Limited to senior history majors who are enrolled in the Albert Dorman Honors College or who receive permission from the undergraduate history advisor. Meets with 510:490 but includes more rigorous research and writing requirements. Effective Until: Fall 2007

R510:201-202 - History of Western Civilization (3,3)
For more details go to Rutgers Catalog. Effective Until: Fall 2007

R510:249 - An Introduction to China (3)
For more details go to Rutgers Catalog.

R510:317 - History of the Caribbean (3)
For more details go to Rutgers Catalog.

R510:321 - Military History of the Western World (3)
For more details go to Rutgers Catalog.

R510:325 - History of Mexico and Central America (3)
For more details go to Rutgers Catalog.

R510:333 - History of Imperialism (3)
For more details go to Rutgers Catalog.

R510:334 - 20th-Century Fascism (3)
For more details go to Rutgers Catalog.

R510:337 - The History of Iran (3)
For more details go to Rutgers Catalog.

R510:338 - The Ottoman Empire (3)
For more details go to Rutgers Catalog.

R510:340 - Women in European History (3)
For more details go to Rutgers Catalog.

R510:346 - Medieval Legal History (3)
For more details go to Rutgers Catalog.

R510:355 - Traditional China: Institutions and Society (3)
For more details go to Rutgers Catalog.

R510:356 - History of the People's Republic of China (3)
For more details go to Rutgers Catalog.

R510:361 - The Near and Middle East (3)
For more details go to Rutgers Catalog.

R510:364 - Contemporary Issues in Puerto Rican History (3)
For more details go to Rutgers Catalog.

R510:366 - History of Poland (3)
For more details go to Rutgers Catalog.

R510:369 - Modern Eastern Europe (3)
For more details go to Rutgers Catalog.

R510:370 - History of Modern Ukraine (3)
For more details go to Rutgers Catalog.

R510:373 - The English Novel in History (3)
For more details go to Rutgers Catalog.

R510:379 - Colonialism and Decolonization (3)
For more details go to Rutgers Catalog.

R510:380 - History of the Mass Media in Europe (3)
For more details go to Rutgers Catalog.

R510:394 - The Peoples and Cultures of Central Asia (3)
For more details go to Rutgers Catalog.

R510:399 - Tudor-Stuart England (3)
For more details go to Rutgers Catalog.

R510:401 - Topics in European History (3)
For more details go to Rutgers Catalog.

R510:402 - History of Spain and Portugal (3)
For more details go to Rutgers Catalog.

R510:403 - Topics on Social History (3)

For more details go to Rutgers Catalog.

R510:404 - Topics in Intellectual History (3)
For more details go to Rutgers Catalog.

R510:433 - Topics in Islamic History (3)
For more details go to Rutgers Catalog.

R510:435 - Topics in Medieval and Early Modern History (3)
For more details go to Rutgers Catalog.

R510:458 - Topics in Women's History (3)
For more details go to Rutgers Catalog.

R510:461 - Topics in Comparative History (3)
For more details go to Rutgers Catalog.

R510:497 - Honors Project: History (3)
For more details go to Rutgers Catalog.

R510:499 - Individual Study in Historical Research, Non-American(BA) (null)
For more details go to Rutgers Catalog.

R512:201-202 - Development of the United States (3,3)
For more details go to Rutgers Catalog. Effective Until: Fall 2007

R512:303 - Topics in the History of Newark (3)
For more details go to Rutgers Catalog.

R512:311 - Colonial America (3)
For more details go to Rutgers Catalog.

R512:318 - Labor History (3)
For more details go to Rutgers Catalog.

R512:330 - History of American Immigration (3)
For more details go to Rutgers Catalog.

R512:337 - History of the Family in the United States (3)
For more details go to Rutgers Catalog.

R512:343 - The Creation of the American Republic (3)
For more details go to Rutgers Catalog.

R512:344 - The Democratic Age in American History: 1820 - 1880 (3)
For more details go to Rutgers Catalog.

R512:349 - Antebellum Reform Movements (3)
For more details go to Rutgers Catalog.

R512:367 - The Age of the Corporation: 1880?1920 (3)
For more details go to Rutgers Catalog.

R512:368 - Modern America (3)
For more details go to Rutgers Catalog.

R512:369 - America in World War II and the Postwar Period (3)
For more details go to Rutgers Catalog.

R512:371 - Contemporary America (3)
For more details go to Rutgers Catalog.

R512:383 - United States Foreign Policy in the Era of the Cold War (3)
For more details go to Rutgers Catalog.

R512:402 - Topics in American Intellectual History (3)
For more details go to Rutgers Catalog.

R512:403 - Topics in American Political History (3)
For more details go to Rutgers Catalog.

R512:404 - Topics in American Business and Economic History (3)
For more details go to Rutgers Catalog.

R512:405 - Topics in the History of Science (3)
For more details go to Rutgers Catalog.

R512:408 - Topics in American Social and Cultural History (3)
For more details go to Rutgers Catalog.

R512:410 - Topics in the History of American Foreign Policy and Diplomacy (3)
For more details go to Rutgers Catalog.

R512:438 - Internship: Administration of Historical Manuscripts (3)
For more details go to Rutgers Catalog.

R512:452 - Topics in Legal History (3)
For more details go to Rutgers Catalog.

R512:462 - Topics in Recent American History (3)
For more details go to Rutgers Catalog.

R512:472 - Topics in Afro-American History (3)
For more details go to Rutgers Catalog.

R512:473 - Topics in Women's History (3)
For more details go to Rutgers Catalog.

R512:499 - Readings in American History (3)
For more details go to Rutgers Catalog.

GRADUATE COURSES:

Hist 620 - City and Disease in History (3 credits)
Explores the dynamic interaction between the growth of cities and changes in the experience and location of disease. Presumes the intertwining of these two historical developments in the birth of a distinctly urban identity, one predicated on the notion that the modern city is somehow inherently diseased. Focuses on the New York and Newark metropolitan areas in the nineteenth and twentieth centuries. Among the topics considered are epidemic outbreaks, quarantines, the technology and organization of sanitation and hygiene, the professional formation of public, industrial and occupational medicine, and medical and popular responses to immigration.

Hist 622 - Culture and Science in the History of American Medicine (3 credits)
Provides an overview of American medical history and a familiarity with the theoretical and practical ramifications of different approaches to the complex relationships between medicine, science, and culture. Topics include: the extent to which medicine is or has been scientific; reasons why science has been considered so important to medicine's professional culture; and the degree to which medicine's professional culture has been shaped by science as well as other factors, such as economic and political self-interest, technology, class, race, gender, and other kinds of cultural values.

Hist 624 - Technology, Environment and Medicine in World History, 1500-1900 (3 credits)
Examines the interrelationship between the emerging modern world system and changes in technology, environment, and medicine, with particular emphasis on European overseas expansion and its impact in non-Western regions.

Hist 626 - Social History of American Medicine Since 1800 (3 credits)
Topics include the practices of 19th-century ?regular? medicine; the relation between medical concepts and mainstream social thought; the treatment of women's health; antebellum alternative healers and alternative politics; the triumphs of late 19th- and early 20th-century medical therapeutics; the emergence of medicine as big business; medicine and racism; the emergence of nursing as a profession; modern medicine in an international perspective; New Age healing; the AIDS crisis and AIDS activism; and contemporary debates on the future of health care in the United States.

Hist 628 - Gender, Science and Technology in the Modern World (3 credits)
Introduction to a wide range of political and cultural analyses of science and technology, with an emphasis on recent feminist critiques of science. Explores the questions of scientific neutrality; the gendering of scientific knowledge; the relationship between science, technology, and capitalism; the role of science in international politics; and why science has not freed women.

Hist 630 - History of the Body in Modern Western Culture (3 credits)
Considers medical or scientific history primarily in terms of implications for bodily experience in everyday life. Begins with grand narratives of historical shifts in bodily perceptions and practices, and proceeds to more focused narratives of changing bodily experience, engaging key distinctions between genders, classes, and species as well as perceptions of pain and internal bodily structure. Materials will be drawn from early modern and modern Europe, as well as more recent bodily experience in the United States.

Hist 632 - Technology, Culture and History (3 credits)
Treats the relationship between technology and cultural values in a variety of historical and geographical settings, from early modern Japan to twentieth-century America. Examines the ways in which cultural ideals, conceptions, and preconceptions serve to influence the rate and manner of technological change, as well as the ways in which technology affects social and cultural life.

Hist 634 - Environmental History of North America (3 credits)
Explores the dialogue between humankind and the environment in North America over the course of the last four centuries. Examines the latest and most interesting work done in the new field of environmental history to see what such a perspective has to offer.

Hist 635 - History of Technology, Environment and Medicine: Theory and Method (3 credits)
A team-taught course which surveys the methods employed in the three fields. Explores the interdisciplinary nature of each field, and the value of interdisciplinary scholarship.

Hist 638 - Social History of Communication (3 credits)
Treats selected themes in the history of communication in different social and cultural contexts, from the ancient world to the twentieth century. Topics include: orality, proto-literacy, and literacy in ancient and medieval cultures; printing and the development of print culture in the early modern world; the ?communication revolution? of the late 19th and early 20th centuries; and historiographical debates over the role of communication technologies in society.

Hist 640 - The Urban Environment (3 credits)
Examines the role of the economy, culture, and technology in shaping the urban environment. Makes extensive use of Newark and the New York metropolitan area, including field observations and local research. In addition to other topics, explores in detail spatial relationships, the role of transportation, and the development of suburbia.

Hist 642 - The History of Health and International Development (3 credits)
This course examines the history of western efforts to promote health and nutrition in the 'developing world" from the beginnings of tropical medicine. We will trace this history through its many permutations from the establishment of colonial health services to the development of the Global Programme on AIDS. In doing so, we will explore the various economic and political interests and underlying cultural assumptions that have shaped the development of ideas and practices associated with international health and development.

Hist 644 - War, Technology and Society, 1500-1914 (3 credits)
Examines key themes in the interrelationship between warfare, technology and society from the beginnings of modern warfare until World War I. Primary emphasis placed on the historical connections between violent conflict, the technical means by which it is carried out, and the socio-political environment within which wars take place. The effect of technology upon war and considerations of the effect of war on technological change and development. Samples the rich tradition of thought and ideas produced by philosophers and theorists on these themes.

Hist 701 - Master's Thesis (6 credits)
Prerequisite: permission of graduate history advisor. For students writing a master's thesis in the history of technology, environment and medicine.

Hist 725, Hist 726, Hist 727 - Independent Study in History (3 credits)
Prerequisites: permission of graduate history advisor and course instructor.

Hist 791 - Seminar in History of Technology, Environment and Medicine (Non-credit)
Faculty, students and invited speakers present and discuss current topics of research in history, technology and medicine.

R510:520 - Topics in the History of Technology (3 credits)
For more details go to Rutgers Catalog.

R510:525 - Colloquium in the History of Women (3 credits)
For more details go to Rutgers Catalog.

R510:526 - Problems and Readings in Afro-American History (3 credits)
For more details go to Rutgers Catalog.

R510:547 - Comparative World Colonialism (3 credits)
For more details go to Rutgers Catalog.

R510:548 - Topics in the History of the American Environment (3 credits)
For more details go to Rutgers Catalog.

R510:559 - Cities in Change I (3 credits)
For more details go to Rutgers Catalog.

R510:560 - Cities in Change II (3 credits)
For more details go to Rutgers Catalog.

R510:566 - American Historiography (3 credits)
For more details go to Rutgers Catalog.

R510:569 - American Legal History to 1860 (3 credits)
For more details go to Rutgers Catalog.

R510:570 - Topics in American Legal History (3 credits)
For more details go to Rutgers Catalog.

R510:571 - Introduction to Historical Method (3 credits)
For more details go to Rutgers Catalog.

R510:572 - Philosophy of History (3 credits)
For more details go to Rutgers Catalog.

R510:576 - Problems and Readings in American History, 1492-1789 (3 credits)
For more details go to Rutgers Catalog.

R510:577 - Problems and Readings in American History, 1789-1865 (3 credits)
For more details go to Rutgers Catalog.

R510:581 - Problems and Readings in American History, 1865-1912 (3 credits)
For more details go to Rutgers Catalog.

R510:583 - Problems and Readings in American History, 1912-1945 (3 credits)
For more details go to Rutgers Catalog.

R510:585 - Problems and Readings in American History, 1945 to Present (3 credits)
For more details go to Rutgers Catalog.

R510:618 - Seminar: Teaching of History (3 credits)
For more details go to Rutgers Catalog.

R510:669 - Business and Government in the Twentieth Century I (3 credits)
For more details go to Rutgers Catalog.

R510:670 - Business and Government in the Twentieth Century II (3 credits)
For more details go to Rutgers Catalog.

R510:695 - Individual Studies in History (3 credits)
For more details go to Rutgers Catalog.

R510:696 - Advanced Individual Studies in History (3 credits)
For more details go to Rutgers Catalog.

Human Resource Management : Offered by the School of Management. See Management course list for faculty.

UNDERGRADUATE COURSES:

HRM 301 - Organizational Behavior (3-0-3)
Prerequisite: upper division standing. A foundation course in individual and group behavior in organizations. Processes such as perception, motivation and leadership are examined with a focus on issues central to technology-based organizations (innovation, creativity, managing technical professionals).

HRM 303 - Human Resources Management (3-0-3)
Covers basic human resources concepts including recruitment, selection, EEO, training, labor relations, and human resources information systems. Human resources management practices in technology-based firms are studied in detail.

HRM 305 - Supervision and Employee Relations (3-0-3)
The nature of supervision, particularly at the first line. Qualifications, duties, and responsibilities of supervisors. Planning the job, making work assignments, progressing, and controlling employees. Techniques of employee relations, such as conducting job instruction, maintaining discipline, appraising performance, and handling grievances. The supervisor's interrelationships with upper management and labor union representatives. The conference method and case study techniques are utilized.

HRM 310 - Managing Diversity in Organizations (3-0-3)
Analyzes issues that arise in managing a diverse work force. After examining the demographic environment of contemporary organizations, significant attention is paid to developing strategies to recruit, train, motivate, and retain employees with diverse personal characteristics. While the emphasis is on developing broad-based interpersonal skills, the impact of federal and state laws and regulations is also studied. In addition, students examine the implications of technological developments for managing a diverse population (e.g., the use of new technologies in retaining the differently abled).

HRM 311 - Job and Work Environments (3-0-3)
Prerequisite: HRM 301. The effect of job and work environments on the individual and on the organization. Covers fit between the worker and the workplace including issues such as: the micro environment of job layout and design, physical conditions of the workplace, the social environment of work, and macro environments of the workplace within a regional context.

HRM 407 - Social Insurance and Employee Benefits (3-0-3)
Prerequisites: Econ 265 and Econ 266, or SS 201. The causes of economic insecurity in an urban, industrial society and the personal and social consequences. Social Security, unemployment insurance, workers? compensation, public assistance, and other government programs. Private programs of employee benefits. Analysis of trends in coverage, benefits, and benefit levels, and the impact of demographic, economic, and technological developments on the viability of present and proposed programs.

HRM 411 - Employee Training and Development (3-0-3)
Prerequisite: HRM 303. Training and development is studied from the standpoint of employee contributions to gaining competitive advantage, with an emphasis on firms in technology-intensive industries. Topics include needs analysis, skills utilization, design and delivery of training programs, manpower planning, and employee development.

HRM 415 - Organizational Design and Development (3-0-3)
Prerequisite: HRM 301. Focuses on the design of modern organizations with an emphasis on effectively responding to environmental and technological change. Design issues include analyzing organizational structures, understanding the process of organizational learning, and evaluating organizational cultures. Development issues focus on employee empowerment, vertical and horizontal communication in organizations, and self-managed work teams.

HRM 485 - Special Topics in Human Resource Management (3-0-3)

The study of new and/or advanced topics in the various fields of business and their application not regularly covered in any other business course. The precise topics to be covered, along with prerequisites, are announced in the semester prior to the offering of the course. Effective From: Fall 2009

GRADUATE COURSES:

HRM 601 - Organizational Behavior (3 credits)
Analysis of key organizational components; individual perception; learning ability; conflict resolution models; group processes in decision making; motivation; problem diagnosis, and the organization as the mechanism for joining into a coherent productive system. Organizational assessment for innovation, leadership styles, and environmental interaction.

HRM 605 - Managing High Performance Work Teams (3 credits)
Developing and managing high performance is central to fostering the innovation and process improvements that are necessary to respond to competitive pressures. This course covers all aspects of building and managing high performance work teams. Case studies and experimental learning are used to reinforce theory and established best practices.

HRM 606 - Human Resource Management (3 credits)
Management of human resources in business, industry, and government; developing personnel programs including wage and job classification, training, employee and labor relations, and accident prevention. Particular attention is directed to cases and roles involving both line and staff managers.

HRM 607 - Personnel and Evaluation Research (3 credits)
Focuses on the assessment and improvement of personnel systems. Emphasis is on the use of diagnostic tools in problem identification, developing action plans, and assessing outcomes of HRM interventions. Special attention is given to survey methodology and to the use of assessment tools in conducting personnel research. Databases and statistical software packages are used in project work.

HRM 608 - Behavioral Issues in Transportation Studies (3 credits)
Behavioral science concepts and principles such as perception, learning, motivation, and information processing as they relate to: transportation, consumer use of mass transit, automobiles, ridesharing and intelligent transportation systems. Same as Tran 608.

HRM 609 - Employee Development and Training (3 credits)
Key concepts in training including needs analysis, curriculum design and delivery, managing external consultants, and the evaluation of off-site training programs are introduced to gain understanding of the training function in organizations. Emphasis is on the impact of technological changes on employee skills utilization and development; training as a means of sustained competitive advantage for technology-based organizations; and the effects of technological advances on the design and delivery of training programs.

HRM 610 - Seminar on Leadership Skills (3 credits)
Leadership theory and research is used to provide a foundation for developing leadership skills in work organizations. This course covers all aspects of leadership properties and processes. Concepts and theory are reinforced with case studies and experiential learning exercises. Topics include charismatic leadership, forming and realizing a vision, motivating and socializing followers, conflict resolution, negotiation, power and authority, and values and ethics.

HRM 616 - Job Analysis and Design (3 credits)
Analyzing and designing jobs in work organizations, particularly technology-based organizations. Principles of job analysis and job design are applied to the allocation of tasks in organizations. Draws upon theory and research from industrial and organizational psychology, organizational sociology, social psychology, industrial engineering and occupational medicine.

HRM 630 - Managing Technological and Organizational Change (3 credits)
Prerequisite: HRM 601. Managing planned and unplanned change in organizations. The change process is studied in relation to technology-driven changes in the workplace and to other environmental factors. Focuses on planned and unplanned systemic change, such as downsizing, re-engineering, mergers, and acquisitions.

HRM 640 - Cultures in Organizations (3 credits)
Prerequisite: HRM 601. Cultures and subcultures in organizations are studied from an ethnographic perspective. Managerial and professional cultures are studied as are engineering and R&D cultures. Organizational cultures are also studied in detail using case studies, with an emphasis on understanding culture as a control mechanism in modern organizations.

HRM 650 - Human Resource Information Systems (3 credits)
Information systems as a tool in improving human resource functions in organizations. Emphasis is on the design of information systems and their applications to HRM problems. The course is applications oriented. A technical MIS background is not required.

HRM 655 - Theory and Research in Organizational Behavior (3 credits)
Prerequisite: permission of the instructor. Survey of theory and empirical research on the behavior of individuals in organizations. Foundation in theories and concepts of organizational behavior, organizational psychology, and social and individual psychology. Read critically and evaluate classic works in these areas.

HRM 660 - HRM Issues in Technology-Based Organizations (3 credits)
Prerequisite: HRM 606. An interactive course that emphasizes the special problems faced by organizations that include a high percentage of technically trained professional employees. Linkages between HRM functions are examined and then built upon to develop a strategic plan for the firm's human resources. Special attention is directed toward the needs of technology-based organizations such as building technical skills aimed at maintaining competitive advantage; managing innovation; assessing employee skills bases company-wide; cross training; and fostering organizational learning. Case studies and comparative analyses are used extensively.

HRM 662 - Organizational Diagnosis and Development (3 credits)
A problem-oriented approach to organizational development with a focus on improving work group and organizational performance. Diagnostic tools are introduced as a means of problem definition. Attention then turns to structural and process issues in organizational development. Issues with respect to technology and structure are also examined. Emphasis is primarily on the internal organization. Representative topic areas include self-managed work teams, empowerment strategies, work group structures and technologies, and conflict resolution strategies. Development also covers quality of work life issues.

HRM 670 - Advanced Issues in Resource Management (3 credits)
Prerequisite: permission of the instructor. A research-based course that studies current issues in HRM. Course is designed for students in the Rutgers-Newark Ph.D. program.

HRM 685 - Cross Cultural Management Studies (3 credits)
Provides insight into the institutional fabric and social and communication behavior of other cultures to better understand problems arising from cultural aspects of managing and doing business in various countries. Focus will be with the manager acting in various cultural environments, not restricted to the traditional human resource function at corporate headquarters. Cultural differences and technologies are also examined.

HRM 693 - Employment Relationships and the Law (3 credits)
Legal issues in government regulation of labor-management relations: selection and designation of bargaining agents; administration and enforcement of collective bargaining agreements; activities of unions and employers in labor disputes; and laws regulating wages, hours, and benefits.

HRM 700 - Project in Human Resource Management (3 credits)
Prerequisites: matriculation and advisor's approval. Comprehensive proposal for a program of human resource management; or a major component of a management program applied to an organization chosen by the student, including a design for recruitment, selection, OSHA, benefits services, and/or training program with an evaluation procedure. Another alternative is a comprehensive evaluation of existing human resource programs, including human resource plans and personnel operations requiring cost-benefit analysis. Students select an acceptable organization on which to base their proposal plans.

HRM 701 - Thesis in Human Resource Management (6 credits)
Prerequisites: matriculation for the master's degree, adequate graduate courses in the field of proposed research, and research advisor's approval. Thesis may be developmental experience at an appropriate professional level, or a scholarly research paper providing useful data and/or conclusions for other professionals interested in further study. A student must register for a minimum of 3 credits per semester. Credit will be limited, however, to the 6 credits indicated.

Industrial Engineering: Offered by the Department of Industrial and Manufacturing Engineering

UNDERGRADUATE COURSES:

IE 101 - Introduction to Industrial Engineering (1-1-1)

An Introduction to the field of Industrial Engineering, the functions performed by industrial engineers, career paths and opportunities in the field, introduction to the student and senior professional societies, and initiation of a mentoring program.

IE 203 - Applications of Computer Graphics in Industrial Engineering (1-2-2)

Prerequisites: CIS 101, FED 101C and FED 101D. Areas of graphical communication germane to manufacturing and production are stressed. Provides mathematical and practical knowledge of graphical standards necessary to meet the requirements of today's industrial engineering practices. Introduction to the use of up-to-date software for computer-aided graphics, databases, spreadsheet, general programming, statistical analysis. Also, ProEngineer, Database, Lotus, Fortran/C/ Pascal, and SAS.

IE 224 - Production Process Design (2-2-3)

Prerequisite: sophomore standing. Introduction to the theory and practice of manufacturing processes. Study covers the fabrication of metallic, plastic, and electrical products, operation of NC and other automatic equipment, and economics of the design and production process.

IE 310 - Co-op Work Experience I (3 additive credits)

Prerequisites: junior standing, approval of co-op faculty advisor, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their aca-demic program. Work assignments facilitated by the co-op office and approved by the co-op faculty advisor. Mandatory participation in seminars and completion of a report.

IE 331 - Applied Statistical Methods (3-0-3)

Prerequisite: Math 211. A presentation of statistical analysis techniques and their applications. Topics include the statistical measures describing data, frequency distributions, probability distributions, sampling parameter estimation, hypothesis testings, regression analyses, and analyses of variance. Special emphasis on their application to industrial fields.

IE 334 - Engineering Economy and Capital Investment (3-0-3)

Prerequisite: junior standing. Introduction to the principles of engineering economics for utilization and evaluation of capital investments, including time value of money, depreciation, cost of capital, life cycle cost, net present value, and payback. Consideration of decisions involving multiple choice replacement, uncertainty, and risk.

IE 335 - Engineering Cost Analysis and Control (3-0-3)

Prerequisite: junior standing. The tools and techniques applicable for cost analysis and control including standard costs, variance analysis, cost volume relationships, cost estimation, and utilization of accounting data for control of operations.

IE 339 - Work Measurement and Standards (2-2-3)

Prerequisites: IE 203, IE 224. Emphasizes the measurement and evaluation of existing work methods and how improvement can be achieved. Topics include visual and micro-motion study techniques, motion economy, time study, and work sampling. The development and use of standard data and computerized techniques. Also, hands-on experience through a series of laboratory experiments.

IE 355 - Human Factors (3-0-3)

Prerequisite: junior standing. Human-machine systems analysis including study of workplace layout, measurement of employee efficiency and productivity, criteria for tool and fixture design or selection, industrial fatigue, environmental influences on performance including the effects of illumination, noise, vibration, thermal, and other atmospheric factors. Basic ideas of industrial hygiene; the impact of OSHA; and special techniques for experimenting with human subjects, via demonstrations and supervised experiments.

IE 411 - Co-op Work Experience II (3 additive credits)

Prerequisites: IE 310, approval of co-op faculty advisor, and permission of the Office of Cooperative Education and Internships. Full-time work experience of approximately one semester's duration. Provides major-related work experience as a co-op/intern. Mandatory participation in seminars and completion of requirements that include a report and an oral presentation to IE faculty.

IE 436 - Cost Analysis and Engineering Economics (3-0-3)
Prerequisite: junior or senior standing. Not open to industrial engineering majors. Focuses on the economic factors of concern to manufacturing engineers. Major topics include justification of proposed capital expenditures, equipment retirement and replacement decisions, cost determination, profitability studies, and manufacturing budget construction and utilization for cost control.

IE 439 - Deterministic Models in Operations Research (3-0-3)
Prerequisite: Math 222 or equivalent. The deterministic techniques of operations research. Topics include the applications of linear, nonlinear, integer, and dynamic programming methods and network flows analysis to solve industrial and systems engineering problems.

IE 440 - Stochastic Models in Operations Research (3-0-3)
Prerequisites: IE 331, Math 222 or their equivalent. Probabilistic techniques of operations research. Topics include the applications of Markov chains, queueing and inventory control models to analyze and evaluate systems performance.

IE 441 - Information and Knowledge Engineering (3-0-3)
Prerequisite: junior or senior standing. Introduction to recent advances in the application of computers in industrial engineering and database structures, both sequential and random. Description of methods for organizing data, database modeling, information storage and retrieval. Also, applications of expert systems concepts and techniques.

IE 443 - Senior Project I (1-3-2)
Prerequisite: senior standing. Introduction to senior design project. Selection of specific system design for the project, establishment of initial contacts, preliminary collection and analysis of system data. Concepts of system design analysis emphasizing simulation modeling and analysis, model verification, and model validation.

IE 444 - Senior Project II (2-2-3)
Prerequisite: IE 443. Senior design project, in which the concepts of industrial engineering systems, principles, and procedures are integrated and applied in industrial projects or case studies.

IE 445 - Idustrial Simulation (2-2-3)
Prerequisites: CIS 101, IE 331 or equivalent. Introduction to the application of simulation modeling for the analysis of complex industrial and manufacturing service systems. Examples are chosen from real-life situations such as warehousing, material handling, robotics, transportation, and hospital emergency rooms. Verification/validation as well as statistical analysis of both input/output data are introduced.

IE 447 - Legal Aspects of Engineering (3-0-3)
Prerequisite: junior or senior standing. Familiarization with the U.S. system of case law, statutes and regulations applicable to professional relationships involving the engineer. Includes contracts, property, product liability and other torts, governmental regulatory bodies such as OSHA, EPA, and NRC, professional liability, and role of codes and standards.

IE 449 - Industrial Robotics (2-2-3)
Prerequisites: CIS 101, Phys 121, junior or senior standing. Robotics in manufacturing systems. The field of robotics is studied with emphasis given to the role of programmable robots in manufacturing. Hands-on experience with hardware and software necessary for various industrial robot systems through laboratory experience.

IE 450 - Product Engineering Standards (3-0-3)
Prerequisite: senior standing. Developing and using standards in the design, manufacturing, and use of products. Topics include economics of parts standardization, drawing and assembly techniques, and use of national and international standards. Review of the role of standards-setting bodies and methods for the development of product testing standards used in industry and commerce.

IE 451 - Industrial Measuring Systems (2-2-3)
Prerequisite: IE 331. Reviews contemporary measuring systems and provides a basic under-standing of the various methods, their accuracy, reliability, and relative costs to perform. Includes measuring methods needed for compliance evaluation in accordance with occupational and safety legislation, industrial processes, and product design.

IE 453 - Computer Integrated Manufacturing (2-2-3)
Prerequisite: junior or senior standing. Examines the components of computer integrated manufacturing (CIM) including the design of information frameworks and network protocols required to orchestrate full manufacturing automation. Study of CAD, CAPP, robotics, NC, CNC, computer interfacing, and database systems in the context of a CIM environment. Exposure to state-of-the-art CIM software and hardware.

IE 455 - Robotics and Programmable Logic Controllers (2-2-3)

Prerequisites: junior or senior standing. Introduction to the design and implementation of programmable logic controllers for use in industry in the areas of automotive assembly, pharmaceutical manufacturers, the chemical industry, and others. Includes ladder logic, input/output ports, continuous process control, timing and counting functions, chaining sequences, and digital gate logic. Effective From: Spring 2009

IE 456 - Introduction to Industrial Hygiene (3-0-3)

Prerequisite: IE 355. Analysis of the effects of various environmental stressors on people at work, including their interference with performance and the development of acute and chronic health problems. Study of how numerous airborne contaminants, noise, thermal extremes, ionizing and nonionizing radiation, etc., affect workers alone and in combination. Topics include measurement and evaluation techniques, TLVs, control methodologies, legal requirements for employers.

IE 459 - Production Planning and Control (3-0-3)

Prerequisites: IE 221, IE 439, junior or senior standing. A study of the components and functioning of integrated production, planning, and control systems. Forecasting, aggregate planning, scheduling, and recent models of production and inventory control for optimizing continuous and intermittent manufacturing operations. MRP basics. Introduction to using a computer to apply scheduling models.

IE 460 - Measuring Techiniques and Quality Control (3-0-3)

Prerequisite: understanding of basic probability. Not open to industrial engineering majors; intended for other engineers, inspection supervisors, and management. Various types of control charts and acceptance sampling systems and procedures. These techniques are used widely in industry to improve product quality and reduce costs.

IE 461 - Product Quality Assurance (3-0-3)

Prerequisite: IE 331. Methods used to achieve higher product quality, to prevent defects, to locate chronic sources of trouble, to measure process capability, and to use inspection data to regulate manufacturing processes are emphasized. Preparation of statistical control charts and selection of suitable sampling plans

IE 463 - Invention and Entrepreneurship (2-1-3)

Prerequisite: Junior or Senior standing or permission of instructor. This course will teach students the process of developing new products. It takes students from the art of creativity through product design and concludes with the formulation of a business plan for marking and production. If the new product satisfies the requirements of novelty, usefulness and nonobviousness, a patent application may be filed. Effective From: Spring 2010

IE 466 - Material Handling and Facilities Layout (3-0-3)

Prerequisite: IE 439. Analysis of organized human activities typified by industrial and office operations. Recent methods are applied to optimize location and layout of facilities. Introduction to modern material handling systems, expert systems in plant layout, logistics of motion of people and materials, flow analysis, plant layout, and material handling techniques.

IE 469 - Reliability in Engineering Systems (3-0-3)

Prerequisites: IE 331 or equivalent, senior standing. Emphasizes the determination of systems reliability from a knowledge of characteristics and reliability of individual system components. Topics include reliability concepts, failure rates, systems analysis, optimization, maintenance, etc. Covers techniques for the formulation and evaluation of reliability models.

IE 472 - Product Liability Engineering (3-0-3)

Prerequisite: junior or senior standing. The techniques available to the engineer to minimize the hazards of design and manufacturing that result in product liability cases. The effect of legal precedents on design, manufacturing, advertising, marketing, and using a product within developing technical disciplines such as: reliability prediction and analysis methods, assuring the quality of manufactured products, loss control systems, safety engineering precepts, human factors principles and design review. Review of government regulations for safety and protection.

IE 473 - Safety Engineering (3-0-3)

Prerequisite: junior or senior standing. The principles and practices of safety engineering in product and facilities design. Safe practices and hazard control, safety standards and codes, inspection procedures, the role of insurance, governmental regulations, and safety statistics. Participation in current safety engineering research studies. The Occupational Safety and Health Act and related legislation.

IE 480 - Special Studies in Industrial Engineering for Non-Majors (3-0-3)

Prerequisite: permission of the IE faculty advisor. Not open to industrial engineering majors. Individual investigations under faculty guidance through consultation, readings, and visits with recognized authorities and institutions, dealing with specialized industrial engineering problems. Explore in depth an area of interest and give a report in a seminar setting, and submit a written project report.

IE 481 - Investigations in Industrial Engineering I (3-0-3)
Prerequisites: junior or senior standing, per-mission of the IE faculty advisor. Individual investigation under faculty guidance through consultation, readings, and visits with recognized authorities and institutions, dealing with specialized industrial engineering design problems. Explore in depth an area of interest and give a report in a seminar setting, and submit a written project report.

IE 481H - Investigations in Industrail Engineering I (3-0-3)
Prerequisites: junior or senior standing, permission of the IE faculty advisor, enrolled in Honors College. Same as IE 481, but investigation is in more comprehensive and in greater depth.

IE 482 - Investigations in Industrial Engineering II (3-0-3)
Prerequisites: IE 481, permission of the IE faculty advisor. Further individual investigations, a continuation of IE 481.

IE 482H - Investigations in Industrial Engineering II (3-0-3)
Prerequisites: IE 481, permission of the IE faculty advisor. Further individual investigations, a continuation of IE 481H.

IE 492 - Engineering Management (3-0-3)
Prerequisite: junior or senior standing. An introduction for engineering majors to the fundamentals of engineering economics and the management process for engineering and development. Major topics include capital investment justification methods, project organization, scheduling and control techniques, legal, quality, and staffing issues.

IE 492H - Engineering Management (3-0-3)
Prerequisite: junior or senior standing and enrolled in Honors College. Same as IE 492, but topics are treated more comprehensively and in greater depth.

GRADUATE COURSES:

IE 501 - Fundamentals of Industrial Engineering (3 credits)
Basic concepts of industrial engineering for students who lack an undergraduate degree in the discipline, including: manufacturing processes, work methods and measurement concepts, basics of human factors, quality control, facilities design, production planning, operations research tools, and simulation models.

IE 590 - Graduate Co-op Work Experience I (3 additive credits)
Prerequisites: permission from the industrial engineering program director and the Division of Career Development Services. Cooperative education internship providing on-the-job reinforcement of academic programs in industrial engineering. Work assignments and projects are developed by the co-op office in consultation with the industrial engineering program director. Work assignments are related to student's major and are evaluated by faculty coordinators in the IE department. Course cannot be applied toward degree credit.

IE 591 - Graduate Co-op Work Experience II (3 additive credits)
Prerequisite: permission from the industrial engineering program director and the Division of Career Development Services. Course cannot be applied toward degree credit.

IE 592 - Graduate Co-op Work Experience III (3 additive credits)
Prerequisites: graduate standing and permission from the industrial engineering program director, and the Division of Career Development Services. Course cannot be applied toward degree credit.

IE 593 - Graduate Co-op Work Experience IV (0 credits)
Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

IE 601 - Measurement Methods for Performance Analysis of Operations (3 credits)
Prerequisite: undergraduate mathematics for management science, or EM 602. Quantitative study of various analytical methods for designing and evaluating systems employed in the management of complex enterprises such as decision-making, efficiency measurement, and methods for obtaining optimal system performance.

IE 603 - Behavioral Science in Engineering Organization (3 credits)
Prerequisite: undergraduate probability and statistics, or EM 503. A study of scientific research on human behavior in organizations. Processes and problems of communication in engineering activities; line-staff and supervisor-subordinate relationships; formal and informal organizations; organization models; and technical and social structure of organizations.

IE 604 - Advanced Engineering Statistics (3 credits)
Prerequisite: IE 331 (see undergraduate catalog for description) or equivalent. The foundations of modern quality improvement, scientific basis of quality engineering, probability, statistical inference, statistical experimental design issues such as randomized blocks, factorial design at different levels, application to factorial design, building models, and implementation and critique of Taguchi's contributions. Statistical software is used in the data analysis.

IE 605 - Engineering Reliability (3 credits)
Prerequisite: statistics. Concepts of modern reliability applied to practical industrial problems: statistical concepts, reliability through design, reliability through testing, analysis of reliability data, and the organization and management of a reliability program. Offered alternate years.

IE 606 - Maintainability Engineering (3 credits)
Prerequisite: statistics. Factors affecting maintainability design applied to military and industrial problems: statistical concepts; maintainability prediction, allocation, and demonstration; availability, system and costeffectiveness; provisioning; optimal maintenance policies; and management of a maintainability program.

IE 608 - Product Liability Control (3 credits)
Product liability and the effect of legal doctrines on minimizing hazards of design and manufacture. Use of actuarial techniques and legal precedents applicable to design, manufacturing, advertising, and marketing problems: warranties, notices, disclaimers, definition of liability, use of expert witnesses, reliability prediction and analysis methods, safety engineering concepts, and design review. A review of government regulations for safety and protection, as well as mandatory and voluntary standards will also be included.

IE 609 - Advanced Analytical Engineering Statistics (3 credits)
Prerequisite: IE 604. An extension of the techniques of engineering statistical analysis to industrial applications. Emphasis is placed on the design of experiments and analysis of tests for multivariate level problems.

IE 610 - Transportion Economics (3 credits)
Prerequisite: undergraduate course in economics. Principles of engineering economy. Costs of highway and public transportation facilities. Economic comparisons and evaluations. Financing approaches, tax allocation theory. Programming highway and public transit improvements. Same as Tran 610.

IE 614 - Safety Engineering Methods (3 credits)
Prerequisites: introductory course in statistics and industrial or construction management. Application of selected safety engineering methods to detect, correct, and prevent unsafe conditions and procedures in future practice. Methods selected are from safety management and programs; loss prevention; fire protection; systems safety; the design of buildings and other facilities; and the design of products, machinery, and equipment. Engineering problems in designing and constructing a hazard-free environment.

IE 615 - Industrial Hygiene and Occupational Health (3 credits)
Prerequisites: one year of college physics and one semester of college chemistry or biology. Introduction to industrial hygiene. Recognition, evaluation and control of human exposure to noise, heat, bio-hazards, chemicals, radiation, and improper lighting. Government standards, field measurements, work practices, engineering designs, and the effects of excessive exposure on worker health and productivity.

IE 618 - Engineering Cost and Production Economics (3 credits)
Prerequisite: IE 502 or equivalent. Cost management of operational activities. Focuses on capital investment decision making and efficient resource utilization to achieve cost-effective operations. Topics include alternative investment evaluation, budgeting activity based costing, quality costs, life cycle management and relevant behavioral science. These are considered in the context of manufacturing and service industry application.

IE 621 - Systems Analysis and Simulation (3 credits)
Prerequisites: IE 331, IE 466 (see undergraduate catalog for descriptions), or equivalent or department approval. The application of well-integrated systems approach, systems and systems engineering in the system life cycle, system design process, mathematical tools and techniques applied to systems analysis, design for operational feasibility, systems engineering management, modeling techniques including simulation, application of discrete simulation techniques to model industrial systems, design of simulation experiments using software, output data analysis.

IE 622 - Simulation and Risk Analysis in Operations Management (3 credits)
Prerequsites: IE 331 (see undergraduate catalog for description) or equivalent. Introduction to the concepts, methodologies and applictions of simulation in operations management. Foundations of simulation, Monte Carlo approaches, simulation models using spreadsheets, generating probabilistic outcomes using random number generation techniques, applying risk analysis software to spreadsheets for various decisions making. Variety of applications in operations management, finance and marketing. Software to develop models of practical operations management applications, is provided.

IE 623 - Linear Programming (3 credits)
Prerequisite: EM 602 or introductory course in operations research. Principles, methodology, and practical applications of linear programming to complex problems in production and marketing, simplex techniques, duality theory, parametric analysis, Wolfe and Dantzig's decomposition methods, ellipsoid method, and Karmakar's method.

IE 624 - Heuristic Methods (3 credits)
Prerequisites: EM 503 or equivalent. Techniques and concepts used to develop intelligent decision support systems. Application of rules called heuristics and models of reasoning to solve problems in engineering design and manufacturing. Topics include set theory, fuzzy subset theory, decision theory, logic, inference expert systems and single and multi-fault diagnostics.

IE 641 - Operations Analysis (3 credits)
Prerequisites: EM 602 and computer programming experience. Management systems and business behavior using industrial models. Special attention is given to the interaction of individual elements that make up the total system.

IE 642 - Network Flows and Applications (3 credits)
Prerequisite: EM 602 or equivalent. Theories, algorithms, computation complexity, and application of networks, shortest path, network flow, and minimum cost flow problems. Models of industrial service systems as network problems.

IE 643 - Transportation Finance (3 credits)
Prerequisite: undergraduate course in economics. Balance sheets and income statements. Asset and liability management, sources and costs of debt and equity financing. Financial performance measures in the private sector (airlines, railroads, trucking and bus companies). Financing issues associated with the public sector (highways and mass transit). Equity and efficiency in pricing. Subsidy allocation formulae. Innovative financing schemes in the public sector. Same as Tran 643.

IE 644 - Application of Stochastic Modeling in Systems Control (3 credits)
Stochastic processes applied to control of various types of systems: Markov chains, queueing theory, storage theory applications to measure performance of flexible manufacturing systems, telecommunication and distributions networks and similar service systems. Knowledge of probability theory and linear algebra is essential.

IE 650 - Advanced Topics in Operations Research (3 credits)
Prerequisite: introductory course in operations research or equivalent. Current topics in deterministic models of operations research: linear programming, large scale decomposition, integer programming, dynamic programming, and nonlinear programming. Emphasis on optimization techniques for solving mathematical programming problems.

IE 651 - Industrial Simulation (3 credits)
Prerequisite: introductory course in statistics/simulation or instructor's permission. Statistical design and analysis of Monte Carlo simulation experiments from an engineering view. Examples are provided with emphasis on industrial and manufacturing applications of simulation modeling. Markovian processes simulation, random number generation, mathematical programming, heuristics and decision theory.

IE 652 - Facilities Location and Plant Layout (3 credits)
Prerequisite: introductory course in operations research or instructor's approval. Basic con-cepts of facilities location and plant layout. Quantitative and qualitative tools needed in industrial engineering, including single and multiple facilities location problems, site selections and allocation models, use of Duality theory in location and plant layout problem, and computerized layout planning.

IE 653 - Facility Maintenance (3 credits)
Prerequisite: EM 501 or equivalent. Intended for those individuals who manage the functioning and maintenance of physical facilities. Emphasis on planning and control of facilities use, maintenance, utility management, managerial control, budgets and costs, personnel administration, legal and safety, flexibility measurement, and design.

IE 659 - Supply Chain Engineering (3 credits)
Coordination of product manufacturing and logistic activities across the global supply chain is studied. Focus is on supply chain design, implementation, and control. Topics include transportation and distribution networks, inventory control, demand planning, materials handling and warehousing, supply chain contracts, manufacturing flexibility, product design for responsiveness, and ERP systems. Supply chain analytics concepts and relevant case studies are introduced. Effective From: Fall 2007

IE 661 - Man-Machine Systems (3 credits)
Prerequisite: human factors engineering. Analysis of integrated man-machine systems: physical and psychological effects of systems of deterministic and conditional responses of individuals and groups, and the resulting interaction between individuals, groups, and machine systems;

also current research and development pertaining to man-machine systems.

IE 662 - Cognitive Engineering (3 credits)

Prerequisite: IE 355 or equivalent. The purpose of this course will be to introduce the application of human factors and cognitive psychology principles to the user interface design of information technology, including computer systems, groupware and communications, handheld devices and Internet applications, and automatic speech recognition interfaces. The course will provide grounding in the engineering design processes used to enhance the usability of products and services, and usability testing methods used by user interface designers. Secondly, major areas and design problems in human-computer interaction and Information Technology will be covered, with real world examples. The course would be appropriate for advanced undergraduates in engineering, computer science, and psychology.

IE 664 - Advanced Ergonomics (3 credits)

Prerequisite: IE 355 or equivalent. The course covers important topics for ergonomics, including functional anatomy of the human body, work physiology and body energy expenditure, and biomechanics for people at work. Commonly used analytical tools for ergonomics will be introduced in the course.

IE 665 - Applied Industrial Ergonomics (3 credits)

Prerequisites: IE 355 (see undergraduate catalog for description) or IE 699. Introduces the fundamentals and applications of industrial ergonomics for improving equipment, tool, workplace, and job design. Engineers, as well as safety and health professionals, will benefit from the course by understanding the design principles for human operators and current issues in industrial ergonomics, and a variety of evaluating methodologies for the design.

IE 669 - Human Design Factors in Engineering (3 credits)

Prerequisite: engineering statistics. Human factors research related to workplace and equipment design and development. Capabilities and limitations of the human sensory-motor system. Design of displays and resulting interaction between individuals, groups, environments and machine systems. Current research in engineering pertaining to the man-machine interface. Not for IE students who have had an undergraduate course in human factors.

IE 670 - Industrial Work Physiology (3 credits)

Prerequisite: IE 669 or equivalent. A study of human physiological responses to industrial environmental factors emphasizing knowledge of human anatomy and physiological tolerances: skeletal, muscle, and neuromuscular systems, evaluation of physical work capacity and performance, changes in circulation and respiration during work. Semester project under the instructor's supervision is also required.

IE 672 - Industrial Quality Control (3 credits)

Prerequisite: engineering statistics. The management of quality assurance: operational and statistical principles of acceptance sampling and process control; quality problems in production lines, and introduction to total quality management concepts.

IE 673 - Total Quality Management (3 credits)

Introduces the concept of total quality management as applicable to industrial systems. Presents methods for product quality improvement. Emphasis is on prevention through quality engineering and design, and goes beyond traditional statistical process quality control. Presentation of recent methods in supplier management, quality assurance, process control, and competitor analysis. Includes Taguchi methods and quality function deployment. Description of ISO 9000 and Baldridge Award.

IE 674 - Quality Maintenance and Support Systems (3 credits)

Prerequisites: probability and statistics, IE 331 (see undergraduate catalog for description) or equivalent. Consideration of factors necessary for cost effective maintenance and support of technical operating systems. Topics discussed include service organization and management, spare parts and logistics, quality assurance, ISO9003 training. Examples from automation, computer systems, clinical engineering, power, and transportation will be used to illustrate application areas.

IE 675 - Safety in Facility and Product Design (3 credits)

Prerequisite: IE 614 or equivalent. Application of safety principles to minimize the health and safety hazards in the design and manufacture of various products. Practical techniques for, and economic ramifications of, conformance with the many statutes enacted to assure safe workplaces and products.

IE 677 - Applied Statistics and Epidemiology for Hazard Analysis (3 credits)

Prerequisite: IE 604 or equivalent. Application of statistical concepts to the field of hazard analysis including: investigation of root causes of accidents, their patterns and trends; rules for systematic data analysis; determination of commonality factors; availability and use of customized computer software.

IE 681 - Interdisciplinary Seminar in Occupational Safety and Health (1 credit)

Prerequisite: OSHE students, or permission of instructor. This is a required course for students who receive the trainee scholarship from the Occupational Safety and Health Engineering Program sponsored by the National Institute for Occupational Safety and Health (NIOSH). Other graduate students are also welcome and encouraged to take the interdisciplinary seminar course. Students and residents in the ERC programs will be able to participate in an interdisciplinary course with students in industrial hygiene, occupational medicine and occupational safety.

IE 682 - Industrial Safety and Health Evaluation (3 credits)

Prerequisite: OSHE students, or permission of instructor. This is a required course for students who receive the trainee scholarship from the Occupational Safety and Health Engineering Program sponsored by the National Institute for Occupational Safety and Health (NIOSH). Other graduate students are also welcome and encouraged to take this site visit course. Upon completion of this course, students will be able to plan and conduct a walk-through evaluation of health and safety hazards in a workplace. Students will also understand the role of occupational health and safety disciplines in the recognition and prevention of occupational injury and illness.

IE 685 - Systems Safety (3 credits)

Prerequisites: applied probability/statistics and introductory safety. Safety decision making and systems engineering applications to safety, including planning, managing and conducting system safety programs.

IE 699 - Special Topics in Industrial Engineering (3 credits)

Prerequisite: approval from the industrial engineering graduate advisor. Special course given when interest in a subject area develops. Advanced notice of topics will be given before registration.

IE 701 - Master's Thesis (6 credits)

Prerequisites: matriculation for the master of science degree, thesis advisor's approval, and adequate graduate courses in the field of the proposed thesis. Candidates for the degree who choose this option must submit an acceptable thesis on an approved subject that contributes to the literature of the field, and preferably aids the candidate's present or potential, career. While original research may not always result, the thesis should provide a new conclusion or application. Approval to register for the thesis must be obtained from the thesis advisor. A student must continuously register for a minimum of 3 credits per semester until the thesis is completed. Total credit will be limited, however, to the 6 credits indicated for the thesis.

IE 704 - Sequencing and Scheduling (3 credits)

Prerequisite: IE 650 or equivalent. Advanced sequencing and scheduling for job shops, flow lines, and other general manufacturing and production systems are discussed in this course. Both deterministic and stochastic scheduling models are covered in detail. Heuristics and worst case analysis for unsolvable hard scheduling problems (NP-C problem) are introduced.

IE 705 - Mathematical Programming in Management Science (3 credits)

Prerequisites: IE 623 and IE 650. An advanced study of various mathematical programming techniques such as linear and non-linear, parametric, integer, stochastic and dynamic programming. Readings and discussions emphasize mathematical advances and applications in operations research.

IE 706 - A Queueing Approach to Performance Analysis (3 credits)

Prerequisite: IE 644 or equivalent. Newly developed techniques in the area of queueing networks that play a critical role in studying several aspects of discrete event stochastic systems such as FMS, computer-aided communication systems, transportation systems and service systems.

IE 725 - Independent Research (3 credits)

Prerequisite: approval from the industrial engineering program director. Program of study prescribed and approved by student's advisor. This special course covers areas in which one or more students may be interested but is not of sufficiently broad interest to warrant a regular course.

IE 753 - Airport Design and Planning (3 credits)

Prerequisite or corequisite: Tran 610 or EM 693. Planning of individual airports and statewide airport systems. Functional decision of air and landside facilities. Orientation, number and length of runways. Concepts of airport capacity. Passenger and freight terminal facility requirements. Airport access systems. FAA operating requirements. Financial, safety and security issues. Same as CE 753 and Tran 753.

IE 754 - Port Design and Planning (3 credits)

Prerequisite: Tran 610 or EM 693. Functional design of the water and landsides for general cargo, liquid and dry bulk, and container operations. Yard and storage systems. Port capacity in an intermodal network. Economic, regulatory, and environmental issues. Same as CE 754 and Tran 754.

IE 760 - Quantitative Methods in Human Factors (3 credits)

Prerequisite: IE 661. More advanced human factors engineering concepts analyzed quantitatively: systems modeling, control theory, human error, and decision making. Discussion of human factors, research design and data analysis. Operator/computer interaction is also emphasized.

IE 761 - Advanced Studies in Human Factors (3 credits)

Prerequisite: one year of graduate work in human factors or the equivalent. The course integrates various areas of graduate studies in human factors such as: work physiology, occupational safety, environment and human-machine systems. Detailed discussion of selected current papers covering theoretical review, experimental design, results, applications, and future research. Completion of semester project under instructor's guidance is mandatory.

IE 762 - Psychophysical Methods in Human Factors (3 credits)

Prerequisite: one year of graduate work in human factors or instructor's approval. This course considers various classical and modern psychophysical methods, signal detection theory, information theory, and human information processing applicable to advanced human factors/occupational safety research measurement and normative modeling.

IE 791 - Graduate Seminar (Non-credit)

A seminar in which faculty or others present summaries of advanced topics suitable for research. Discussion of research procedures, thesis organization, and content. Students engaged in research will present their own research for discussion and criticism. Effective From: Fall 2005

Infrastructure Planning: Offered by the School of Architecture

GRADUATE COURSES:

MIP 601 - Interdisciplinary Infrastructure Studio I (6 credits)

Collaborative work on realistic infrastructure projects by teams of students with different professional backgrounds under the supervision of interdisciplinary faculty. A project manager coordinates and ensures that working conditions in practice are simulated in the studio. Projects include analytical, financial and design components and emphasize planning strategies and the coordinating function of the design process. Studio products are presented orally in reviews and documented in written and illustrated reports.

MIP 602 - Interdisciplinary Infrastructure Studio II (6 credits)

A comprehensive planning and design project emphasizing infrastructure technologies and information management. CAD and other computer applications are used to produce computer-generated graphics and multi-media presentations. Although subjects and approaches will vary, the work of the studio is intended to develop the students' ability to deal with all facets of infrastructure planning regardless of previous academic background. The final products must include a full written and illustrated report on the project and the research on which it is based.

MIP 612 - Introduction to Environmental Policy Studies (3 credits)

Introduction to six areas essential to a comprehensive understanding of environmental policy: concepts of environmental policy; tools (law, economics, planning, science, engineering, ethics) for environmental policy; the U.S. perspective (NEPA, clean air and water acts, CERCLA, etc.); the international perspective (Club of Rome models, 1972 UNEP, 1992 Rio, etc.); industrial perspective (pollution prevention/life cycle engineering, privatization, etc.); and the local perspective (New Jersey DEP, NGOs, local industry, shoreline, etc.). Same as EPS 612

MIP 615 - Introduction to Transportation Studies (3 credits)

Prerequisite: elementary probability and statistics. Presentation of the characteristics of the traffic stream, road users, and of vehicles, and a review of traffic flow relationships. Students are exposed to the principal methodologies followed by transportation practices to perform volume, speed, travel time, delay, accident, parking, pedestrian, transit and goods movement studies. Presentation of the principal methodologies used to perform transportation facility capacity analyses for: basic freeway sections, weaving areas, ramps and ramp junctions, multi-lane and two lane roadways, signalized and unsignalized intersections. Students get hands on experience using the highway capacity software (HCS) and SiDRA. Same as CE 660 and Tran 615.

MIP 618 - Public and Private Financing of Urban Areas (3 credits)

Ties government's budget, tax, policy, allocation of resources between public and private sectors, with the structure, development, and growth needs of urban metropolitan areas. Focuses on problems of poverty, transportation, land-use, economic base, relation between central cities and suburban areas, and alternative engineering and economic solutions. Same as Fin 618 and Tran 604.

MIP 631 - History and Theory of Infrastructure (3 credits)

The historical role of infrastructure in the formation of cities and the relation of planning theories to urban culture. Case studies are used to develop effective ways of learning urban design; method and substance are equally emphasized. Concentration on the social, economic, political, technological and topographic factors that affect urban form; analysis of urban design schemata and their relation to patterns of use; and the critical appraisal of planning ideologies and strategies. Same as Arch 631H.

MIP 652 - Geographic Information Systems (3 credits)

Prerequisite: course or working knowledge of CADD or permission of instructor. Geographical/Land Information System (GIS/LIS) is a computerized system capable of storing, manipulating and using spatial data describing location and significant properties of the earth's surface. GIS is an interdisciplinary technology used for studying and managing land uses, land resource assessment, environmental monitoring and hazard/ toxic waste control, etc. Introduces this emerging technology and its applications. Same as CE 602 and Tran 602.

MIP 655 - Land Use Planning (3 credits)

Spatial relations of human behavior patterns to land use: methods of employment and population studies are evaluated; location and spatial requirements are related to land use plans; and concepts of urban renewal and recreational planning are investigated by case studies. Same as Tran 655 and CE 655.

MIP 673 - Infrastructure Planning in Practice (3 credits)

Infrastructure planning principles, methods and tools. Through selected examples, acquaintance with infrastructure planning theories and models, quantitative methods of research and analysis, information management, decision making, and implementation techniques. Same as Arch 673.

MIP 674 - Infrastructure and Architecture (3 credits)

Examination of areas of overlap and continuity between architecture, landscape architecture, urban design, building science and infrastructure. Topics include the typology, programming and design of public facilities; the housing fabric; the relation between built form, urban space and infrastructure. Same as Arch 674.

MIP 675 - Elements of Infrastructure Planning (3 credits)

Introductory survey of the basic principles, operation and design of physical infrastructure systems including roads, public transportation, community facilities, public open space, surface drainage, and electric, gas, water, waste disposal, and telecommunications services. Same as Arch 675.

Information Systems:

UNDERGRADUATE COURSES:

IS 118 - Introduction to Application Development Tools (3-0-3)

Application development principles, and associated development tools and programming. HTML,and PHP are examples of open source development tools that are becoming defacto standards within the development community. Knowledge of these tools will benefit the student in subsequent courses and in their senior capstone project. In the proprietary arena, VB.Net is extensively used for application in all environments and its penetration into the development area is quite large and often is the language of choice of many Windows shops. Effective From: Fall 2006

IS 127 - Introduction to Web Systems Design (3-0-0)

This course provides a critical, hands-on introduction to Web-based Information Systems and Web systems design. Students will research and discuss emerging trends, capabilities, and limitations of web technologies used to capture, store, access, and disseminate information for both businesses and online communities. Students will design and develope different types of websites and web applications which will then be analyzed as to their usability in real public and private settings. Effective From: Fall 2008 Until: Summer 2009

IS 218 - Introduction to Web Systems Design (3-0-3)

Prerequisites: GUR in Computing, such as, IS 118, CS 101, CS 113, CS 115. This course provides a critical, hands-on introduction to the design of Web-based Information Systems. We will explore and discuss emerging trends, capabilities, and limitations of web technologies used to capture, store, access, and disseminate information for both businesses and online communities. Students, working in groups, will design and develop different types of web applications, which will then be analyzed and critiqued by the students as their usability in actual public and private settings. An open-source web content management system will be utilized throughout the course. Effective From: Fall 2009

IS 245 - Information Technology Systems: Hardware/Software (3-0-3)

This course reviews hardware/software technologies in order to enable system developers to understand tradeoffs in the design of computer architectures for effective computer systems. Also covered are operating systems and systems architecture for networked computing systems. Topics include Hardware (CPU architecture, memory, registers, addressing modes, busses, instruction sets, multi processors versus single processors, and peripheral devices), Operating systems (processes, process management, memory and file system managaement), and Telecommunications (basic network components, switches, multiplexers and media, installation and configuration of multi-user operating systems). Effective From: Fall 2006

IS 265 - Introduction to Information Systems (3-0-3)

Prerequisite: Completion of 100 level course in the computing sciences: CS 101 or CS 111 or CS 113 or CS 115 or IS 118. Information systems is the study of how organizations use information technology. This course is an overview of the information systems discipline, the role of information systems in organizations, and the changing nature of information technology. Computer tools for analysis and presentation are used. Effective From: Fall 2006

IS 270 - Multimedia Information Systems (3-0-3)

Prerequisite: Completion of 100 level course in the computing sciences: CS 101 or CS 111 or CS 113 or CS 115 or IS 118. Multimedia combines text, graphics, sound, video, and animation in a single application. Preparation for creating multimedia information systems, and understanding the crucial issues involving technology, design and effectiveness of multimedia applications. Programming techniques for integrating video, sound, animation, and graphics, and design strategies for multimedia information systems. Effective From: Fall 2006

IS 305 - Community Service Internship (0-2-1)

Prerequisite: IS 350. Increasingly, computer scientists are recognizing their ethical responsibility to provide advice and assistance that will improve the ability of government and social service agencies to use computers to serve the public. This course involves approximately 40 hours of internship in a community agency, arranged through the NJIT Cares Program. The interns will use their skills to improve the effectiveness of the use of computers at the agency. Bi-weekly progress reports will be submitted, with required meetings with the course supervisor, and a final report. (IS 305 may be combined with two approved credits of CIS 105 and used as a technical elective in a CIS degree program.) Effective From: Fall 2006

IS 310 - Co-op Work Experience I (3)

Prerequisites: completion of the sophomore year, approval of the department, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the Co-op office. Mandatory participation in seminars and completion of a report. Effective From: Fall 2006

IS 333 - Systems Integration for Social Network Applications (3-0-3)

Prerequisite: Completion of computing GUR, such as, IS 118, CS 101, CS 113, CS 115 or BNFO 135. In this intensely hands-on course, you will analyze existing social networking sites (Facebook, MySpace, LinkedIn, LISTSERV, etc.) in terms of usage and security implications, and identify design considerations for new application use. Working in teams, you will design and execute an implementation plan for add-on applications to an existing social networking site, manage the security settings and other aspects of these applications. This involves combining existing reusable components and developing the interface to these from the soical networking sites. The team project will design solutions for an existing organization. Effective From: Fall 2009

IS 335 - Introduction to .NET Framework (3-0-3)

Prerequisite: IT 202 or equivalent. This course introduces students to .NET Framework, a new computational environment that supports more than 25 programming languages and is platform and device independent. Problem solving and system development topics are integrated into the course by using C# languages as a vehicle to illustrate the concepts. Effective From: Spring 2007

IS 344 - Computing Applications in Business (3-0-3)

Prerequisites: Acct 115, and either CS 113 or CS 115 (or Department permission). A comprehensive overview of the various types of computing applications used by businesses in order to run effectively and efficiently. All the major functional departments within organizations are examined and evaluated to see how applications are integrated to implement "business processes" that flow across department boundaries, and from suppliers to customers. The modeling of business situations and the design of applicable software solutions. A full-semester hands-on student project will provide experience in designing solutions to changes in the business environment. Effective From: Fall 2008

IS 350 - Computers and Society (3-0-3)

Prerequisites: Completion of 100 level course in the computing sciences: CS 101 or CS 111 or CS 113 or CS 115 or IS 118 and one basic SS course, and HUM 101. Examines the historical evolution of computer and information systems and explores their implications in the home, business, government, medicine and education. Topics include automation and job impact, privacy, and legal and ethical issues. Co-listed as STS 350. Effective From: Fall 2006

IS 365 - Computer Applications to Commercial Problems (3-0-3)

Prerequisite: Completion of 100 level course in the computing sciences: CS 101 or CS 111 or CS 113 or CS 115 or IS 118. Covers design and implementation of commercial application software systems. Concepts of organization and management of data and files including file operations and organization of sequential access, relative access, indexed sequential access, virtual storage access and multi-key access methods. The COBOL language is used to illustrate these concepts and to implement application systems. The design and implementation of commercially oriented computer systems. Emphasis is placed on modern computers as a tool for solving business problems. The COBOL programming language will be extensively studied and utilized in developing the programming techniques for the solution of these problems. Effective From: Fall 2006

IS 373 - World Wide Web Standards (3-0-3)

Prerequisites: Completion of 100 level course in the computing sciences: CS 101 or CS 111 or CS 113 or CS 115 or IS 118. This course covers the standards that are emerging for formatting, accessing, displaying, transmitting and structuring information, including the standards and protocols existing and under development today. Topics include: Standards, Rationale, Pros and Cons, the Standards Process; Standards Bodies & Participating on Standards Bodies; How Companies Influence Standards; How Developers Incorporate Standards in their Programs; Planning for Emerging Standards; Company Policies Regarding Web Standards; Standards and Legal Issues. Effective From: Fall 2006

IS 390 - Requirements Analysis and Systems Design (3-0-3)

Prerequisite: Completion of 100 level course in the computing sciences: CS 101 or CS 111 or CS 113 or CS 115 or IS 118. A study of the information systems development life-cycle, from the initial stages of information requirements analysis and determination to the ultimate activities involving systems design. Theory, methodologies and strategies for information requirements analysis, including the assessment of transactions and decisions, fact-finding methodologies, structured analysis development tools, strategies of prototype development, and an overview of computer-aided software engineering (CASE) tools. Theory, methodologies and strategies for systems design, including design of user-interfaces, particularly menu-driven and keyword dialogue strategies, and issues in the proper design of computer output. Effective From: Fall 2006

IS 392 - Web Mining and Information Retrieval (3-0-3)

Prerequisites: Completion of 100 level course in computing sciences: CS 101 or CS 111 or CS 113 or CS 115 or IS 118. Text retrieval concerns the representation, organization, storage, and retrieval of text elements. Students will learn methods of text and data organization, as well as numerical data storage methods in commercial databases. Topics include techniques such as automatic indexing, query expansion, and how to use these techniques to improve retrieval effectiveness and efficiency. Effective From: Spring 2010

IS 405 - Internship in Community Service (1-0-1)

Prerequisite: IS 305 or its equivalent, approval of the department, and permission of the Office of Service Learning and Career Development Services. This course involves approximately 40 hours of internship in a community agency, arranged through the NJIT Cares Program. The interns will use their skills to improve the effectiveness of the use of computers at the agency. Bi-weekly progress reports will be submitted, with required meetings with the course supervisor, and a final report. Effective From: Fall 2006

IS 410 - Co-op Work Experience II (3 additive credits)

Prerequisites: IS 310 or its equivalent, approval of the department, and permission of the Office of Cooperative Education and Internships. Provides major-related work experience as co-op/internship. Mandatory participation in seminars and completion of requirements that include a report and/or project. Effective From: Fall 2006

IS 413 - Requirements for Emergency Management Information Systems (3)

Requirements analysis, interface design, and supporting functionality of information systems related to the complete preparedness lifecycle for emergency, disaster, and crisis situations for government bodies and/or private organizations. Components of the lifecycle-planning, mitigation, training, alerting, response, recovery, and assessment, are studied. Human and organizational behavior in this environment and how it influences system functionality and design of the user interface. Integration and coordination issues across the phases of the process. Effective From: Fall 2006

IS 421 - Rich Internet Applications (3-0-3)

Prerequisite: IS 118 and CS 113. This course introduces the next generation of web application platform and web applications - Web 2.0 and Rich Internet Applications (RIAs). The course covers key attributes of RIA development, defines Service Oriented Architecture (SOA) and introduces different application development platform, design and development tools and languages supporting development and deployment of RIAs. The in-depth study of Microsoft.NET Framework 4.0 and Silverlight 4.0 will provide hands-on experience to develop and deploy RIAs. Effective From: Fall 2010

IS 431 - Database Design, Management and Applications (3-0-3)

Prerequisite: completion of 100 level course in the computing sciences: CS 101 or CS 111 or CS 113 or CS 115 or IS 118. Database system components; data modeling using the Entity-Relationship model, Semantic Object model, UML and other data models; Relational Database Managment Systems-functionality and design concepts and applications; querying a database; Structured Query Language; functional dependencies and higher order normalization for relational database design; relation decomposition; overview of concurrency control and transaction management, Database application design and management issues. Student projects involve the use of DBMS packages, including Oracle and Microsoft Access. Effective From: Fall 2006

IS 433 - Electronic Commerce Requirements and Design (3-0-3)

Prerequisites: IS 431 or CS 431 and IS 390 or CS 490. Introduces critical concepts emerging in the field of electronic commerce, such as business to consumer (B2C), business to business (B2B), supply chain management (SCM) systems, and peer to peer (P2P). The course provides concepts and practical skills for building effective, usable, and secure electronic commerce systems, offering a conceptual framework for the study of electronic commerce as well as hands-on skills for building systems for electronic commerce. Effective From: Fall 2006

IS 441 - Geographic Information Systems (3-0-3)

Prerequisite: IS 431 or CS 431. Geographic Information Systems (GIS) allow individuals and organizations to pose, explore and answer a variety of public- and private-sector questions using spatial data. In this course the student will learn to identify, manipulate and analyze spatial data using state-of-the-art software. The course is project-driven and hands-on: students will define and address real problems using real data. The course will also cover selected topics in information visualization as they relate to the use of GIS. Effective From: Fall 2006

IS 447 - Designing the User Experience (3-0-3)

Prerequisite: IS 390. This course covers the design and evaluation of the human-computer interface in interactive computer systems. Among the topics covered are approaches to interface design such as menus, commands, direct manipulation; screen layout strategies; metaphor models; models of human information process; evaluation approaches such as protocol for analysis, interactive monitoring, use of surveys; and requirements for documentation and help. Students are expected to design interface mockups and evaluate them. Effective From: Spring 2010

IS 448 - Ubiquitous Computing (3-0-3)

Handheld devices, mobile and wireless technologies, 'smart spaces', wearables and other technologies are creating a ubiquitous computing environment that is moving application development off the desktop. This course explores recent developments in both the technical and Human Computer Interaction(HCI) side of ubiquitous computing. To put into practice what is being learned, the class will use scenario based usability engineering techniques to design various aspects of a ubiquitous computing application to be deployed at NJIT. Effective From: Fall 2006

IS 455 - IT Policy and Strategy (3-0-3)
Prerequisite: Completion of 100 level course in the computing sciences: CS 101 or CS 111 or CS 113 or CS 115 or IS 118. This course provides an understanding of the use of information technology from an organizational perspective by focusing on the development of IT policies and plans to achieve organizational goals. Topics include the strategic uses of IT, translating IT objectives into operating principles, IT architecture and infrastructure, software development management, organizational change, outsourcing, governance, risk management, and performance measurement. Effective From: Fall 2006

IS 461 - Systems Simulation (3-0-3)
Prerequisites: completion of a 100-level GUR course in CIS; Math 333. This course introduces computer simulation as an algorithmic problem solving technique. Includes discrete simulation models, elementary theory, stochastic processes, use of simulation languages, random number generators, simulation of probabilistic processes, design of simulation experiments, validation of models, queueing systems, and applications to the design and analysis of operational systems. The GPSS language is covered in detail. Effective From: Fall 2006

IS 465 - Computer Techniques for Management Information Systems (3-0-3)
Prerequisite: CS 431. Design and programming concepts are presented for automation of management information systems. Includes the organization of files and techniques for processing information based upon organizational requirements and available hardware and software. Some case studies are presented. Effective From: Fall 2006

IS 475 - Evaluation of Computer Applications (3-0-3)
Prerequisite: a course in probability and statistics, or social science research methods. Methods for identifying usability problems and for testing the relative merits of alternative designs for interactive systems. Following a review of ** pending approval usability heuristics, students read journal articles about and practice five different methods: semi-structured interviews, protocol analysis, cognitive walkthroughs, user surveys, and controlled experiments. Effective From: Fall 2006

IS 485 - Special Topics in Computer Science/Information Systems (3-0-3)
Prerequisites: junior standing and/or department approval. The study of new and/or advanced topics in an area of computer science not regularly covered in any other CIS course. The precise topics to be covered in the course, along with prerequisites, will be announced in the semester prior to the offering of the course. A student may register for no more than two semesters of Special Topics. Effective From: Fall 2006

IS 486 - Topics in Computer Science/Information Systems (3-0-3)
Prerequisites: Same as for IS 485. A continuation of IS 485. Effective From: Fall 2006

IS 488 - Independent Study in Computer Science (3-0-3)
Prerequisites: open only to students in the Honors Program who are computer science majors and who have the prior approval of the department and the CIS faculty member who will guide the independent study. Independent studies, investigations, research, and reports on advanced topics in computer science. Students must prepare, in collaboration with their faculty mentor and in the semester prior to enrolling in this course, a detailed plan of topics and expected accomplishments for their independent study. This must have the approval of both the department and the faculty mentor. A student may register for no more than one semester of Independent Study. Effective From: Fall 2006

IS 491 - Senior Project (3-0-3)
Prerequisites: IS 465, senior standing, and, in a prior semester, project proposal approved by the faculty advisor. Integration of knowledge and skills gained in previous information systems courses into an individual research project. The project entails investigation of current literature and the design, implementation and evaluation of an information system. Effective From: Fall 2006

IS 491H - Honors Senior Project (3-0-3)
Prerequisites: IS 465 and senior standing in the Honors College. A course similar to IS 491, with a project of greater depth and scope. Effective From: Fall 2006

GRADUATE COURSES:

IS 500 - Introduction to Systems Analysis (3 credits)

Prerequisites: statistics and differential equations. Covers a wide variety of systems oriented approaches to solving complex problems. Illustrative examples are chosen from a wide variety of applications. Mathematical tools are only introduced to the extent necessary to understand the technique and its application to the problem. Topic areas include probabilistic and decision theory models, simulation, morphological analysis, cluster analysis, structural modeling, Delphi and dynamic system models. The role for the computer in applying these techniques to complex problems will be discussed. The student will be exposed to some of the fundamental controversies concerning the appropriateness or validity of systems approaches to human problem solving. Effective From: Fall 2006

IS 565 - Aspects of Information Systems (3 credits)

Co-requisite: CS 431 or permission of the department. Methods and models of supporting the management process; ethical issues pertaining to the construction, deployment, and impact of information systems on organizations and society; description, analysis, and design of information systems to assist problem solving and decision-making in a business environment. Effective From: Fall 2006

IS 590 - Graduate Co-op Work Experience I (3 additive credits)

Prerequisite: students must have the approval of the co-op advisor for the CIS department. Provides on-the-job reinforcement and application of concepts presented in the undergraduate computer science curriculum. Work assignments are identified by the co-op office and developed and approved by the CIS department in conjunction with the student and employer. Students must submit, for CIS department approval, a proposal detailing the nature of the intended work. A report at the conclusion of each semester's work experience is required. Credits for this course may not be applied toward degree requirements for either the bachelor's or master's in computer science. Effective From: Fall 2006

IS 591 - Graduate Co-op Work Experience II (3 additive credits)

Prerequisite: students must have the approval of the co-op advisor for the CIS department. Provides on-the-job reinforcement and application of concepts presented in the undergraduate computer science curriculum. Work assignments are identified by the co-op office and developed and approved by the CIS department in conjunction with the student and employer. Students must submit, for CIS department approval, a proposal detailing the nature of the intended work. A report at the conclusion of the semester work experience is required. Credits for this course may not be applied toward degree requirements for either the bachelor's or master's in computer science. Effective From: Fall 2006

IS 592 - Graduate Co-op Work Experience III (3 additive credits)

Prerequisites: graduate standing, and acceptance by the CIS department and the Division of Career Development Services. Students must have the approval of the co-op advisor for the CIS department. Provides on-the-job reinforcement and application of concepts presented in the undergraduate or graduate computer science curriculum. Work assignments are identified by the co-op office and developed and approved by the CIS department in conjunction with the student and employer. Students must submit, for CIS department approval, a proposal detailing the nature of the intended work. A report at the conclusion of the semester work experience is required. Credits for this course may not be applied toward degree requirements for either the bachelor's or master's in computer science. Effective From: Fall 2006

IS 593 - Graduate Co-op Work Experience IV (0 credits)

Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

IS 613 - Design of Emergency Management Information Systems (3)

This course is concerned with the development of requirements, the design of the human interaction,and the supporting functionality of any Information System related to the complete preparedness lifecycle for emergency, disaster, and crisis situations for government bodies, non-profit, and/or private organizations that are concerned with business continuity. It also focuses on organizational behavior and its effects on the functionality of the system and the design of the human interface. Effective From: Fall 2006

IS 614 - Command and Control Systems (3)

This course investigates the adaptability and use of military Command and Control (C2) to emergency response. It examines the functionality and properties of C2 systems in terms of matching requirements for these systems to the behavior of individuals, groups, and organizations under emergency conditions. The course will also address the concept of integrating systems across the operational, tactical, and strategic spectrum surfacing during various stages of emergency management and response. Effective From: Fall 2006

IS 615 - Improvisation in Emergency Management (3)

This course explores the continuum between planned and improvised behavior in emergency management. It introduces tools and techniques useful for understanding and supporting decision-making in emergencies, and enables learners to apply them in simulated emergency response scenarios. The focus is on decision making under time pressure, the influence of cognitive, policy and organizational factors, and the design and use of technologies to support planned and improvised decision making. Effective From: Fall 2006

IS 616 - Learning Methodologies and Training Technologies (3 credits)

This course provides an overview of learning methodologies and training technologies, with an emphasis on emergency management. It reviews theories and develops skills for the planning, evaluation and selection of traditional and new technology-driven learning and training methods. Course participants will review relevant research and learn how to choose the most effective training methodologies, technologies and content resources appropriate to the needs of different audiences. Effective From: Fall 2007

IS 617 - Social Dimensions of Risk (3 credits)

Low-probability/high consequence events involving terrorism, food safety, and extreme weather offer ample evidence the prevalent approaches of economics and statistics are not able to deal with the complex ways that risk permeates modern societies. This course treats risk analysis as a broad interdisciplinary activity and draws on the full range of the social sciences to explore the multifaceted way that risk infuses itself into the fabric of contemporary affairs. Effective From: Spring 2007

IS 623 - Qualitative Research on Information Systems (3 credits)

Prerequisites: IS 350 (or equivalent covering basics of research in IS) or IS 675. A review of major qualitative research methods in Information Systems research, including interviews, content analysis, participant observation (ethnography), case and field studies, group techniques, and selected other methods. Students read and make experiential use of articles providing examples of the use of these methods in the IS journal literature. Effective From: Fall 2006

IS 631 - Enterprise Database Management (3 credits)

This course introduces the foundations of database systems, focusing on data modeling, query organization, query processing, and transactions. It provides an understanding of the issues in managing database systems as an essential organizational resource. It covers the components of enterprise data architecture, data storage configurations, and information retrieval methods. It proceeds from the relational model to the multidimensional model, object-relational techniques, and web accessed data. Effective From: Fall 2007

IS 634 - Information Retrieval (3 credits)

Prerequisites: CS 631. Covers the concepts and principles of information retrieval systems design. Techniques essential for building text databases, document processing systems, office automation systems, and other advanced information management systems. Effective From: Fall 2006

IS 658 - Multimedia Systems (3 credits)

Prerequisite: CS 601 (Object-Oriented Programming) or equivalent. Multimedia software systems incorporate various media, such as text, images, video and audio, to provide rich experiences for users. This is a course in the design, implementation and evaluation of multimedia systems. The course has three major content areas and goals: (1) multimedia data types-the goal being to understand the development and use of various multimedia data types; (2) usability and user modeling-the goal being to incorporate theories of human perception and cognition into the design and evaluation of multimedia systems; and (3) multimedia design and software tools-the goals being to plan and develop multimedia projects and to be aware of ways in which multimedia is being used in the public and private sectors. Both terms must be completed to receive credit toward the history requirement. Effective From: Fall 2006

IS 663 - Advanced System Analysis and Design (3 credits)

This course focuses on the systems analysis and design techniques employed in the development of software applications. Topics include software process and process models (e.g. Rational Unified Process), project management, structured and object oriented analysis, system design, quality systems, system and software architecture, design patterns, re-use and component-based design, change control and configuration managemnet. Analysis and design will be covered primarily from an object oriented perspective. Students will read selected material from the literature, actively participate in discussions, labs and exercises in addition to participating in projects that involve analysis and design for real-world problems. Effective From: Fall 2006

IS 675 - Information System Evaluation (3 credits)

Theoretical perspectives and methodological approaches to evaluate information systems within the context of the user and organizational environment. Topics include qualitative techniques such as protocol analysis and interviews; quantitative techniques such as sample surveys and controlled experiment; cost-benefit analysis, and analyses of data gathered by these approaches by methods such as regression, correlation, and analysis of variance. Emphasis on the application of these approaches to improve functionality, interface, and acceptance of information systems in organizations. Effective From: Fall 2006

IS 676 - Requirements Engineering (3 credits)

Prerequisites: IS 663 or CS 673 or equivalent project experience in the field. Theory, principles, and practical application of the methodologies and tools of requirements engineering. The focus is development of large software systems and the integration of multiple systems into a comprehensive, domain dependent solution. All aspects of requirements engineering will be covered, including problem analysis, requirements specification techniques and tools, and specification of functional and non-functional requirements. Related technologies like domain analysis and pre-planned systems integration are also discussed. Effective From: Fall 2006

IS 677 - Information System Principles (3 credits)

Prerequisites: familiarity with the organization of a computer system and knowledge of at least one higher-level language. Reviews the role of information systems in organizations and how they relate to organizational objectives and organizational structure. Identifies basic concepts such as the systems point of view, the organization of a system, the nature of information and information flows, the impact of systems upon management and organizations, human information processing and related cognitive concepts. Introduces various types of applications that are part of information systems. The course focus is on management information systems. Effective From: Fall 2006

IS 678 - Business Systems Management (3 credits)

This course adopts a common framework of practices for managing business information systems. It introduces the widely-deployed international standard IT Infrastructure Library (ITIL) fundamentals. These include the service management life cycle, service strategy, service design, service transition, service operation, and continual service improvement. Services are the individual operations or task components that a business needs to perform. This course presents an overview of how each topic applies to managing the services embodied within business systems and focuses in depth on the service design and service operation processes. Effective From: Fall 2008

IS 679 - Management of Computer and Information Systems (3 credits)

Management of the development, planning, and utilization of information systems within organizations. Focuses on the current literature in the management of information systems. Topics include the approval and decision process for the development of systems, use of steering committees and various approaches to user involvement. Utilizes a number of Harvard University case studies. Project utilizing professional literature required. Effective From: Fall 2006

IS 680 - Information Systems Auditing (3)

This course is intended to provide the student with a fundamental working knowledge of a number of IS risk and control issues that affect industries today. Topics include the IS audit process, IT infrastructure and operations, information protection, disaster recovery and business continuity, IT service delivery and support, business application systems, and project management. Following each section, students will work through a series of Certified Information Systems Audit exam questions. Effective From: Fall 2006

IS 681 - Computer Security Auditing (3 credits)

Prerequisites: CS 601 or CS 631 or permission of the instructor. Security control risks and issues. Information protection concepts, elements of security systems, computer crime and legal issues, controls and auditing systems, firewall configuration. Effective From: Fall 2006

IS 682 - Forensic Auditing for Computing Security (3 credits)

Prerequisites: CS 652 or CS 656. A computer forensics audit is the proper identification and collection of computer evidence. Computers are involved in security violations through crime or violations of policy, or being targeted by an attack. This course deals with the preservation, identification, extraction, documentation, reporting, acquisition, analysis and interpretation of computer data. Topics covered include evidence handling, chain of custody, collection, preservation, identification and recovery of computer data. In this hands-on course, you will conduct several labs where you will be taught to analyze, review and extract information from computer hard drives, and determine what and how the information could have been compromised. Computer Forensics Audit professionals become experts in e-discovery and preserving sensitive evidential matter. Effective From: Summer 2009

IS 683 - Object-Oriented Software Development (3 credits)

Prerequisites: CS 635, experience in software design and development or explicit approval of the instructor. Advanced course in software development. Presents the object-oriented methodology for software development and examines various areas to which this methodology can be applied. Analysis, design, and implementation of object-oriented software and the effect of this methodology on code reusability, extensibility, and robustness. Examines object-oriented languages, object-oriented databases, and object-oriented user-interfaces. Effective From: Fall 2006

IS 684 - Business Process Innovation (3 credits)

Prerequisites: IS 663 or CS 673. Knowledge of information systemsdevelopment. Discusses a balanced approach to business process innovation (BPI) that includes both incremental improvement and re-engineering. Introduces strategy and process alignment, various types of busines processes, and process mapping software. Details a BPI implementation methodology, interwoven with many case studies. Students will work on real process re-design projects using a process mapping software product. Effective From: Fall 2006

IS 685 - Enterprise Architecture and Integration (3 credits)

Prerequisites: None, but recommend completion of IS 663 or CS 673. The Enterprise Architecture (EA) describes an organization's IT strategy and operational structure. IS and IT professionals utilize the EA to analyze, design and integrate the (often heterogeneous) IT infrastructure and applications to most effectively support the enterprise and respond to risks. Students learn to develop an EA analysis which reflects its business strategies, capabilities, processes, and systems, metrics, information resources, and networking infrastructure. This enables students to determine the impact of IT solutions, by learning to deconstruct, analyze and configure IT systems in alignment with enterprise-wide business strategies. The course covers the industry standard TOGAF enterprise architecture framework and focuses on Enterprise Application Integration (EAI). Effective From: Summer 2009

IS 686 - Pervasive Computing: An HCI Perspective (3 credits)
This course examines Pervasive/Ubiquitous Computing, the trend toward increasingly ubiquitous connected computing devices in the environment. A trend being brought about by a convergence of advanced electronic, and particularly, wireless technologies and the internet. It does this from a Human Computer Interaction perspective looking at the current and future design of various systems. Effective From: Fall 2006

IS 687 - Transaction Mining and Fraud Detection (3 credits)
Pre-requisite: Math 333 or equivalent. Increasingly, all of our transactions are electronic. We use debit and credit cards (electronic transactions) instead of checks and cash at banks, restaurants, stores and many other businesses. This course presents methods for finding opportunity and risk in this transaction data. Evaluation of transactions to find risk includes detection of terrorists and money launderers. This course will review case studies of transaction monitoring and will discuss the range of methods that are applied. Effective From: Spring 2007

IS 688 - Web Mining (3 credits)
Web mining aims to discover useful information and knowledge from the Web hyperlink structure, page contents and usage logs. It has direct applications in e-commerce, Web analytics, information retrieval/filtering, personalization, and recommender systems. Employees knowledgeable about Web mining techniques and their applications are highly sought by major Web companies such as Google, Amazon, Yahoo, MSN and others who need to understand user behavior and utilize discovered patterns from terabytes of user profile data to design more intelligent applications. The primary focus of this course is on Web usage mining and its applications to business intelligence and biomedical domains. We learn techniques from machine learning, data mining, text mining, and databases to extract useful knowledge from the Web and other unstructured/semistructured, hypertextual, distributed information repositories. This data could be used for site management, automatic personalization, recommendation, and user profiling. Topics covered include crawling, indexing, ranking and filtering algorithms using text and link analysis, applications to search, classification, tracking, monitoring, and Web intelligence. Programming assignments give hands-on experience. A group project highlights class topics. Effective From: Fall 2009

IS 690 - Web Services and Middleware (3 credits)
Web services enable integration of web-based applications and feature sets to any other web-based system in a modular way. Middleware is a set of functionality positioned in between and enabling interoperability among different, distributed enterprise and other computing applications. This course provides an introduction to web services and middleware in the context of digital libraries - large scale multimedia information repositories. Students will gain hands on experience in developing their own web services manageing a complex distributed computing platform. Effective From: Spring 2010

IS 698 - Special topics in Information Systems (3)
Special area course given when suitable interest develops. Advance notice of forthcoming topics will be given. Effective From: Fall 2006

IS 725 - Independent Study in Information Systems (3 credits)
Prerequisites: Graduate standing and department consent. Effective From: Fall 2006

IS 732 - Design of Interactive Systems (3 credits)
Prerequisite: IS 675. Design of interactive systems and human computer interfaces. Covers the current professional literature in this field and the knowns about design. Emphasizes application areas that have a great deal of cognitive variability and diverse user populations. Design interfaces for various applications. The impact of costs and operational practices upon user behavior and current research topics in interface design are covered. Effective From: Fall 2006

IS 735 - Computer Mediated Communication Systems (3 credits)
Prerequisite: IS 675. Seminar for students contemplating research in the following areas: designs and the impact of, computer-based systems for human communication, including electronic mail, computer conferencing, Computer-Supported Cooperative Work (CSCW), Group Decision Support Systems (GDSS), the Internet and the World Wide Web. Topics include alternative design structures, impacts of primarily text-based asynchronous group communication, and recent empirical studies. Completion of a publishable state-of-the-art written review or design of a tailored CMC system is required. Effective From: Fall 2006

IS 754 - Measurement and Evaluation of Software Quality and Performance (3 credits)
Prerequisites: Ph.D. core courses, CS 630, CS 661. A study of the tools for the measurement of software products and the use of these tools in the evaluation of software quality and performance. Structural and functional models of algorithms, programs, and systems are presented to define the quantitative and subjective characteristics of computer products. Course includes the use of hardware and software tools, the study of simulation and analytic techniques, description of workloads and benchmarks for system evaluation, problems of scale, proof of program correctness, feature value analysis, and the design and interpretation of experiments. Effective From: Fall 2006

IS 762 - Computerized Information Systems for Planning and Forecasting (3 credits)
Prerequisite: IS 675. Capturing and processing of subjective and empirical data for use in planning and forecasting information systems and the incorporation of these facilities into information systems designs. Emphasis on conveying understanding of the limitations of various methods

and techniques to meet various planning and forecasting objectives. Use of various techniques such as the Delphi method, structural modeling, cluster analysis and regression approaches. Effective From: Fall 2006

IS 763 - Qualitative Methods in IS Research (3)

Prerequisites: IS 675 or IS 350 (or an equivalent course) A review of major qualitative research methods in Information Systems research, including interviews, content analysis, participant observation (ethnography), case and field studies, group techniques, and selected other methods. Students read and make experiential use of articles providing examples of the use of these methods in the IS journal literature. Effective From: Fall 2006

IS 764 - Research Methods for Human-Centered Computing and Design (3 credits)

Prequisites: None. This introductory seminar in human centered computing and design provides a survey of the methodological literature on qualitative research methods paired with appropriate article-length exemplars. We cover a variety of different research strategies including design science, action research, case study, qualitative data collection and analysis techniques, and scenario-based design. This course develops skills in designing and evaluating systems using qualitative methods. We also discuss writing and reviewing academic articles and research proposals. The course utilizes information systems as the primary domain but could be extended for students in other disciplines. Effective From: Fall 2009

IS 767 - Decision Support Systems (3 credits)

The design, implementation, and utilization of models and their software support systems for application in managerial decision making at the strategic, tactical, and operational levels. Topics include the perspective of decision-support systems, the management of large simulation models and documentation standards, combined hybrid simulation languages and their applications, financial modeling and financial modeling languages. Systems dynamics and its managerial applications at the strategic level; specialized modeling and analysis software packages for managerial decision making; and recent research in computer-aided tools for capturing group judgment, modeling, and decision-making are also discussed. Effective From: Fall 2006

IS 776 - Independent Study in Information Systems (3 credits)

Prerequisite: restricted to students in the doctoral program in Information Systems (or students in the joint Rutgers- NJIT PhD in management who major in CIS). Students must have an approved program of study and approval of a faculty advisor to register for this course. Normally used for work on the "state of the art literature review," preceding the thesis, which is then presented to a committee for approval. Effective From: Fall 2006

IS 786 - Special Topics (3 credits)

Prerequisites: same as for CS 785. A continuation of CS 785. Effective From: Fall 2006

IS 787 - Information Systems PhD Seminar A (1 credit)

The seminar includes student presentations related to their research, faculty presentations, and occasional outside speakers. Its goal is to enable students to identify their research areas for the dissertation, and to obtain constructive feedback on their papers and research in progress. Two presentations are required of each student. Open to students in the PhD program in Information Systems. Effective Until: Fall 2006

IS 788 - Information Systems PhD Seminar (3 credits)

Prerequisite: restricted to students in the doctoral program in Information Systems (or students in the joint Rutgers- NJIT PhD in management who major in CIS). The seminar includes student presentations related to their research, faculty presentations, and occasional outside speakers. Its goal is to enable students to identify their research area for the dissertation, and to obtain constructive feedback on their papers and research in progress. Students are required to engage in a research internship under the direction of a faculty member, and to make at least three presentations, including at least one for a paper to be submitted to a professional meeting or journal. Effective From: Spring 2007

IS 791 - Graduate Seminar (Non-credit)

A seminar in which faculty, students, and invited speakers will present summaries of advanced topics in computer and information systems management. In the course students and faculty will discuss research procedures, dissertation organization, and content. Students engaged in research will present their own problems and research progress for discussion and criticism. Effective From: Spring 2007

IS 792 - Pre-Doctoral Research (3 credits)

Prerequisite: permission from department chairperson. For students admitted to the doctoral program in computer and information science who have passed the field exam or the qualifying examination. Research is carried out under the supervision of a designated faculty member. Students identify a research problem and prepare a plan to solve the problem. A maximum of 6 credits of CS 792 may be applied to the CIS 790 requirement. Effective From: Fall 2006

IS 794 - Computer Science/Information Systems Colloquium (Non-credit)

Prerequisite: graduate standing with major in computer science. Colloquium in which national and international experts in the various fields of computer science are invited to present and discuss the results of their recent research. Effective From: Fall 2006

International Studies:

UNDERGRADUATE COURSES:

MR INTL - Study Abroad (12 maintenance-of-registrations credits)

Prerequisite: permission from the Office of International Students and Faculty. NJIT, through direct exchange agreements and through membership in an engineering educational exchange consortium, offers students the opportunity to study abroad for a semester or an academic year. Students may select any of the courses that meet their degree requirements with written approval from the academic advisor. Transfer credits will be awarded for pre-approved courses successfully completed at the end of the exchange period. Open to all majors.

GRADUATE COURSES:

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Management: Offered by the School of Management.

UNDERGRADUATE COURSES:

Mgmt 190 - Introduction to Business (3-0-3)

Introduction to business enterprise, including organization structure, basis of authority and responsibility, financial systems, marketing, and the interaction of government and business. The interrelationships of the broad economic, political, psychological, and social influences upon business. Effective From: Spring 2008

Mgmt 216 - Business Statistics (3-0-3)

Prerequisite: Math 105 or Math 333. Introduction to business data analysis for application in management decision-making processes. Productivity measures, employment trends, national income data, and consumer price changes. Methods for collection of business and economic data, presentation of data and computer applications, index numbers, historical analysis trend projections, survey sampling, and planning for business research.

Mgmt 290 - Legal Environment of Business (3-0-3)

The basic principles of common and statutory law applicable to business and professional relationships, emphasizing contracts, negotiable instruments, sales of goods, agency and business organizations.

Mgmt 310 - Co-op Work Experience I (3 additive credits)

Prerequisites: junior standing, approval of the school, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the co-op office. Mandatory participation in seminars and completion of a report.

Mgmt 316 - Business Research Methods (2-1-3)

Prerquisites: Mgmt 216, MIS 245. This course covers business research methodologies with an emphasis on data collection/mining and data analysis. It offers the knowledge skills to conduct research in all applicable fields from the traditional areas of business, such as, marketing, finance, human resources, operations and service management, as well as web-based e-commerce related research applications. Upon completion, students will be able to: (1) understand business research methodologies, (2) conduct business research studies, (3) present the results, analyses and recommendations to management. Effective From: Fall 2009

Mgmt 350 - Knowledge Management (3-0-3)

The purpose of this course is to introduce students to Knowledge Management. This term is used to refer to the ways in which organizations create, gather, manage and use the knowledge. Emphasis is placed on the information systems needed to capture and distribute knowledge and how knowledge can be used to gain competitive advantage.

Mgmt 380 - Principles of E-Commerce (3-0-3)

This course is designed to provide an overview of electronic commerce technologies, e-commerce strategies and their implications for work organizations. The course focuses on how the Internet has transformed business and the emergence of the digital firm. Effective Until: Spring 2009

Mgmt 390 - Principles of Management (3-0-3)

Prerequisite: junior or senior standing. The broad basic principles of the managerial process that are fundamental to the successful operation of various types of enterprises. Emphasizes the role of management at all levels of responsibility. Organization, motivation and morale; scientific management and human relations; the functions of planning, directing, and controlling. A rational synthesis of research and concepts, which together constitute the subject matter of management.

Mgmt 390H - Honors Principles of Management (3-0-3)

Prerequisites: member of the Honors College or permission of the instructor

Mgmt 410 - Co-op Work Experience II (3 credits)
Prerequisites: Mgmt 310 or equivalent, approval of the school, and permission of the Office of Cooperative Education and Internships. Provides major-related work experience as a co-op/intern. Mandatory participation in seminar and completion of requirements that include a report and/or project.

Mgmt 460 - Management Strategies for E-Commerce (3-0-3)
Prerequisite: MIS 360. Learn about the Internet, intranets and extranets and incorporating them into business planning and operations

Mgmt 480 - Managing Technology and Innovation (3-0-3)
Prerequisite: Mgmt 390. Introduction to an array of technologies affecting management functions to provide an appreciation and understanding of the importance of new technologies as critical success factors for modern organizations. An integrative approach is taken in analyzing how changes in technology affect individual, group, and organizational effectiveness. Effective From: Spring 2008

Mgmt 485 - Special Topics in Management (3-0-3)
The study of new and/or advanced topics in the various fields of business and their application not regularly covered in any other business course. The precise topics to be covered, along with prerequisites, are announced in the semester prior to the offering of the course. Effective From: Fall 2009

Mgmt 491 - International Business (3-0-3)
A basic understanding of the activities in international business providing a framework for understanding them from the perspective of a company manager. Covers international trade, multinational enterprises, foreign exchange, foreign direct investment, international financial institutions, barriers to international trade, accounting of taxation, industrial relations, multinational enterprise, and world order

Mgmt 492 - Business Policy (3-0-3)
Prerequisite: senior standing. A capstone course in the area of business administration focusing on the integration of concepts taught in various functional courses such as marketing, finance, operations management, accounting, organizational behavior. Issues related to corporate responsibilities and ethical behavior are also incorporated in this course. Emphasis on application of concepts to real life situation is achieved through case discussion and projects.

Mgmt 492H - Honors Business Policy (3-0-3)
Prerequisites: member of the Honors College, senior standing.

Mgmt 496* - Introduction to Transportation (3-0-3)
Prerequisite: upper division standing. Introduction to transportation systems and the transportation industry. Survey of the various modes of transportation, organizational structure and operation of private and public carriers. The role of government in the regulation of the U.S. transportation industry. Management of traffic and physical distribution operations. Cost and service comparisons of competing modes of transportation. Organized labor and associated costs.

GRADUATE COURSES:

IM 593 - Graduate Co-op Work Experience IV (0 credits)
Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

Mgmt 501 - Management Foundations (3-0-3)
This course provides foundation knowledge for MSM and MBA students whose undergraduate coursework does not include coursework in accounting and finance. It therefore, serves as a pre-qualifier for the MSM and MBA programs. Effective From: Fall 2004

Mgmt 580 - Managerial Science (3 credits)
Introduction to methods of operations research and systems analysis of managerial problems: objective functions and constraints, theories of values, optimization and simulation modeling with emphasis on models of production systems, decision analysis, inventory systems, project planning, and transportation systems. Deterministic and stochastic approaches to these topics are covered.

Mgmt 610 - Foundations of Management in Organizations (3 credits)
Presented during the residence week for the Executive Program. Includes management accounting, managerial economics, statistics, operations research, marketing, MIS, and finance.

Mgmt 612 - Principles of Emergency Management (3 credits)
This course covers core aspects of Emergency Management (EM). EM theory identifies four critical areas: 1) understanding & mitigating risk, 2)

planning & preparedness, 3) reaction & response, 4)recovery/normalization. This course focuses on innovative approaches to EM in each area. Also: risk & cost assessment, entrepreneurial approaches to disaster prevention & response, self-organized response, new technologies for emergency management, terrorism & global issues, and after-action evaluations. Effective From: Fall 2007

Mgmt 616 - Learning Methodologies and Training Technologies (3 credits)

This course provides an overview of learning methodologies and training technologies, with an emphasis on emergency management. It reviews theories and develops skills for the planning, evaluation and selection of traditional and new technology-driven learning and training methods. Course participants will review relevant research and learn how to choose the most effective training methodologies, technologies and content resources appropriate to the needs of different audiences. Effective From: Fall 2007

Mgmt 620 - Management of Technology (3 credits)

Technology as a main component of an organizational entity. Generation, development, and implementation of technology are outlined. Influence of technology on global competitiveness is also discussed.

Mgmt 625 - Distribution Logistics (3 credits)

Distribution logistics emphasizing techniques used to optimize corporate profit and customer service; transportation modes; inventory policies; warehousing and order processing; and the best logistics gross margin. Same as EM 640 and Tran 640.

Mgmt 630 - Decision Analysis (3 credits)

Introduction to the methodology of decision analysis using computer based techniques and systems analysis. Introduces concepts of modeling, probability, and choice. Addresses the philosophy and detailed methods involved in decision analysis. Methods are applied to address routine and special business decisions.

Mgmt 635 - Data Mining and Analysis (3 credits)

This course provides an introduction to data mining with an emphasis on large scale databases as a source of knowledge generation and competitive advantage. Specific topics include: framing research questions; data modeling; inferential data mining techniques; and evaluation and deployment of data mining systems.

Mgmt 640 - New Venture Management (3 credits)

Prerequisite: Fin 516. For the student who is considering starting or managing a new business. The course combines classroom instruction in business management and a term project involving the analysis of a business case. The course is designed to build upon and integrate the student's previously acquired business knowledge and skills into an understanding of how to start and run a new business.

Mgmt 642 - Corporate Communication (3 credits)

Develops communication skills for modern global corporate and business markets. Business documents may include mission/vision statements, business plans, financial statements/plans, marketing plans, and corporate policies and procedures. Effective From: Fall 2007

Mgmt 644 - Communication in Technology Transfer and Innovation (3 credits)

In order to help prepare students for careers in a market-oriented productive economy, this course builds on the understanding that communication is essential to innovation development and technology transfer. Students first review the principles of successful technical communication and the models and literature of communication in technology transfer. Then, students apply this knowledge in team-based projects to develop Technology Transfer Communication Strategy (TTCS) for technology start-up companies as needed (business plans, documentation, technical reports, etc.) Effective From: Fall 2007

Mgmt 645 - New Venture Finance (3 credits)

Prerequisite: Fin 516. This course is designed to provide students with understanding of the problems and opportunities posed by the financing of a new and growing technology-based business. Students will study the financial conditions of new businesses and examine the effect of growth upon cash flow while exploring optimal sources of capital.

Mgmt 650 - Knowledge Management (3 credits)

Prerequisite: MIS 545. Students will learn the principles of the knowledge management process. At the end of the course, students will have a comprehensive framework for designing and implementing a successful knowledge management effort and be able to assist in the development of knowledge.

Mgmt 655 - Global Competitiveness (3 credits)

Improves knowledge of the issues involved in international business operations and their management. Develops skills in selecting key issues and familiarization with emerging methods for organizing and managing international operations. Emphasis will be on companies with technological, product, production, or design focus.

Mgmt 657 - Import/Export Processes (3 credits)
Prerequisite: Mgmt 670 or Mgmt 655. Discusses key elements of import/export planning processes with an emphasis on the technology-based firm. International environment, market analysis, export strategy, and transactions are studied. Covers trade regulations and policies, financial advantage of foreign trade zones, and international standards for technology-based products. Factors underlying trade encouragement and restrictions between nations are also considered.

Mgmt 660 - Managing Supply and Value Chains (3 credits)
This course is focused on the flow of products, information and revenue across supply and value chains in organizations. Special emphasis is placed on emerging e-business models and their effects on supply and value chains, and customer relationship management. The course also includes a survey of relevant information technologies.

Mgmt 665 - International Product Development (3 credits)
Prerequisite: Mgmt 670 or Mgmt 655. Students will learn about product development processes as part of international business development operations. Examines differences in developing products for: national and international customers, production and service industries, and static and dynamic client needs. Examines methods of design management, means to integrate product design, production, and marketing functions, and measures for product life-cycle accounting. Term projects examine national differences in product development.

Mgmt 670 - International Business (3 credits)
Covers the scope and the essential characteristics of international business in the world economy; MNEs as economic, political, and social institutions; national and international control; functional management and operations; country evaluation; and regional market analysis.

Mgmt 675 - Legal Environment of International Business (3 credits)
Focuses on the legal aspects of international business activities. Topics include: international trade practices and government regulations; legal aspects of international joint ventures, mergers, and acquisitions; and the legal component of intellectual property rights and its relation to trade disputes.

Mgmt 676 - Managing the Digital Firm (3 credits)
Sweeping technological change coupled with globalization has led to the development of new organizational forms which fall into the general category of digital firms. This course is focused on the digital processes that are transforming organizations and on managing all aspects of the digital firm. Topics include managing a virtual workforce, managing digital technologies, and protecting and leveraging digital assets.

Mgmt 678 - Management Strategies for Electronic Commerce (3 credits)
Examines recent developments in information technology that have had a significant impact on the economy and various industries with a focus on management strategies. Topics include intellectual property rights, privacy, ownership of information, and security.

Mgmt 680 - Entrepreneurial Strategy (3 credits)
For the student who is considering starting and/or managing a new business. Integrates knowledge of the different aspects of business that have been learned as separate subjects. Provides an understanding of the decisions that guide the overall operations of an entrepreneurial business organization and how it interacts with its markets, competitors, and suppliers. Combines classroom instruction in business strategy along with case analysis of small firms. Should be taken in the last semester of the program, unless prior arrangement has been made with the instructor or the graduate advisor. Taken in the final semester only.

Mgmt 681 - Project-Based Enterprise Development (3 credits)
Enterprise development involves activities geared toward substantive renewal of established enterprises or industries. In this Course, students will work with enterprise development projects including corporate venturing, international expansion, or business development initiatives, as well as, identification and implementation of new, more ethical business models, or restructuring of established businesses, just to mention a few examples. Effective From: Fall 2008

Mgmt 685 - Operations Research and Decision Making (3 credits)
Introduces the concepts of objective functions and constraints, concepts of value and utilities, optimization algorithms, networks, and game theory. Covers models of linear programming, inventory systems, multi-criteria decision-making, project management, and transportation planning. Topics discussed from probabilistic and deterministic approaches.

Mgmt 686 - Corporate Governance (3 credits)
Presents inter-disciplinary perspectives on the rights, responsibilities and roles of the corporation in society. Focuses on the relationships among owners, managers, and other stakeholders. Analyzes corporate control mechanisms including ownership concentration, executive compensation, boards of directors, and the market for corporate control. Includes changes in political/legal/regulatory institutional environments over time, and develops a comparative international framework. Effective From: Fall 2009

Mgmt 688 - Information Technology, Business and the Law (3 credits)

Includes historical and constitutional foundations, crimes, and torts in cyberspace, virtual property (patents online, copyrights in digital information, trade secrets in cyberspace, and cybermarks), electronic commerce contracting, electronic commerce, electronic money and the law, and information technology and online infringement of rights of intellectual property.

Mgmt 690 - Electronic Communities in Organizations (3 credits)

The rapid acceptance of the Internet and the growth of corporate intranets have spawned the development of electronic communities within and outside of organizations that share ideas, information and knowledge. This course explores the development, use and dynamics of electronic communities with an emphasis on their role in work organizations. Students will learn how to analyze and evaluate learning communities and to examine their relationship to important processes in organizations such as change, knowledge management, and customer relationship management.

Mgmt 691 - Legal and Ethical Issues (3 credits)

Explores the legal and ethical responsibilities of managers. Analyzes extent to which shareholders should be allowed to exercise their legitimate economic, legal, and ethical claims on corporate managers; extent of regulation of a particular industry, individual rights of the employee and various corporate interests, and corporate responsibility to consumers, society, and conservation of natural resources and the environment.

Mgmt 692 - Strategic Management (3 credits)

Prerequisites: Business Fundamentals Core. Integration of the functional areas in management providing a top management perspective to the role of chief executive in an organization; strategy formulation and implementation; and ethical issues related to corporate strategies. Taken in the final semester only.

Mgmt 695 - Business Strategy for Environmental Management (3 credits)

This is a capstone course integrating the functional areas in management to provide a top management perspective to potential managers. The course deals with the role of the chief executive in environmental management and how strategies are formulated and implemented.

Mgmt 701 - Master's Thesis (6 credits)

Prerequisite: approval of the assistant dean for graduate programs. For students who desire to complete a thesis in management. Students must register every semester until the thesis is completed. Only 6 credits indicated for the thesis is applied to degree credit.

Mgmt 710 - Forecasting Methods for Business Decisions (3 credits)

Covers the application of forecasting techniques to various phases of business and management decision making. Topics include forecasting with cyclical and seasonal series; Box-Jenkins modeling; regression modeling; use of stochastic models; and the linkage of management forecasts to macro forecasts. Actual models in use will be reviewed and evaluated.

Mgmt 791 - Graduate Seminar (Non-credit)

Faculty, students and invited speakers present and discuss current topics of research in management.

R620:555 - Seminar in Organizational Behavior (3 Credits)

For more details go to Rutgers Catalog.

R620:556 - Seminar in Organizational Theory (3 credits)

For more details go to Rutgers Catalog.

R620:671 - Management of Innovation and Technology (3 credits by arrangement)

For more details go to Rutgers Catalog.

R620:677 - Culture and Organizations (3 credits by arrangement)

For more details go to Rutgers Catalog.

Marketing Management: Offered by the School of Management

UNDERGRADUATE COURSES:

Mrkt 330 - Principles of Marketing (3-0-3)

Provides an understanding of how environmental factors (political, legal, economy, competition, socio-cultural, and technology) influence the design of product, pricing, promotion and distribution strategies. Topics discussed include strategies to satisfy target markets, market segmentation, buyer behavior, marketing ethics, and an introduction to global marketing issues. Fundamentals of marketing are integrated using cases, videos, and class projects. Effective From: Spring 2008

Mrkt 331 - Consumer and Buyer Behavior ((3-0-3))

Prerequisites: Math 105 and Mrkt 330. Psychological, social, and economic influences on consumer behavior. The application of consumer behavioral innovation to marketing decisions: research and measurement techniques, individual influences, environmental influences, and consumer information processing and decision making. A field research project will be undertaken. Effective From: Fall 2005

Mrkt 338 - Product Development and Management (3-0-3)

Prerequisite: Mrkt 330. The process of product development is studied in detail with specific emphasis on technology-driven innovation. Techniques for getting closer to customers including TQM principles are also covered.

Mrkt 339 - Professional Selling (3-0-3)

Prerequisite: Mrkt 330. Provides an understanding of multifaceted roles salespeople play and prepares students for sales careers in business-to-business firms. Discusses the personal selling process that include prospecting and qualifying, sales call planning, approaching prospects, giving sales demonstrations and presentations, negotiating sales resistance, confirming and closing "win-win" agreements. Places emphasis on building customer relationships and partnerships by providing customer service and to ensure satisfaction and build customer loyalty. Concepts are discussed and integrated using role-playing, experiential exercies, videos, cases and class projects. Effective From: Spring 2008

Mrkt 360 - Internet Marketing (3-0-3)

Prerequisite: Mrkt 330. Provides an overview of fundamental principles of Internet marketing for the contemporary business environment. Topics include Internet marketing strategies, Internet marketing plan, and development of Internet-based marketing programs. Effective From: Spring 2008

Mrkt 430 - Marketing Research (3-0-3)

Prerequisite: Mrkt 330. The process of marketing research is studied in detail from study design through report preparation. A hands-on, experiential approach is taken with an emphasis on secondary research and multivariate statistical methods. Data analysis is conducted using SAS and/or SPSS.

Mrkt 432 - Sales Management (3-0-3)

Prerequisite: Mrkt 330. This course helps the student to understand the various sales management activities that sales managers are responsible for in their important role as revenue generation managers. Key topics that are discussed within the realm of organizing, managing and controlling the sales force include sales forcasting, budgeting, sales force organization, time and territory management, recruitment, selection and training the salespeople, leadership, motivation, compensation, and sales force performance evaluation. Sales ethics and customer relationship management issues are also addressed. Effective From: Fall 2008

Mrkt 434 - Business to Business Marketing (3-0-3)

Prerequisite: Mrkt 330. Techniques for marketing industrial products to organizations in the manufacturing, service, government, and non-profit sectors are covered within the context of a global marketplace. Emphasis is on the marketing of high technology products using a customer-driven approach. Effective From: Spring 2008

Mrkt 435 - International Marketing (3-0-3)

Prerequisite: Mrkt 330. This course will help students understand how the product, pricing, promotion and distribution elements of the marketing mix are influenced by international forces (cultural, political-legal, economic, competitive, and technological environment). Topics discussed include global market segmentation, marketing ethics, standardization or adaptation of the marketing mix as well as global information systems and market research, segmentation, targeting, and foreign market entry strategies (importing, exporting, licensing, and strategic alliances). Course concepts are integrated using cases, videos, and class projects. Effective From: Summer 2008

Mrkt 485 - Special Topics in Marketing (3-0-3)

The study of new and/or advanced topics in the various fields of business and their application not regularly covered in any other business course. The precise topics to be covered, along with prerequisites, are announced in the semester prior to the offering of the course. Effective From: Fall 2009

GRADUATE COURSES:

Mrkt 530 - Principles of Marketing 3 credits (3 credits)

Examination of the factors relating to marketing process. The nature and significance of consumer and organization buying behaviors, competition, government regulations, consumerism, and social responsibility are analyzed. Covers decision making in market research, product development, pricing, distribution, advertising, promotion, selling, and marketing strategy.

Mrkt 620 - Competing in Global Markets (3 credits)

Designed to help prepare students to become effective managers overseeing global market activities in an increasingly competitive environment. It will examine the impact of global economic, financial, cultural, political, and legal factors on the development of marketing programs and on the marketing/R&D and marketing/manufacturing interfaces.

Mrkt 630 - Models of Consumer Behavior (3 credits)

Provides students a framework, the buyer decision process model, to analyze how and why products and services are selected and purchased. Impact of consumer decisions on the marketing strategies of organizations is emphasized. Focus on quality management of the marketing function to determine customer needs; provide the appropriate products, prices, distribution systems, and promotion messages; and measure customer satisfaction after purchase and use.

Mrkt 631 - Market Planning and Analysis (3 credits)

Provides a research and managerial perspective on advanced marketing research methods and analytical techniques. Topics include problem formulation, research design, data collection and analysis, managerial report writing. Students will acquire experience by developing and executing their own marketing research project using sophisticated computerized analytical techniques.

Mrkt 632 - Marketing Strategy for Technology-Based Organizations (3 credits)

Students combine the knowledge and skills learned in other marketing courses and develop strategic marketing plans that focus on quality management, productivity improvement, and international competitiveness. Buyer decision making, market segmentation and targeting, product positioning, market response, and competitive actions are analyzed. Case studies and student projects add realism and practical experience to the course.

Mrkt 636 - Design and Development of High Technology Products (3 credits)

Focus on analysis of needs of buyers and consumers for specific product characteristics and the development of appropriate products to satisfy such needs. The process of identifying new product opportunities, screening new product concepts, product testing and test marketing, product positioning, and development of the marketing strategy and implementation plans.

Mrkt 637 - Marketing Communications and Promotions (3 credits)

Communications, sales promotion, and public relations are examined from the perspective of the manager. Topics include advertising and promotion research, media selection, creative production of electronic and print materials, and the budgeting and control of their use. Field research will be stressed as part of the course project requirement.

Mrkt 638 - Sales Management for Technical Professionals (3 credits)

Focuses on the promotion and sales of products in the business-to-organization market. All elements of the marketing communications mix are covered according to their importance in that market: selling, sales promotion, trade advertising, and publicity. The latest techniques are reviewed and discussed using case histories and student projects. Issues of global competitiveness, high technology products, and the role of total quality management in marketing communications are emphasized.

Mrkt 640 - Industrial Marketing Management (3 credits)

Stresses the role of the manager in all aspects of marketing. Managerial decision-making techniques and strategies for product development, product pricing, distribution channels, personal selling, advertising and promotion. Strategic and operational marketing plans are developed based on student field research.

Mrkt 642 - International Marketing Management (3 credits)
Focus on multinational enterprise in the global market, emphasizing special managerial skills required to adapt sound marketing practices to foreign cultural, political, economic and financial environments. Foreign opportunities and marketing strategies are examined. Students prepare a marketing plan for entry into an international market after conducting appropriate research.

Mrkt 645 - Internet Marketing Strategy (3 credits)
Introduction to the use of the Internet and electronic commerce in the development of marketing strategy. Examines the characteristics of electronic markets, the use of Internet for data collection and market research, the Internet as a communication and distribution medium, and the development of Internet-based marketing strategies.

Mrkt 701 - Thesis in Marketing Management (3 credits)
Prerequisites: Mrkt 630, Mrkt 631, Mrkt 632 or waived with approval of the Dean. For students who do a thesis in marketing. State-of-the-art marketing research methods: importance in marketing decision making, research objectives, research design, measurement concepts, reliability and validity, primary and secondary data collection, sampling design, qualitative and quantitative research and analytical methods, field studies and survey research, multivariate analytical models. Also covers planning, preparation and submission of the thesis.

Mrkt 731 - Advanced Market Planning and Analysis (3 credits)
Prerequisite: Mrkt 631. Covers advanced topics in the design and analysis of market research studies. Focus on the development of statistical sampling methods and techniques to develop estimates for complex marketing problems. Also focuses on advanced multivariate analysis and estimation techniques needed in the interpretation of complex marketing problems.

Mrkt 753 - Marketing Science (3 credits)
Prerequisite: Mrkt 631. Emphasizes quantitative model building approach to the complex problems of marketing decision making using the principles of quantitative decisions to management problems and econometrics to the understanding of large amounts of data, which lead to improvements in marketing decision effectiveness. Such areas of marketing as buyer behavior, pricing, promotion, advertising, sales force management, and new product planning will be analyzed.

R630:576 - Quantitative Methods in Marketing Credits by arrangement (3 credits)
For more details go to Rutgers Catalog.

R630:625 - Clustering Analysis (3 Credits by arrangement)
For more details go to Rutgers Catalog.

R630:660 - Qualitative Research Methods (3 credits)
For more details go to Rutgers Catalog.

R630:668 - Causal Modeling (3 credits)
For more details go to Rutgers Catalog.

Marketing Management: Offered by the School of Management

UNDERGRADUATE COURSES:

Mrkt 330 - Principles of Marketing (3-0-3)

Provides an understanding of how environmental factors (political, legal, economy, competition, socio-cultural, and technology) influence the design of product, pricing, promotion and distribution strategies. Topics discussed include strategies to satisfy target markets, market segmentation, buyer behavior, marketing ethics, and an introduction to global marketing issues. Fundamentals of marketing are integrated using cases, videos, and class projects. Effective From: Spring 2008

Mrkt 331 - Consumer and Buyer Behavior ((3-0-3))

Prerequisites: Math 105 and Mrkt 330. Psychological, social, and economic influences on consumer behavior. The application of consumer behavioral innovation to marketing decisions: research and measurement techniques, individual influences, environmental influences, and consumer information processing and decision making. A field research project will be undertaken. Effective From: Fall 2005

Mrkt 338 - Product Development and Management (3-0-3)

Prerequisite: Mrkt 330. The process of product development is studied in detail with specific emphasis on technology-driven innovation. Techniques for getting closer to customers including TQM principles are also covered.

Mrkt 339 - Professional Selling (3-0-3)

Prerequisite: Mrkt 330. Provides an understanding of multifaceted roles salespeople play and prepares students for sales careers in business-to-business firms. Discusses the personal selling process that include prospecting and qualifying, sales call planning, approaching prospects, giving sales demonstrations and presentations, negotiating sales resistance, confirming and closing "win-win" agreements. Places emphasis on building customer relationships and partnerships by providing customer service and to ensure satisfaction and build customer loyalty. Concepts are discussed and integrated using role-playing, experiential exercies, videos, cases and class projects. Effective From: Spring 2008

Mrkt 360 - Internet Marketing (3-0-3)

Prerequisite: Mrkt 330. Provides an overview of fundamental principles of Internet marketing for the contemporary business environment. Topics include Internet marketing strategies, Internet marketing plan, and development of Internet-based marketing programs. Effective From: Spring 2008

Mrkt 430 - Marketing Research (3-0-3)

Prerequisite: Mrkt 330. The process of marketing research is studied in detail from study design through report preparation. A hands-on, experiential approach is taken with an emphasis on secondary research and multivariate statistical methods. Data analysis is conducted using SAS and/or SPSS.

Mrkt 432 - Sales Management (3-0-3)

Prerequisite: Mrkt 330. This course helps the student to understand the various sales management activities that sales managers are responsible for in their important role as revenue generation managers. Key topics that are discussed within the realm of organizing, managing and controlling the sales force include sales forcasting, budgeting, sales force organization, time and territory management, recruitment, selection and training the salespeople, leadership, motivation, compensation, and sales force performance evaluation. Sales ethics and customer relationship management issues are also addressed. Effective From: Fall 2008

Mrkt 434 - Business to Business Marketing (3-0-3)

Prerequisite: Mrkt 330. Techniques for marketing industrial products to organizations in the manufacturing, service, government, and non-profit sectors are covered within the context of a global marketplace. Emphasis is on the marketing of high technology products using a customer-driven approach. Effective From: Spring 2008

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Prerequisite: Mrkt 330. This course will help students understand how the product, pricing, promotion and distribution elements of the marketing mix are influenced by international forces (cultural, political-legal, economic, competitive, and technological environment). Topics discussed include global market segmentation, marketing ethics, standardization or adaptation of the marketing mix as well as global information systems and market research, segmentation, targeting, and foreign market entry strategies (importing, exporting, licensing, and strategic alliances). Course concepts are integrated using cases, videos, and class projects. Effective From: Summer 2008

Mrkt 485 - Special Topics in Marketing (3-0-3)

The study of new and/or advanced topics in the various fields of business and their application not regularly covered in any other business course. The precise topics to be covered, along with prerequisites, are announced in the semester prior to the offering of the course. Effective From: Fall 2009

GRADUATE COURSES:

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Mrkt 631 - Market Planning and Analysis (3 credits)

Provides a research and managerial perspective on advanced marketing research methods and analytical techniques. Topics include problem formulation, research design, data collection and analysis, managerial report writing. Students will acquire experience by developing and executing their own marketing research project using sophisticated computerized analytical techniques.

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Mrkt 731 - Advanced Market Planning and Analysis (3 credits)
Prerequisite: Mrkt 631. Covers advanced topics in the design and analysis of market research studies. Focus on the development of statistical sampling methods and techniques to develop estimates for complex marketing problems. Also focuses on advanced multivariate analysis and estimation techniques needed in the interpretation of complex marketing problems.

Mrkt 753 - Marketing Science (3 credits)
Prerequisite: Mrkt 631. Emphasizes quantitative model building approach to the complex problems of marketing decision making using the principles of quantitative decisions to management problems and econometrics to the understanding of large amounts of data, which lead to improvements in marketing decision effectiveness. Such areas of marketing as buyer behavior, pricing, promotion, advertising, sales force management, and new product planning will be analyzed.

R630:576 - Quantitative Methods in Marketing Credits by arrangement (3 credits)
For more details go to Rutgers Catalog.

R630:625 - Clustering Analysis (3 Credits by arrangement)
For more details go to Rutgers Catalog.

R630:660 - Qualitative Research Methods (3 credits)
For more details go to Rutgers Catalog.

R630:668 - Causal Modeling (3 credits)
For more details go to Rutgers Catalog.

Material, Science and Engineering : Offered by the Materials Science and Engineering Committee

UNDERGRADUATE COURSES:

MtSE 301 - Principles of Material Science and Engineering (3-0-3)

Prerequisites: Phys 111 and Phys 121, Chem 125 and Chem 126, Math 111 and Math 112 or equivalent. Examines the interrelationships among structure, properties, and performance of engineering materials. Topics to be covered include atomic structure, crystallography, solid state imperfections and diffusion. The properties of metals, semiconductors, polymers, ceramics, and composites as well as their behavioral response to mechanical, chemical, optical, electrical, and magnetic stimuli are examined in light of their performance in service.

MtSE 311 - Properties of Materials (3-0-3)

Prerequisite: two semesters of college physics or equivalent. Intended for engineering technology students and is an introduction to the principal metallic and nonmetallic engineering materials, including their physical properties, response to heat treatment, and corrosion -resistance.

MtSE 318 - Engineering Materials (3-2-4)

Prerequisites: Physics III; Chem 126. Introduces the student to such engineering materials as metals, viscoelastic materials, ceramics, polymers, and semiconductors. The approach is interdisciplinary with stress upon the structure of materials. Various mechanical and thermal treatments are discussed and related to the stability of the resultant properties. The laboratory sessions implement and emphasize the effects of these mechanical and thermal treatments on the materials.

MtSE 319 - Engineering Materials (3-0-3)

Prerequisites: Physics III; Chem 126. This course is identical to MtSE 318, with the laboratory omitted.

MtSE 450 - Electron Microscopy (2-2-3)

Prerequisites: Physics III; Chem 126. Combines the lecture and laboratory in introducing the field of electron microscopy. Topics include magnetic electron lenses, electron optical systems, selected area diffraction, sample preparation, thin foil techniques, and photography.

MtSE 451 - X-Ray Diffraction (2-2-3)

Prerequisites: Physics III; Chem 126. Combines the lecture and laboratory in introducing the methods of X-ray diffraction. Topics include directions and intensities of diffracted beams, diffractometer methods, Laue methods, power photographs, reciprocal lattice constructions, and the rotating crystal method.

MtSE 452 - Materials Science I (3-0-3)

Prerequisites: Physics III; Chem 126; ME 435 or Phys 335. Emphasizes the structure and properties of materials and the relationships between them. The primary topics include the thermodynamics of solids, fracture mechanisms, diffusion, elasticity, plasticity, fatigue strength, viscosity, and creep.

MtSE 453 - Materials Science II (3-4-5)

Prerequisite: MtSE 452. Emphasizes the electronic properties of materials in conjunction with an introduction to ceramics. Topics include semiconductors, thermoelectricity, magnetism, conductivity, dielectric, optical properties, and an introduction to the properties and behavior of ceramics.

GRADUATE COURSES:

MtSE 593 - Graduate Co-op Work Experience IV (0 credits)
Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

MtSE 601 - Fundamentals of Engineering Materials (3 credits)
Prerequisite: graduate standing. The effect of structure on the properties and behavior of engineering materials. Topics include atomic structure, bonding, crystallography, and defects in solids; properties of metals, semiconductors, ceramics, and polymers and their behavioral response to mechanical, chemical, optical, electrical, and magnetic stimuli. Effective From: Fall 2005

MtSE 602 - Thermodynamics of Materials (3 credits)
Prerequisite: undergraduate thermodyamics. Review of first, second, and third laws of thermodynamics and their applications to materials. Stability criteria, simultaneous chemical reactions, binary and multicomponent solutions, phase diagrams, surfaces, adsorption phenomena, thermochemistry of homogeneous and heterogeneous reactions are covered. Effective From: Fall 2005

MtSE 605 - Fundamentals of Engineering Materials (3 credits)
Prerequisite: graduate standing. The effect of structure on the properties and behavior of engineering materials. Topics include atomic structure, bonding, crystallography, and defects in solids; properties of metals, semiconductors, ceramics, and polymers and their behavioral response to mechanical, chemical, optical, electrical, and magnetic stimuli.

MtSE 610 - Mechanical Properties of Materials (3 credits)
Prerequisite: graduate standing. Elements of elasticity and plasticity theory, deformation and fracture behavior of materials, the concept of dislocations and their interaction with other lattice defects, strengthening mechanisms in solids, and principles of failure analysis. Materials to be studied include metals, polymers, ceramics, glasses, and composites.

MtSE 615 - Composite Materials (3 credits)
Prerequisites: MtSE 605 and MtSE 610. Introduction to fundamental principles of design and technology of composite materials. Materials based on polymer, ceramic, and metal matrices are discussed. Properties of the constitutive materials, their structure, methods of structural arrangements, as well as properties and characterization of the final products are described. The different perspectives, examples, and problems in composite applications are outlined.

MtSE 619 - Nano-scale Characterization of Materials (3 credits)
The course presents the basics of nanotechnology and the principles and application of advanced instrumentation for the characterization of nanostructures. Topics include atomic force microscopy, near-field optics, dielectric spectroscopy, and light scattering. The significant component of the course is laboratory work at the W. M. Keck Foundation Laboratory and research project. Effective From: Fall 2007

MtSE 625 - Introduction to Ceramics (3 credits)
Prerequisite: MtSE 605. Mechanical, thermal, electrical, magnetic, and optical properties of crystalline and glassy ceramics are discussed from a structural viewpoint. Important processing methods, design and evaluation of properties, and modern applications of ceramic materials are emphasized.

MtSE 627 - Glass Science and Engineering (3 credits)
Prerequisites: MtSE 605 and MtSE 630. Formation and structure of inorganic, polymeric, and metallic glasses. Transport phenomena, kinetics of crystallization, glass transition, and phase separation; chemical, mechanical and optical properties of glasses.

MtSE 630 - Thermodynamics of Materials (3 credits)
Prerequisite: undergraduate thermodyamics. Review of first, second, and third laws of thermodynamics and their applications to materials. Stability criteria, simultaneous chemical reactions, binary and multicomponent solutions, phase diagrams, surfaces, adsorption phenomena, thermochemistry of homogeneous and heterogeneous reactions are covered.

MtSE 648 - NanoMaterials (3 credits)
Prerequisite: Junior or Senior courses of modern materials science, chemistry and physics. Introduction to functional nanomaterials and nanotechnology. Types of nanomaterials-fullerenes, nanotubes, quantum dots, supramolecules, dendrimers. Fundamental, materials science, chemistry and physics of nanomaterials. Nanoscale properties and computational modeling. Synthesis, assembly and fabrication techniques. Characterization of nanomaterials. Emerging applications in nanoelectronics, nano-sensors, biology and fuel cells. Effective Until: Fall 2008

MtSE 650 - Physical Metallurgy (3 credits)
Prerequisite: MtSE 605. Processing-structure-property relationships in metallic alloys. Alloy systems covered include carbon steels, stainless

steels, aluminum and titanium alloys, and super alloys. Topics to be presented include elementary theory of metals, defects and related phenomena, solidification, phase phenomena, solid state diffusion, nucleation and growth kinetics, as well as transformation and deformation processes.

MtSE 655 - Diffusion and Solid State Kinetics (3 credits)
Prerequisite: MtSE 630. The atomic theory of diffusion and mathematical derivation of the diffusion equations. Diffusion phenomena in dilute alloys as well as in ionic and covalent solids are considered. High atom mobility effects at defect sites and surfaces are examined. Chemical kinetics and kinetics of phase transformations including nucleation, growth, and spinodal decomposition are discussed.

MtSE 681 - Composite Materials (3 credits)
Prerequisites: MtSE 601 and MtSE 610. Introduction to fundamental principles of design and technology of composite materials. Materials based on polymer, ceramic, and metal matrices are discussed. Properties of the constitutive materials, their structure, methods of structural arrangements, as well as properties and characterization of the final products are described. The different perspectives, examples, and problems in composite applications are outlined. Effective From: Fall 2005

MtSE 682 - Introduction to Ceramics (3 credits)
Prerequisite: MtSE 601. Mechanical, thermal, electrical, magnetic, and optical properties of crystalline and glassy ceramics are discussed from a structural viewpoint. Important processing methods, design and evaluation of properties, and modern applications of ceramic materials are emphasized. Effective From: Fall 2005

MtSE 685 - Physical Metallurgy (3 credits)
Prerequisite: MtSE 601. Processing-structure-property relationships in metallic alloys. Alloy systems covered include carbon steels, stainless steels, aluminum and titanium alloys, and super alloys. Topics to be presented include elementary theory of metals, defects and related phenomena, solidification, phase phenomena, solid state diffusion, nucleation and growth kinetics, as well as transformation and deformation processes. Effective From: Fall 2005

MtSE 687 - Glass Science and Engineering (3 credits)
Prerequisites: MtSE 601 and MtSE 602. Formation and structure of inorganic, polymeric, and metallic glasses. Transport phenomena, kinetics of crystallization, glass transition, and phase separation; chemical, mechanical and optical properties of glasses. Effective From: Fall 2005

MtSE 688 - Mathematical and Statistical Methods in Materials Science (3 credits)
More emphasis on analytical methods and statistics. Course is required for Ph.D. students in Materials Science. Effective From: Fall 2006

MtSE 690 - Directed Study in Materials Science and Engineering (3 credits)
Prerequisites: As specified by the instructor. Directed study at the Master's level under the guidance of a faculty member on a topic in materials science and engineering.

MtSE 700 - Master's Project (3 credits)
Prerequisites: sufficient experience and/or graduate courses to work on the project and approval of project advisor. An extensive report involving an experimental, theoretical, or literature investigation is required. The literature investigation should result in a critical review of a specific area. Students may extend the master's project into a master's thesis.

MtSE 701 - Master's Thesis (6 credits)
Prerequisites: sufficient experience and/or graduate courses to work on the thesis and approval of thesis advisor. Research involving experimental or theoretical investigations or collaborative projects with industry or governmental agencies may be accepted. Completed work in the form of a written thesis should merit publication in a technical journal and must be approved by a committee consisting of three faculty members. A student must register for 3 credits per semester. Only the 6 credits indicated for the thesis will be applied to the degree.

MtSE 702 - Characterization of Solids (3 credits)
Current methods for characterizing the chemical composition, crystallographic structure, electrical mapping, and morphology of solid materials. Principles and application of Auger Electron Spectroscopy (AES), Secondary Ion Mass Spectroscopy (SIMS), X-ray Photoelectron Spectroscopy (XPS), X-ray Emission Spectroscopy (XES), and Rutherford Backscattering Spectroscopy (RBS) for chemical analysis, X-ray Diffraction (XRD) and electron diffraction for crystallographic analysis, Electron Beam Induced Current (EBIC) microscopy, voltage contrast microscopy, Cathodoluminescence for electrical mapping, and Atomic Force Microscopy (AFM), Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM) and Nomarski interference contrast microscopy (DIC) for morphology.

MtSE 719 - Physical Principles of Characterization of Solids (3 credits)
Prerequisite: MtSE 619/ME 619, Nano-scale characterization of materials. Basic science behind solid state characterization. Elements of modern physics. Optical microscope. Neutron scattering. Infrared and Raman spectroscopy. Rutherford backscattering spectroscopy. NMR. X-ray diffraction. X-ray photoelectron spectroscopy and Auger Electron Spectroscopy. SEM, TEM, STEM and STM.

MtSE 722 - Science and Technology of Thin Films (3 credits)
Prerequisite: graduate standing. Methods of preparing thin films by physical and chemical means are examined. Topics pertinent to nucleation and growth mechanism of single and polycrystalline films, structure determination, film thickness and compositional evaluation properties are discussed. The electrical, magnetic, optical, and mechanical properties of metallic, semiconductor, and insulating thin films are studied with particular relevance to integrated circuit applications. Effective From: Fall 2005

MtSE 723 - Defects in Solids (3 credits)
Prerequisites: MtSE 601 and MtSE 725. Crystallographic defects in solids, namely point defects such as vacancies and interstitial, line defects such as dislocations, and planar defects such as grain boundaries. Correlation of these defects to the mechanical, electrical and optical behavior of materials is examined in particular. Experimental methods for observation and characterization of defects including TEM, EBIC, DLTS are described. Effective From: Fall 2005

MtSE 724 - Transport of Electrons and Phonons in Solids (3 credits)
Prerequisite: Phys 687/26:755:687. Basic transport processes involving electrons and phonons in solids. Topics inlcude transport-related phenomena such as Hall effect, quantum Hall effect, magneto-resistance, size effects, thermal conductivity, thermoelectric effects, phonon drag, ballistic phonons, and ballistic electrons. Applications of transport to the characterization of new electronic materials including thin films are stressed. Effective From: Fall 2005

MtSE 725 - Crystallography and Diffraction (3 credits)
Prerequisite: graduate standing. The atomic arrangement of crystalline materials including treatment of crystalline defects and diffraction phenomena. Lattices, crystal systems, symmetry operations are covered as well as the fundamentals of electron and X-ray diffraction.

MtSE 737 - Transport of Electrons and Phonons in Solids (3 credits)
Prerequisite: Phys 687/26:755:687. Basic transport processes involving electrons and phonons in solids. Topics inlcude transport-related phenomena such as Hall effect, quantum Hall effect, magneto-resistance, size effects, thermal conductivity, thermoelectric effects, phonon drag, ballistic phonons, and ballistic electrons. Applications of transport to the characterization of new electronic materials including thin films are stressed.

MtSE 757 - Defects in Solids (3 credits)
Prerequisites: MtSE 605 and MtSE 725. Crystallographic defects in solids, namely point defects such as vacancies and interstitial, line defects such as dislocations, and planar defects such as grain boundaries. Correlation of these defects to the mechanical, electrical and optical behavior of materials is examined in particular. Experimental methods for observation and characterization of defects including TEM, EBIC, DLTS are described.

MtSE 765 - Science and Technology of Thin Films (3 credits)
Prerequisite: graduate standing. Methods of preparing thin films by physical and chemical means are examined. Topics pertinent to nucleation and growth mechanism of single and polycrystalline films, structure determination, film thickness and compositional evaluation properties are discussed. The electrical, magnetic, optical, and mechanical properties of metallic, semiconductor, and insulating thin films are studied with particular relevance to integrated circuit applications.

MtSE 780 - Current Topics in Materials Science and Engineering (3 credits)
Prerequisites: As specified by the program for the semester's offering. Topics of current interest in materials science and engineering.

MtSE 790 - Doctoral Dissertation (Credits as designated)
Required of all candidates for the degree of Doctor of Philosophy. A minimum of 36 credits is required. Students must register for 6 credits each semester until 36 credits are reached. If the dissertation is not yet complete, registration for an additional 3 credits is required each semester thereafter.

MtSE 791 - Graduate Seminar (Non-credit)
Required of all students enrolled in the M.S. or Ph.D. Program in Materials Science and Engineering. Faculty, students, and invited speakers will present and discuss current topics of research in materials science and engineering.

MtSE 792 - Pre-Doctoral Research (3 credits)
Prerequisite: permission of the program director. For students enrolled in the Ph.D. program before passing the Ph.D. qualifying examinations. Research is carried out under the supervision of a faculty member of the student's choice. A maximum of 6 credits may be applied to MtSE 790

Mathematics: Mathematics

UNDERGRADUATE COURSES:

Math 098 - Introduction to College Math A (4-1-4 additive credits)

Intended for students whose major requires Math 113, Math 135 or Math 138. Topics include: Elementary Algebra, Introduction to Graphs and Functions, Linear Functions, Equations, Inequalities, Systems of Linear Equations, Radicals and Complex Numbers, Quadratic Equations, Rational Expressions and Rational Functions, Functions and Relations, Exponential and Logarithmic Functions and Equations. Introduction to the logistics of applied calculus. Diverse applications will be emphasized throughout the course. This course may not be used to satisfy degree requirements in any program. Effective From: Fall 2007

Math 099 - Introduction to College Math B (4-1-4 additive credits)

Intended for students whose major requires Math 111. Topics include: Elementary Algebra, Introduction to Graphs and Functions, Linear Functions, Equations, Inequalities, Systems of Linear Equations, Radicals and Complex Numbers, Quadratic Equations, Rational Expressions and Rational Functions, Functions and Relations, Exponential and Logarithmic Functions and Equations. Introduction to the logistics of applied calculus. Diverse applications will be emphasized throughout the course. This course may not be used to satisfy degree requirements in any program. Effective From: Fall 2007

Math 101 - University Mathematics II-Trigonometry (4-1-4)

Intended for students whose major requires Math 113, Math 135, or Math 138. Prerequisite: Placement by performance on standardized entrance examinations. This course reviews the trigonometry needed for higher level mathematics courses. The following topics are covered: radian measure, conic sections, trigonometric functions and identities, laws of sines and cosines, logarithmic equations, partial fraction decomposition, systems of linear and nonlinear equations, functions in polar coordinates, and hyperbolic functions. Degree credit awarded for the following majors only: Hist, PTC, MGMT, and STS. Effective From: Spring 2009

Math 102 - Modern Pre-calculus (6 credits)

This course is an intensive non-traditional approach to pre-calculus employing curriculum innovations for the preparation of students for college calculus. The course infuses calculus techniques into the pre-calculus curriculum. The format includes both regular class and workshop environments with a focus on student problem solving. Course meets on Saturdays in the fall and spring terms and M, T, W, R in the summer, second session. This course is only available to high school students.

Math 103 - University Mathematics I (4-1- 4 additive credits)

Prerequisite: Math 098 with a grade of C or better or placement by performance on standardized entrance examinations. Consists of a series of projects, many of which introduce and use elementary differentiation and/or integration in which the students perform sustained algebraic and trigonometric computations. The projects involve the following topics: polynomials, rational expressions, expressions involving radicals, exponential and logarithmic functions, right triangle trigonometry, and the solution of linear and quadratic equations. This course may not be used to satisfy degree requirements in any program. Effective Until: Summer 2007

Math 104 - University Mathematics II (4-1- 4 additive credits)

Prerequisite: Math 103 with a grade of C or better or placement by performance on standardized entrance examinations. Consists of a series of projects, many of which introduce and use elementary differentiation and/or integration in which the students perform sustained algebraic and trigonometric computations. The projects involve the following topics: radian measure, conic sections, trigonometric functions and identities, law of sines and cosines, logarithmic equations, partial fraction decomposition, systems of linear and nonlinear equations, functions in polar coordinates, and hyperbolic functions. This course may not be used to satisfy degree requirements in any program. Effective Until: Summer 2007

Math 105 - Elementary Probability and Statistics (3-0-3)

Prerequisite: (Intended for students who are not in Science or in Engineering.) Math 107 or Math 109 with a grade of C or better or placement by performance on standardized entrance examinations. Considers notions of probability. Topics include the binomial and normal distributions, expected value, and variance. The notions of sampling, hypothesis testing, and confidence intervals are applied to elementary situations.

Math 106 - University Mathematics I A (4-1-4)

Prerequisite: Math 098 with a grade of C or better or placement by performance on standardized entrance examinations. Intended for students whose major requires Math 113, Math 135 or Math 138. Consists of a series of projects, many of which introduce and use elementary differentiation and/or integration in which the students perform sustained algebraic and trigonometric computations. The projects involve the following topics: polynomials, rational expressions, expressions involving radicals, exponential and logarithmic functions, right triangle trigonometry, and the solution of linear and quadratic equations. Degree credit awarded for the following majors only: Hist, PTC and STS. Effective From: Fall 2007

Math 107 - University Mathematics II A (4-1-4)

Intended for students whose major requires Math 113, Math 135 or Math 138. Prerequisite: Math 106 with a grade of C or better. Consists of a series of projects, many of which introduce and use elementary differentiation and/or integration in which the students perform sustained algebraic and trigonometric computations. The projects involve the following topics: radian measure, conic sections, trigonometric functions and identities, laws of sines and cosines, logarithmic equations, partial fraction decomposition, systems of linear and nonlinear equations, functions in polar coordinates, and hyperbolic functions. Degree credit awarded for the following majors only: Hist, PTC and STS. Effective From: Fall 2007

Math 108 - University Mathematics I B (4-1-4)

Intended for students whose major requires Math 111. Prerequisite: Math 099 with a grade of C or better or placement by performance on standardized entrance examinations. Consists of a series of projects, many of which introduce and use elementary differentiation and/or integration in which the students perform sustained algebraic and trigonometric computations. The projects involve the following topics: polynomials, rational expressions, expressions involving radicals, exponential and logarithmic functions, right triangle trigonometry, and the solution of linear and quadratic equations. Degree credit awarded for the following majors only: Hist, PTC and STS. Effective From: Fall 2007

Math 109 - University Mathematics II B (4-1-4)

Intended for students whose major requires Math 111. Prerequisite: Math 108 with a grade of C or better. Consists of a series of projects, many of which introduce and use elementary differentiation and/or integration in which the students perform sustained algebraic and trigonometric computations. The projects involve the following topics: radian measure, conic sections, trigonometric functions and identities, laws of sines and cosines, logarithmic equations, partial fraction decomposition, systems of linear and nonlinear equations, functions in polar coordinates, and hyperbolic functions. Degree credit awarded for the following majors only: Hist, PTC and STS. Effective From: Fall 2007

Math 110 - University Mathematics II - Trigonometry (4-1-4)

Prerequisite: Placement by performance on standardized entrance examinations. This course reviews the trigonometry needed for higher level mathematics courses. The following topics are covered: radian measure, conic sections, trigonometric functions and identities, laws of sines and cosines, logarithmic equations, partial fraction decomposition, systems of linear and nonlinear equations, functions in polar coordinates, and hyperbolic functions. Degree credit awarded for the following majors only: Hist, PTC and STS. Effective From: Fall 2007

Math 111 - Calculus I (4-1-4)

Prerequisite: Math 109 or Math 110 with a grade of C or better or placement by performance on standardized entrance examinations. Topics include limits, differentiation, applications of differentiation, and integration. Effective From: Fall 2007

Math 111H - Honors Calculus I (4-1-4)

Admission to this course is by invitation, based on standardized entrance exams. Topics enhance those of Math 111 and concepts are studied in detail. Emphasizes science and engineering applications.

Math 112 - Calculus II (4-1-4)

Prerequisite: Math 111 with a grade of C or better. Topics include integration, applications of integration, series, exponential and logarithmic functions, transcendental functions, polar coordinates, and conic sections.

Math 112H - Honors Calculus II (4-1-4)

Prerequisite: grade of B or better in Math 111H or grade of A in Math 111. Topics enhance those of Math 112 and concepts are studied in detail. Emphasizes science and engineering applications.

Math 113 - Finite Mathematics and Calculus I (4-0-4)

Prerequisite: (Intended for Architecture students.) Math 107 or Math 110 with a grade of C or better or placement by performance on standardized entrance examinations. An introduction to differential and integral calculus. Applications include area, volumes, curve lengths, surface area, centroids, and moments. Focus is on application throughout the course. Effective From: Fall 2007

Math 114 - Finite Mathematics and Calculus II (4-0-4)

Prerequisite: (Intended for Architecture students.) Math 113 with a grade of C or better. Topics include numerical methods, set theory and counting, series, descriptive statistics and basic probability, matrices, and optimization.

Math 116 - Mathematics of Design (3-0-3)
Prerequisite: Placement exam or Math 101 or Math 107 with a grade of C or better. The course is project oriented, covering theories of proportion; tiling, symmetry, symmetry groups, and informal geometry; fractals; theory of graphs and knots; three-dimensional geometry and polyhedra; and projective geometry. The course is intended for BA of Fine Arts students from the College of Art & Design but might be used as an elective for other students. Effective From: Spring 2010

Math 135 - Mathematics for Business (3-0-3)
Intended for students with major offered by SOM. Prerequisite: Math 107 or Math 101 with a grade of C or better or placement by performance on standardized entrance examinations. An introduction to mathematics of business, principles of differential and integral calculus, and optimization. Effective From: Spring 2009

Math 138 - General Calculus I (3-0-3)
Intended for students who are not in Science or in Engineering. Prerequisite: Math 107 or Math 110 with a grade of C or better or placement by performance on standardized entrance examinations. An introduction to differential and integral calculus of a single variable. Effective From: Fall 2007

Math 211 - Calculus III A (3-0-3)
Prerequisite: Math 112 with a grade of C or better. Topics include vectors, curvature, partial derivatives, multiple integrals, line integrals, and Green's theorem. Students who are considering a major in Mathematical Sciences or who are undecided about their major should take Math 213.

Math 211H - Honors Calculus IIIA (3-0-3)
Prerequisite: Grade of B or better in Math 112H or grade of A in Math 112. Topics enhance those of Math 211 and concepts are studied in detail. Effective From: Fall 2008

Math 213 - Calculus III B (4-0-4)
Prerequisite: Math 112 with a grade of C or better. Topics include vectors, curvature, partial derivatives, multiple integrals, line integrals, and Green's, divergence, and Stokes' theorems.

Math 213H - Honors Calculus III (4-0-4)
Prerequisite: grade of B or better in Math 112H or grade of A in Math 112. Topics enhance those of Math 213 and concepts are studied in detail. Emphasizes science and engineering applications.

Math 222 - Differential Equations (4-0-4)
Prerequisite: Math 211 with a grade of C or better or Math 213 with a grade of C or better. Methods for solving ordinary differential equations are studied together with physical applications, Laplace transforms, numerical solutions, and series solutions.

Math 222H - Honors Differential Equations (4-0-4)
Prerequisite: grade of B or better in Math 213H or grade of A in Math 211 or Math 213. Topics enhance those of Math 222 and concepts are studied in detail. Emphasizes science and engineering applications.

Math 225 - Survey of Probability and Statistics (1-0-1)
Prerequisite: Math 112 with a grade of C or better. Topics include descriptive statistics, elements of probability, random variables and distributions; mean and variance; introduction to estimation and inference. This course satisfies the Mathematics GUR in probability and statistics. However, degree credit will not be granted for both Math 225 and any other upper level course in probability and/or statistics. Effective Until: Fall 2007

Math 225A - Survey of Probability and Statistics (1-0-1)
For Chemical Engineering students only. Prerequisite: Math 112 with grade of C or better. Topics include descriptive statistics, elements of probability, random variables and distributions; mean and variance; introduction to estimation and inference. This course satisfies the Mathematics GUR in probability and statistics. However, degree credit will not be granted for both Math 225 and any other upper level course in probability and/or statistics.

Math 226 - Discrete Analysis (4-0-4)
Prerequisite: Math 112 with a grade of C or better. An introduction to discrete mathematics. Topics include elementary set theory, logic, combinatorics, relations, graphs and trees, algebraic systems.

Math 226H - Honors Discrete Analysis (4-0-4)
Prerequisite: grade of "B"or better in Math 112H or grade of "A" in Math 112. An introduction to discrete mathematics. Topics enhance those of Math 226 and concepts are studied in detail. Emphasizes science and engineering applications.

Math 227 - Mathematical Modeling (4-0-4)

Prerequisite: Math 112 with a grade of C or better. An introduction to the theory and practice of mathematical modeling. Techniques include scaling and dimension, fitting of data, linear and exponential models, elementary dynamical systems, probability, optimization, Markov chain modeling. Models are drawn from applications including biology, physics, economics, finance, and chemistry. Effective From: Fall 2009

Math 238 - General Calculus II (3-0-3)

Prerequisite: (Intended for students who are not in Science or in Engineering.) Math 138 with a grade of C. A continuation of Math 138. Topics include applications of integral calculus and an introduction to ordinary differential equations.

Math 240 - Numerical Mathematics Laboratory (3-0-3)

Prerequisite: Math 112 with a grade of C or better, and CIS 113 or knowledge of FORTRAN, C, or C++. Introduction to basic concepts and processes of numerical mathematics with emphasis on practical issues of implementation, use of numerical algorithms and software, and interpretation of numerical data. Weekly projects involving writing computer programs, presenting numerical results in tables and graphs, evaluation and approximation of standard numerical functions, round-off errors and loss of significance, basic iterative processes, matrix arithmetic, random number generation, and Monte Carlo methods. Students gain experience using a programming language, such as C, and mathematical software, such as MATLAB.

Math 244 - Introduction to Probability Theory (3-0-3)

Prerequisite: Math 112 with a grade of C or better. Topics include basic probability theory in discrete and continuous sample space, conditional probability and independence, Bayes' theorem and event trees, random variables and their distributions, joint distribution and notion of dependence, expected values and variance, moment generating functions, useful parametric families of distributions including binomial, geometric, hypergeometric, negative binomial, exponential, gamma, normal and their applications, simple case of central limit theorem and its uses.

Math 245 - Multivariate Probability and Stochastic Processes (3-0-3)

Prerequisite: Math 244 with a grade of C or better or Math 333 with a grade of C or better. Topics include discrete and continuous multivariate distributions and their moments, multivariate normal distributions, order statistics, discrete and continuous Markov chains, Poisson processes, and Brownian motion processes.

Math 246 - Introduction to Financial Mathematics ((3-0-3))

Prerequisite: Math 135 with a grade of C or better or Math 138 with a grade of C or better or Math 111 with a grade of C or better. An introduction to the basics of simple interest and discount, compound interest and discount, and simple annuities. This course is primarily intended for students whose major only requires Calculus I. It cannot be used for credit towards major or minor degrees offered by the Department of Mathematical Sciences. Effective From: Fall 2005

Math 279 - Statistics and Probability for Engineers (2-0-2)

Prerequisite: Math 112 with a grade of C or better. This course introduces methods of summarizing and analyzing engineering data and the importance of observing processes over time such as control charts. Descriptive statistics, plots and diagrams are then used to summarize the data. Elements of probability and random variables with their distributions along with mean and variance are taught. All this knowledge is then used as a platform towards covering how to do basic estimation and inference, including confidence intervals and hypothesis testing based on a single sample. Students taking this course cannot receive degree credit for Math 225, 244, or 333. Effective From: Spring 2008

Math 305 - Statistics for Technology (3-0-3)

Prerequisite: (Intended for students in Engineering Technology.) Math 111 with a grade of C or better or Math 138 with a grade of C or better. An introduction to the modern concepts of statistics needed by engineering technologists. Topics include organization of data, descriptive statistics, discrete and continuous probability distributions, sampling distribution and designs, estimation -- one and two populations, tests of hypotheses.

Math 309 - Mathematical Analysis for Technology (4-0-4)

Prerequisites: (Intended for students in Engineering Technology.) Math 111 with a grade of C or better or Math 138 with a grade of C or better. Emphasis on integration techniques; applications such as related rates, curve sketching, maximum and minimum, area, moments, centroids, volumes, approximate methods, partial derivatives, vector calculus, parametric equations, and infinite series.

Math 310 - Co-op Work Experience I (3 Credits)

Prerequisites: Completion of the sophomore year, departmental approval, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the co-op office. Mandatory participation in seminars and completion of a report.

Math 321 - Introduction to the Finite Element Method (3-0-3)

Prerequisite: Math 222 with a grade of C or better. An elementary introduction to the theory and practice of the finite element method (FEM) is given. The mathematical underpinnings covered in this course include the basics of Sobolev spaces, Galerkin's method and various other weak formulations. Mathematical modeling of different physical problems and their solution techniques are also discussed. Existing finite element programs will be introduced through a course project. Effective From: Spring 2009

Math 322 - Differential Equations for Technology (3-0-3)

Prerequisite: (Intended for students in Engineering Technology.) Math 309 with a grade of C or better. An applied science study using differential equations as the vehicle for comprehension of the unknown. Introduction to first-order differential equations and their applications to motion, cooling and electromechanical systems followed by higher order differential equations and their solutions. Study of methods of undetermined coefficients, variation of parameters, and many series and numerical methods. Includes Laplace transforms, matrix methods, and eigenvalue problems.

Math 326 - Discrete Analysis for Computer Engineers (3-0-3)

Prerequisite: Math 112 with a grade of C or better. An introduction to mathematical logic, Boolean algebra, and Karnaugh maps. Other topics include functions, equivalence relations and partially ordered sets, counting, graph theory and finite state machines. The emphasis is on computation but proofs will be addressed. Students cannot receive credit for both Math 226 and Math 326.

Math 328 - Mathematical Methods for Scientists and Engineers (3-0-3)

Prerequisites: Math 211 with a grade of C or better or Math 213 with a grade of C or better. Corequisite: Math 222. The course exposes students to concepts of mathematics encountered throughout the physical science and engineering disciplines. Topics include matrix algebra, vector analysis, complex numbers, and boundary value problems in partial differential equations. Effective From: Spring 2008

Math 331 - Introduction to Partial Differential Equations (3-0-3)

Prerequisite: Math 222 with a grade of C or better. Partial differential equations in science and engineering. Topics include initial- and boundary-value problems for parabolic, hyperbolic, and elliptic second-order equations. Emphasis is placed on separation of variables, special functions, transform methods, and numerical techniques.

Math 331H - Honors Introduction to Partial Differential Equations (3-0-3)

Prerequisite: grade of "B" or better in Math 222H or grade of "A" in Math 222. Topics enhance those of Math 331 and concepts are studied in detail. Emphasizes science and engineering applications.

Math 332 - Introduction to Functions of a Complex Variable (3-0-3)

Prerequisite: Math 222 with a grade of C or better. Functions of a complex variable: Cauchy-Riemann equations, Cauchy-Goursat theorem, integration, series, residues, poles, geometrical aspects. Emphasis on techniques.

Math 332H - Honors Introduction to Functions of a Complex Variable (3-0-3)

Prerequisite: grade of "B" or better in Math 222H or grade of "A" in Math 222. Topics enhance those of Math 332 and concepts are studied in detail. Emphasizes science and engineering applications.

Math 333 - Probability and Statistics (3-0-3)

Prerequisite: Math 112 with a grade of C or better. Descriptive statistics and statistical inference. Topics include discrete and continuous distributions of random variables, statistical inference for the mean and variance of populations, and graphical analysis of data.

Math 333H - Honors Probability and Statistics (3-0-3)

Prerequisite: grade of "B" or better in Math 112H or grade of "A" in Math 112. Topics enhance those of Math 333 and concepts are studied in detail. Emphasizes science and engineering applications.

Math 334 - Operations Research (3-0-3)

Prerequisite: Math 244 with a grade of C or better or Math 333 with a grade of C or better. Considers mathematical methods found especially in contemporary fields such as operations research and reliability engineering. Topics include linear programming, graph theory, finite mathematics, differential equations, matrices, and determinants.

Math 335 - Vector Analysis (3-0-3)

Prerequisite: Math 211 with a grade of C or better or Math 213 with a grade of C or better. Algebra and calculus of vectors. Topics include the theorems of Gauss, Green, and Stokes, and curvilinear coordinates.

Math 336 - Applied Abstract Algebra (3-0-3)

Prerequisite: Math 112 with a grade of C or better. Classical algebra from a modern and constructive viewpoint. Emphasis is on the development of algorithmic and computational skills. Topics include rings, fields, and groups and their applications to science and engineering.

Math 337 - Linear Algebra (3-0-3)

Prerequisite: Math 112 with a grade of C or better. Matrices, determinants, systems of linear equations, vector spaces, linear transformations, eigenvalues, eigenvectors, and related topics.

Math 337H - Honors Linear Algebra (3-0-3)
Prerequisite: grade of "B" or better in Math 112H or grade of "A" in Math 112. Topics enhance those of Math 337 and concepts are studied in detail. Emphasizes science and engineering applications.

Math 340 - Applied Numerical Methods (3-1-3)
Prerequisites: Math 211 with a grade of C or better or Math 213 with a grade of C or better, and CS 101 with a grade of C or better or CS 113 with a grade of C or better or CS 115 with a grade of C or better or Math 240 with a grade of C or better. Introduction to numerical methods with emphasis on mathematical models. Implements and investigates numerical techniques for the solution of linear and nonlinear systems of equations, eigenvalue problems, interpolation and approximation, techniques of optimization, Monte Carlo methods, and applications to ordinary differential equations and integration. Effective From: Fall 2009

Math 340H - Honors Applied Numerical Methods (3-0-3)
Prerequisites: CS 101 with a grade of C or better or CS 113 with a grade of C or better or CS 115 with a grade of C or better. Grade of "B" or better in Math 213H or grade of "A" in Math 211 or Math 213. Topics enhance those of Math 240 and concepts are studied in detail. Emphasizes science and engineering applications.

Math 341 - Introduction to Statistics (3-0-3)
Prerequisite: Math 244 with a grade of C or better or Math 333 with a grade of C or better. Covers the theory and applications of classical statistical inference. Topics include sampling distributions, point and interval estimation, criteria of good estimators, maximum likelihood estimators and their large sample properties, statistical hypotheses and tests, including most powerful and uniformly most powerful tests and likelihood ratio tests, classical tests of parametric hypotheses about means and variances of normal populations, tests for proportion, chi-square tests of homogeneity, independence, goodness-of-fit, sign test and Wilcoxon test.

Math 344 - Regression Analysis (3-0-3)
Prerequisite: Math 333 with a grade of C or better or Math 341 with a grade of C or better. An introduction to statistical data analysis using regression techniques. Topics include least squares estimation, hypothesis testing, prediction, regression diagnostics, residual analysis, variance stabilizing transformations, regression using indicator variables, variable selection, and model building.

Math 345 - Multivariate Distributions (3-0-3)
Prerequisites: Math 244 with a grade of C or better or Math 333 with a grade of C or better. Topics include discrete and continuous multivariate distributions and their moments, multivariate distributions including multivariate normal and multinominal distributions, order statistics, conditional probability and the use of conditioning, discrete time Markov chains and their examples, discrete time branching processes, homogeneous and nonhomogeneous Poisson processes. Effective From: Spring 2008

Math 346 - Mathematics of Finance I (3-0-3)
Prerequisite: Math 112 with a grade of C or better. The main topics include basic problems in interest, annuities, certain amortization and sinking funds, bonds and related securities. Effective From: Spring 2005

Math 347 - Mathematics of Finance II (3-0-3)
Prerequisites: Math 346 with a grade of C or better and Math 244 with a grade of C or better or Math 333 with a grade of C or better and Math 211 with a grade of C or better or Math 213 with a grade of C or better. This course introduces mathematical models of bond and stock prices, which lead to arbitrage pricing of options and other derivative securities, and portfolio management. These areas of mathematical finance have a great impact on the way financial markets function. Topics include risk-free, and risky assets, portfolio management, futures, and options. Effective From: Spring 2005

Math 371 - Physiology and Medicine (3-0-3)
Prerequisite: Math 222 with a grade of C or better. (No biology requirement.) Mathematical models of organs and organ systems: the heart and circulation, gas exchange in the lungs, electrical properties of excitable membranes, neuro-biological clocks, the renal countercurrent mechanism, muscle mechanics. The biology is introduced with each topic. Emphasis is on quantitative problem solving, model building, and numerical simulation. Effective From: Fall 2008

Math 372 - Population Biology (3-0-3)
Prerequisite: Math 222 with a grade of C or better. (No biology requirement.) Introduction to the mathematics of populations: Malthus' model of geometric population growth, Euler's renewal equations, age structure in human populations, predator satiation, chaos, mathematical models of inheritance, and the theory of epidemics. The ability to weave back and forth between physical concepts and mathematical notation is emphasized as well as the relationships between random and non-random models of similar phenomena. Effective From: Fall 2008

Math 373 - Introduction to Mathematical Biology (3-0-3)
Prerequisites: Math 211 with a grade of C or better or Math 213 with a grade of C or better or Math 213H with a grade of C or better and Math 337 with a grade of C or better. This course provides an introduction to the use of mathematical techniques applied to problems in biology. Discrete and continuous models of biological phenomena will be discussed. Biological topics discussed range from the subcellular molecular systems and cellular behavior to physiological problems, population biology and developmental biology. Techniques of phase plane analysis for differential equations are introduced in the course. No prior background in biology is necessary. Effective From: Spring 2005

Math 388 - Introduction to Chaos Theory (3-0-3)
Prerequisite: Math 211 with a grade of C or better or Math 213 with a grade of C or better. An elementary treatment of chaos theory and its applications concentrating on discrete dynamical systems. Uses theory and applications illustrated by computer experiments to develop such topics as bifurcation, attractors, the logistic map, period-doubling routes to chaos, symbolic dynamics, Sarkovskii's theorem, fractals, and Julia and Mandelbrot sets for complex dynamics.

Math 391 - Numerical Linear Algebra (3-0-3)
Prerequisites: Math 337 with a grade of C or better and CS 113 with a grade of C or better or CS 115 with a grade of C or better or CS 101 with a grade of C or better. This course provides an introduction to computational linear algebra. Topics include direct solution of linear systems, iterative methods for linear systems, fast Fourier transforms, least squares problems, singular value decomposition and eigenvalue/ eigenvector problems. Effective From: Fall 2008

Math 401 - Undergraduate Research Seminar (1-1-1)
Research seminar intended for students who participate in year-long research projects. Methodologies and techniques needed for summer research projects are discussed. Presentations of current research topics are made by various faculty. Effective From: Spring 2008

Math 410 - Co-op Work Experience II (3 credits)
Prerequisites: Math 310, departmental approval, and permission of the Office of Cooperative Education and Internships. Provides major-related work experience. Mandatory participation in seminars and completion of requirements that include a report and/or project.

Math 426 - Advanced Discrete Analysis (3-0-3)
Prerequisite: Math 226 with a grade of C or better or Math 326 with a grade of C or better. Topics include graphs, trees and their applications, grammars, finite state machines, Turing machines and Petri nets, applied combinatorics -- Stirling, Catalan, and Ramsey numbers, Polya-Burnside counting methods, finite Markov chains and coding theory.

Math 430 - Analytical and Computational Neuroscience (3-1-3)
Prerequisites: Math 211 with a grade of C or better or Math 213 with a grade of C or better, Phys 121 with a grade of C or better and CS 101 with a grade of C or better or CS 113 with a grade of C or better or CS 115 with a grade of C or better. A mathematical and computational introduction to the biophysical mechanisms that underlie physiological functions of single neurons and synapses. Topics include voltage-dependent channel gating mechanisms, the Hodgkin-Huxley model for membrane excitability, repetitive and burst firing, nerve impulse propagation in axons and dendrites, single- and multi-compartmental modeling, synaptic transmission, calcium handling dynamics and calcium dependent currents and processes.

Math 431 - Systems Computational Neuroscience (3-1-3)
Prerequisites: Math 211 with a grade of C or better or Math 213 with a grade of C or better and CS 101 with a grade of C or better or CS 113 with a grade of C or better or CS 115 with a grade of C or better. This course provides a mathematical and computational introduction to operations of neuronal systems and networks. Topics covered include central pattern generators, neuroethology of sensory systems, sensory-motor transformations, models of various brain regions, models of visual processes, large networks modeling, models of learning and memory, neural coding and mathematics of neural networks. Effective From: Fall 2007

Math 432 - Mathematics of Financial Derivatives I (Capstone I) (3-0-3)
Prerequisites: Math 222 with a grade of C or better and Math 346 with a grade of C or better. Mathematical analysis of models encountered in the area of financial derivatives. Topics include modeling and analysis of futures markets, determination of future prices, hedging strategies, swaps, option markets, stock options and their trading strategies. Effective From: Fall 2007

Math 433 - Mathematics of Financial Derivatives II (Capstone II) (3-0-3)
Prerequisites: Math 340 with a grade of C or better and Math 432 with a grade of C or better. Mathematical analysis of models encountered in the area of financial derivatives with emphasis on numerical methods. Topics include: Binomial Trees, Black Scholes Models, Finite Difference Methods. Effective From: Fall 2009

Math 440 - Advanced Applied Numerical Methods (3-0-3)
Prerequisites: Math 331 with a grade of C or better and Math 340 with a grade of C or better. A survey of numerical methods for solving ordinary and partial differential equations. Includes initial-value and boundary-value problems for ordinary differential equations and for elliptic, hyperbolic,

and parabolic partial differential equations.

Math 440H - Honors Advanced Applied Numerical Methods (3-0-3)

Prerequisites: grade of "B" or better in Math 331 or Math 331H and Math 340 or Math 340H. Topics enhance those of Math 440 and concepts are studied in detail. Emphasizes science and engineering applications.

Math 441 - Actuarial Mathematics I (3-0-3)

Prerequisite: Math 346 with a grade of C or better. Topics include the economics of insurance, individual risk models for a short term, survival distributions and life tables, life insurance per year, life annuities, and net premiums.

Math 442 - Actuarial Mathematics II (3-0-3)

Prerequisite: Math 441 with a grade of C or better. Topics include net premium reserves, insurance models including expenses, nonforfeiture benefits, and dividends.

Math 443 - Statistical Methods (3-0-3)

Prerequisite: Math 341 with a grade of C or better. Topics include complete sufficient statistics and uniformly minimum variance estimators, general linear hypotheses and related topics, nonparametric inference including rank and order statistics, permutation methods, U-statistics, and Pitman efficiency. Effective Until: Spring 1996

Math 444 - Applied Sampling Methods and Quality Control (3-0-3)

Prerequisite: Math 333 with grade of C or better, or Math 244 with a grade of C or better and Math 341 with a grade of C or better. An introduction to sample survey and statistical quality control. Topics include sampling from a finite population and different sampling techniques, more detailed study of random sampling and stratification, control charts and acceptance sampling plans in statistical quality control.

Math 445 - Introduction to Experimental Design (3-0-3)

Prerequisite: Math 333 with a grade of C or better, or Math 244 with a grade of C or better and Math 341 with a grade of C or better. Basic concepts and principles of designs are covered. Topics include randomized blocks, Latin squares, factorial designs.

Math 446 - Topics in Applied Statistics (3-0-3)

Prerequisite: Math 341 with a grade of C or better or Math 333 with a grade of C or better. Topics may include biostatistics, environmental statistics, statistical consulting.

Math 447 - Applied Time Series Analysis (3-0-3)

Prerequisite: Math 341 with a grade of C or better or Math 333 with a grade of C or better. An introduction to applied univariate time series analysis. Topics include regression techniques for modeling trends, smoothing techniques (moving average smoothing, exponential smoothing), autocorrelation, partial auto-correlation, moving average, and autoregressive representation of series, Box-Jenkins models, forecasting, model selection, estimation, and diagnostic checking, Fourier analysis, and spectral theory for stationary processes.

Math 448 - Stochastic Simulation (3-0-3)

Prerequisite: Math 333 with a grade of C or better or Math 244 with a grade of C or better and Math 340 with a grade of C or better. An introduction in the use of computer simulation to study stochastic models. Topics include the generation of samples of continuous and discrete random variables and processes with applications to stochastic models, statistical analysis of the results, and variance reduction techniques. Effective From: Fall 2009

Math 450H - Methods of Applied Mathematics I (Capstone I) (3-0-3)

Prerequisites: Math 331 with a grade of C or better, Math 337 with a grade of C or better, and Math 340 with a grade of C or better. Combines mathematical modeling with physical and computational experiments conducted in the Undergraduate Mathematics Computing Laboratory.

Math 451H - Methods of Applied Mathematics II (Capstone II) (3-0-3)

Prerequisite: Math 450H with a grade of C or better. Small teams of students conduct research projects under the guidance of faculty members who perform applied research.

Math 453 - High-Performance Numerical Computing (3-0-3)

Prerequisites: Math 391 with a grade of C or betterr and Math 440 with a grade of C or better. The course covers state-of-the-art numerical algorithms for solving large-scale problems accurately and efficiently. Topics include iterative methods for linear systems and eigenvalue computations, introduction to parallel program and parallel numerical algorithms and spectral methods. An instructor-selected advanced topic will be included in the course. Effective From: Spring 2009

Math 460 - Differential Geometry of Curves and Surfaces (3 credits)

Prerequisites: Math 222 with a grade of C or better. Curves in the plane and Euclidean space, moving frames, surfaces in Euclidean space, orientability of surfaces, Gaussian and mean curvatures, surfaces of revolution, ruled surfaces, minimal surfaces, special curves on surfaces, Theorema Egregium, the intrinsic geometry of surfaces.

Math 473 - Intermediate Differential Equations (3-0-3)
Prerequisites: Math 222 with a grade of C or better and Math 337 with a grade of C or better. Topics in the qualitative behavior of solutions of ordinary differential equations with applications to engineering problems. Includes phase plane analysis, stability, dynamical systems, and chaos.

Math 475 - Intermediate Partial Differential Equations (3-0-3)
Prerequisites: Math 331 with a grade of C or better and Math 337 with a grade of C or better. A survey of methods, beyond separation of variables, for analyzing and solving the fundamental partial differential equations of mathematical physics. Considers first-order equations, Laplace's equation, the wave equation, the heat equation, and linear hyperbolic systems. Emphasizes using methods of calculus to solve canonical initial- and boundary-value problems.

Math 475H - Honors Intermediate Partial Differential Equations (3-0-3)
Prerequisites: Grade of "B" or better in Math 331H and Math 337H or Grade of "A" in Math 331 and Math 337. Topics enhance those of Math 475 and concepts are studied in detail. Emphasizes science and engineering applications.

Math 477 - Stochastic Processes (3-0-3)
Prerequisites: Math 244 with a grade of C or better or Math 333 with a grade of C or better and Math 337 with a grade of C or better. This course introduces the theory and applications of random processes needed in various disciplines such as mathematical biology, finance, and engineering. Topics include discrete and continuous Markov chains, Poisson processes, as well as topics selected from Brownian motion, renewal theory, and simulation. Effective From: Fall 2006

Math 480 - Introductory Mathematical Analysis (3-0-3)
Prerequisite: Math 211 with a grade of C or better or Math 213 with a grade of C or better. Builds on principles taught in basic calculus courses. Topics discussed include continuity, differentiation, integration, and the limit process of sequences and series.

Math 481 - Advanced Calculus (3-0-3)
Prerequisite: Math 480 with a grade of C or better. Systematic development of partial differentiation, multiple and improper integrals, transformations, inverse and implicit function theorems, and integrals over curves and surfaces.

Math 491 - Independent Study in Mathematics (3-0-3)
Prerequisites: Senior standing and departmental approval. Each student works under the direct supervision of a member of the Department of Mathematical Sciences. The work consists primarily of a project applying the student's mathematical skills to an engineering- or science-oriented project.

Math 493 - Seminar in Actuarial Science (1-0-1)
Prerequisite: Departmental approval. A series of lectures by practicing actuaries on topics of technical and/or current practices. Subjects announced at the time of registration. Progress is evaluated through projects and term papers. A comprehensive report summarizing some aspect of special interest to the student is required.

Math 495 - Topics in Applied Mathematics (3-0-3)
Prerequisites: Math 331 with a grade of C or better, Math 332 with a grade of C or better, and Math 340 with a grade of C or better, or departmental approval. A survey of selected areas of applied mathematics. Case histories of problems in applied mathematics from an industrial background.

GRADUATE COURSES:

Math 545 - Introductory Mathematical Analysis (3 credits)
Prerequisite: Math 211 or Math 213, and departmental approval. Rigorous treatment of the calculus of real-valued functions of one real variable: the real number system, epsilon-delta theory of limit, continuity, derivative, and the Riemann integral. The fundamental theory of calculus. Series and sequences including Taylor series and uniform convergence. The inverse and implicit function theorems.

Math 546 - Advanced Calculus (3 credits)
Prerequisite: Math 545 or Math 480. Rigorous treatment of the calculus of real-valued functions of several real variables: the geometry and algebra of n-dimensional Euclidean space, limit, continuity, derivative, and the Riemann integral of functions of several variables, the inverse and implicit function theorems, series, including Taylor series, optimization problems, integration on curves and surfaces, the divergence and related theorems.

Math 573 - Intermediate Differential Equations (3 credits)
Prerequisites: Math 222, Math 337, or departmental approval. Methods and applications for systems of ordinary differential equations: existence and uniqueness for solutions of ODEs, linear systems, stability analysis, phase plane and geometrical methods, Sturm-Liouville eigenvalue problems.

Math 590 - Graduate Co-op Work Experience I (3 additive credits)
Prerequisites: Graduate status, departmental approval, and permission of the Division of Career Development Services. Cooperative education/internship providing on-the-job complement to academic programs in mathematics. Work assignments and projects are developed by the Co-op Office in consultation with the Department of Mathematical Sciences.

Math 591 - Graduate Co-op Work Experience II (3 additive credits)
Prerequisites: Graduate status, departmental approval, and permission of the Division of Career Development Services.

Math 592 - Graduate Co-op Work Experience III (3 additive credits)
Prerequisites: Graduate status, departmental approval, and permission of the Division of Career Development Services.

Math 593 - Graduate Co-op Work Experience IV (0 credits)
Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

Math 599 - Teaching in Mathematics (3 credits)
Required of all master's and doctoral students in Mathematical Sciences who are receiving departmental or research-based awards. Provides students with the skills needed to communicate effectively and to perform their teaching and related duties. Students are exposed to strategies and methods for communicating and for teaching undergraduate mathematics, and they are required to practice and demonstrate these techniques. Not counted for degree credit.

Math 605 - Stochastic Calculus (3 credits)
This course provides an introduction to stochastic calculus. Topics include conditioning, Poisson processes, martingales, Brownian motion, Ito integrals, Ito's formula, stochastic differential equations, Feynman-Kac formula, Girsanov's theorem, and the martingale representation theorem. Financial applications include pricing, hedging, and interest rate models. Effective From: Fall 2009

Math 608 - Partial Differential Equations for Finance (3 credits)
This course presents the subject of partial differential equations (PDE's) with a strong emphasis on the PDE's arising in the study of stochastic processes and finance. The focus is on analytical and numerical methods for obtaining solutions in a form useful for solving problems in financial engineering. Topics include modeling with PDE's, classification of PDE's, analytical and numerical methods for PDE's and application to finance. Effective From: Fall 2009

Math 611 - Numerical Methods for Computation (3 credits)
This course provides a practical introduction to numerical methods. Numerical solution of linear systems. Interpolation and quadrature. Interative solution of nonlinear systems. Computation of eigenvalues and eigenvectors. Numerical solution of initial and boundary value problems for ODE's. Introduction to numerical solution of PDE's. Applicatons drawn from science, engineering, and finance. Effective From: Spring 2009

Math 613 - Advanced Applied Mathematics I: Modeling (3 credits)
Prerequisites: Math 331 and Math 337, or departmental approval. Concepts and strategies of mathematical modeling are developed by investigation of case studies in a selection of areas. Consistency of a model, nondimensionalization and scaling, regular and singular effects are discussed. Possible topics include continuum mechanics (heat and mass transfer, fluid dynamics, elasticity), vibrating strings, population dynamics, traffic flow, and the Sommerfeld problem.

Math 614 - Numerical Methods I (3 credits)

Prerequisites: Math 222, Math 337, Math 340, and proficiency in a computer language (FORTRAN, C, or C++), or departmental approval. Theory and techniques of scientific computation, with more emphasis on accuracy and rigor than Math 611. Machine arithmetic. Numerical solution of a linear system and pivoting. Interpolation and quadrature. Iterative solution of nonlinear systems. Computation of eigenvalues and eigenvectors. Numerical solution of initial- and boundary-value problems for systems of ODEs. Applications. The class includes examples requiring student use of a computer.

Math 615 - Approaches to Quantitative Analysis in the Life Sciences (3 credits)

A graduate seminar-style course based around case studies of common data analytic methods used in the life sciences. The case studies are designed to help students who are interested in applications of statistical thinking to biological sciences appreciate the scope of quantitative methods, their underlying concepts, assumptions and limitations. While the mathematics of specific methods are not covered, students of the course will get an understanding of the diverse approaches to statistical inference in the life sciences. Effective From: Fall 2009

Math 630 - Linear Algebra and Applications (3 credits)

Prerequisites: (This course is not intended for students in the Master's in Applied Mathematics program or in the doctoral program in Mathematical Sciences.) Math 211 or Math 213, and Math 222. Development of the concepts needed to study applications of linear algebra and matrix theory to science and engineering. Topics include linear systems of equations, matrix algebra, orthogonality, eigenvalues and eigenvectors, diagonalization, and matrix decomposition.

Math 631 - Linear Algebra (3 credits)

Prerequisites: Math 222 and Math 337, or departmental approval. Similar in aim and content to Math 630 but with more emphasis on mathematical rigor. Linear systems of equations, matrix algebra, linear spaces, orthogonality, eigenvalues and eigenvectors, diagonalization, and matrix decomposition. Applications.

Math 635 - Analytical Computational Neuroscience (3 credits)

Prerequisites: Math 211 or 213, Math 337, and CIS 113 or Math 240, or departmental approval. This course will provide an intermediate-level mathematical and computational modeling background for small neuronal systems. Models of biophysical mechanisms of single and small networks of neurons are discussed. Topics include voltage-dependent channel gating mechanisms, the Hodgkin-Huxley model for membrane excitability, repetitive and burst firing, single- and multi-compartmental modeling, synaptic transmission, mathematical treatment of 2-cell inhibitory or excitatory networks. In this course, the students will be required to build computer models of neurons and networks and analyze these models using geometric singular-perturbation analysis and dynamical systems techniques.

Math 636 - Systems Computational Neuroscience (3 credits)

Prerequisites: Math 635. This course covers mathematical and computational modeling of neuronal networks. Topics covered include central pattern generators, models of visual processes, models of learning and memory, neural coding and mathematics of neural networks, models of oscillations in sensory, thalamic and thalamo-cortical networks, neuronal wave propagation.

Math 637 - Foundations of Mathematical Biology (3 credits)

Prerequisites: Math 222 and Math 337, or departmental approval. This course provides an introduction to the use of mathematical techniques applied to solve problems in biology. Models discussed fall into 3 categories: discrete, continuous, and spatially distributed. Biological topics discussed range from the subcellular molecular systems and cellular behavior to physiological problems, population biology and developmental biology.

Math 639 - Mathematical Modeling II (3-0-3)

Continuation of Math 613 (Advanced Applied Mathematics I, Modeling). Concepts and strategies of Mathematical modeling are developed by case studies in a selection of areas. Topics will be complementary to those presented in Math 613, and include for example, the mathematical theory of elasticity and electromagnetism. Effective From: Fall 2006

Math 644 - Regression Analysis Methods (3 credits)

Prerequisite: Math 661. Regression models and the least squares criterion. Simple and multiple linear regression. Regression diagnostics. Confidence intervals and tests of parameters, regression and analysis of variance. Variable selection and model building. Dummy variables and transformations, growth models. Other regression models such as logistic regression. Using statistical software for regression analysis.

Math 645 - Analysis I (3 credits)

Prerequisite: Math 546 or departmental approval. Review and extension of the fundamental concepts of advanced calculus: the real number system, limit, continuity, differentiation, the Riemann integral, sequences and series. Point set topology in metric spaces. Uniform convergence and its applications.

Math 646 - Time Series Analysis (3 credits)

Prerequisite: Math 661 or departmental approval. Time series models, smoothing, trend and removal of seasonality. Naive forecasting models, stationarity and ARMA models. Estimation and forecasting for ARMA models. Estimation, model selection, and forecasting of nonseasonal and seasonal ARIMA models.

Math 647 - Time Series Analysis II (3 credits)

Prerequisite: Math 646. Continuation of Math 646. Covers methods of time series analysis useful in engineering, the sciences, economics, and modern financial analysis. Topics include spectral analysis, transfer functions, multivariate models, state space models and Kalman filtering. Selected applications from topics such as intervention analysis, neural networks, process control, financial volatility analysis.

Math 651 - Methods of Applied Mathematics I (3 credits)

Prerequisite: Math 222 or departmental approval. A survey of mathematical methods for the solution of problems in the applied sciences and engineering. Topics include: ordinary differential equations and elementary partial differential equations. Fourier series, Fourier and Laplace transforms, and eigenfunction expansions.

Math 652 - Methods of Applied Mathematics II (3 credits)

Prerequisite: (This course is not intended for students in a graduate program in Mathematical Sciences.) Math 651. Continuation of Math 651. Topics include: partial differential equations, functions of a complex variable, and the calculus of variations.

Math 654 - Clinical Trials Design and Analysis (3 credits)

Prerequisites: Math 665 or equivalent with Departmental approval. Statistical methods and issues in the design of clinical trials and analysis of their data. Topic include clinical trial designs for phases 1-4, randomization principle and procedures, analysis of pharmacokinetic data for bioequivalence, multi-center trials, categorical data analysis, survival analysis, longitudinal data analysis, interim analysis, estimation of sample size and power, adjustment for multiplicity, evaluation of adverse events, and regulatory overview. Effective From: Fall 2007

Math 656 - Complex Variables I (3 credits)

Prerequisite: Math 545 or Math 645 or departmental approval. The theory and applications of analytic functions of one complex variable: elementary properties of complex numbers, analytic functions, elementary complex functions, conformal mapping, Cauchy integral formula, maximum modulus principle, Laurent series, classification of isolated singularities, residue theorem, and applications.

Math 659 - Survival Analysis (3 credits)

Prerequisites: Math 665 or equivalent with Departmental approval. Introduction to statistical methods for modeling time-to-event data in the presence of censoring and truncation, with emphasis on applications to the health sciences. Topics include survival and hazard functions, censoring and truncation, parametric and nonparametric models for survival data, competing-risks, regression models including Cox proportional hazards model and time-dependent covariates, one and two sample tests, and use of appropriate statistical software for computations. Effective From: Fall 2007

Math 661 - Applied Statistics (3 credits)

Prerequisite: Math 112. Role and purpose of applied statistics. Data visualization and use of statistical software used in course. Descriptive statistics, summary measures for quantitative and qualitative data, data displays. Modeling random behavior: elementary probability and some simple probability distribution models. Normal distribution. Computational statistical inference: confidence intervals and tests for means, variances, and proportions. Linear regression analysis and inference. Control charts for statistical quality control. Introduction to design of experiments and ANOVA, simple factorial design and their analysis.

Math 662 - Probability Distributions (3 credits)

Prerequisite: Math 341 or Math 333, and departmental approval. Probability, conditional probability, random variables and distributions, independence, expectation, moment generating functions, useful parametric families of distributions, transformation of random variables, order statistics, sampling distributions under normality, the central limit theorem, convergence concepts and illustrative applications.

Math 663 - Introduction to Biostatistics (3-0-3)

Prerequisites: Undergraduate Calculus. Introduction to statistical techniques with emphasis on applications in health related sciences. This course will be accompanied by examples from biological, medical and clinical applications. Summarizing and displaying data; basic probability and inference; Bayes' theorem and its application in diagonostic testing; estimation, confidence intervals, and hypothesis testing for means and proportions; contingency tables; regression and analysis of variance; logistic regression and survival analysis; basic epidemiologic tools; use of statistical software. Effective From: Spring 2005

Math 664 - Methods for Statistical Consulting (3 credits)

Prerequisite: Math 661 or departmental approval. Communicating with scientists in other disciplines. Statistical tools for consulting. Using statistical software such as JMP, SAS, and S-plus. Case studies which illustrate using statistical methodology and tools are presented by the instructor and guest speakers from academia and industry. Assignments based on case studies with use of statistical software is required.

Math 665 - Statistical Inference (3 credits)

Prerequisite: Math 662 or departmental approval. Review of sampling distributions. Data reduction principles: sufficiency and likelihood. Theory and methods of point estimation and hypothesis testing, interval estimation, nonparametric tests, introduction to linear models. Effective From: Fall 2007

Math 668 - Probability Theory (3 credits)
The subject matter of this course deals with the foundations of axiomatic probability - based on abstract measure theory, stochastic convergence, limit theorems, conditional expectations and martingales - is aimed primarily at Ph.D. level students. Modified pre-requisite require appropriate background in real analysis. Course content remains unchaged. Effective From: Spring 2009

Math 671 - Asymptotic Methods I (3 credits)
Prerequisite: Math 645 or Math 545, and Math 656, or departmental approval. Asymptotic sequences and series. Use of asymptotic series. Regular and singular perturbation methods. Asymptotic methods for the solution of ODEs, including: boundary layer methods and asymptotic matching, multiple scales, the method of averaging, and simple WKB theory. Asymptotic expansion of integrals, including: Watson's lemma, stationary phase, Laplace's method, and the method of steepest descent.

Math 672 - Biomathematics I: Biological Waves and Oscillations (3 credits)
Prerequisites: Math 222, Math 331, and Math 337, or departmental approval. Models of wave propagation and oscillatory phenomena in nerve, muscle, and arteries: Hodgkin-Huxley theory of nerve conduction, synchronization of the cardiac pacemaker, conduction and rhythm abnormalities of the heart, excitation-contraction coupling, and calcium induced waves, wave propagation in elastic arteries, models of periodic human locomotion.

Math 673 - Biomathematics II: Pattern Formation in Biological Systems (3 credits)
Prerequisites: Math 222, Math 331, and Math 337, or departmental approval. Emergence of spatial and temporal order in biological and ecological systems: Hopf and Turing bifurcation in reaction-diffusion systems, how do zebras get their stripes, patterns on snake skins and butterfly wings, spatial organization in the visual cortex, symmetry breaking in hormonal interactions, how do the ovaries count. Basic techniques of mathematics are introduced and applied to significant biological phenomena that cannot be fully understood without their use.

Math 675 - Partial Differential Equations (3 credits)
Prerequisite: Math 690 or departmental approval. A survey of the mathematical theory of partial differential equations: first-order equations, classification of second-order equations, the Cauchy-Kovalevsky theorem, properties of harmonic functions, the Dirichlet principle. Initial- and boundary-value problems for hyperbolic, elliptic, and parabolic equations. Systems of equations.

Math 676 - Advanced Ordinary Differential Equations (3 credits)
Prerequisites: Math 222, Math 337, and Math 545 or Math 645. A rigorous treatment of the theory of systems of differential equations: existence and uniqueness of solutions, dependence on initial conditions and parameters. Linear systems, stability, and asymptotic behavior of solutions. Nonlinear systems, perturbation of periodic solutions, and geometric theory of systems of ODEs.

Math 677 - Calculus of Variations (3 credits)
Prerequisite: Math 545 or Math 645 or departmental approval. Necessary conditions for existence of extrema. Variation of a functional, Euler's equation, constrained extrema, first integrals, Hamilton-Jacobi equation, quadratic functionals. Sufficient conditions for the existence of extrema. Applications to mechanics.

Math 685 - Combinatorics (3 credits)
Prerequisite: Math 545 or Math 645. Generating functions, principle of inclusion-exclusion, pigeonhole principle, partitions. Polya's theory of counting, graph theory, and applications.

Math 687 - Quantitative Analysis for Environmental Design Research (3 credits)
Prerequisites: Math 333 and departmental approval. Fundamental concepts in the theory of probability and statistics including descriptive data analysis, inferential statistics, sampling theory, linear regression and correlation, and analysis of variance. Also includes an introduction to linear programming and nonlinear models concluding with some discussion of optimization theory.

Math 688 - Mathematical and Statistical Methods in Materials Science (3 credits)
More emphasis on analytical methods and statistics. Course will be required for Ph.D. students in Materials Science. Effective From: Fall 2006

Math 689 - Advanced Applied Mathematics II: Ordinary Differential Equations (3 credits)
Prerequisites: Math 545 or Math 645, Math 613, and Math 631. A practical and theoretical treatment of boundary-value problems for ordinary differential equations: generalized functions, Green's functions, spectral theory, variational principles, and allied numerical procedures. Examples will be drawn from applications in science and engineering.

Math 690 - Advanced Applied Mathematics III: Partial Differential Equations (3 credits)

Prerequisite: Math 689. A practical and theoretical treatment of initial- and boundary-value problems for partial differential equations: Green's functions, spectral theory, variational principles, transform methods, and allied numerical procedures. Examples will be drawn from applications in science and engineering.

Math 691 - Stochastic Processes with Applications (3 credits)

Prerequisite: Math 662. Renewal theory, renewal reward processes and applications. Homogeneous, non-homogeneous, and compound Poisson processes with illustrative applications. Introduction to Markov chains in discrete and continuous time with selected applications.

Math 698 - Sampling Theory (3 credits)

Prerequisite: Math 662. Role of sample surveys. Sampling from finite populations. Sampling designs, the Horowitz-Thompson estimator of the population mean. Different sampling methods, simple random sampling, stratified sampling, ratio and regression estimates, cluster sampling, systematic sampling.

Math 699 - Design and Analysis of Experiments (3 credits)

Prerequisite: Math 662. Statistically designed experiments and their importance in data analysis, industrial experiments. Role of randomization. Fixed and random effect models and ANOVA, block design, latin square design, factorial and fractional factorial designs and their analysis.
Effective From: Spring 2006

Math 700 - Master's Project (3 credits)

Prerequisites: Matriculation for the Master of Science in Applied Mathematics or in Applied Statistics and departmental approval. Work must be initiated with the approval of a faculty member, who will be the student's project advisor. Work of sufficient quality may qualify for extension into a master's thesis, see Math 701.

Math 701 - Master's Thesis (6 credits)

Prerequisite: Matriculation for the master's degree and departmental approval. Students must register for a minimum of 3 credits per semester until completion. The work is carried out under the supervision of a designated member of the faculty.

Math 707 - Advanced Applied Mathematics IV: Special Topics (3 credits)

Prerequisite: Departmental approval. A current research topic of interest to departmental faculty. Typical topics include: computational fluid dynamics, theoretical fluid dynamics, acoustics, wave propagation, dynamical systems, theoretical and numerical aspects of combustion, mathematical biology, and various topics in statistics.

Math 710 - Graduate Research Methods (3 credits)

Prerequisite: Math 614, Math 671, and Math 690. Acquaints second-year graduate students with the techniques and vocabulary of a field in applied mathematics. Each student contacts a designated faculty member and is given several basic papers or books on a research topic of current interest. The student prepares two lectures on his/her topic to be given at the end of the semester. A sample list of active fields of research includes acoustics, electromagnetic theory, elasticity, fluid dynamics, combustion, and mathematical biology.

Math 712 - Numerical Methods II (3 credits)

Prerequisites: Math 614, Math 331 or departmental approval, and proficiency in a computer programming language (FORTRAN, C, or C++). Numerical methods for the solution of initial- and boundary-value problems for partial differential equations, with emphasis on finite difference methods. Consistency, stability, convergence, and implementation are considered.

Math 713 - Advanced Scientific Computing: Multi-Dimensional Finite-Difference Schemes and Spectral Methods (3 credits)

Prerequisite: Math 712 and proficiency in a computer programming language (FORTRAN, C, or C++). Derivation and analysis of finite difference schemes for systems of partial differential equations in two and three spatial dimensions and time. Issues pertaining to efficient implementation of algorithms and to stability of physical and numerical boundary conditions. Pseudo-spectral and spectral methods to solve partial differential equations. Approximation properties of Fourier and Chebyshev series and techniques based on the Fast Fourier Transform (FFT) and on matrix multiplication to numerically compute partial derivatives. Time-discretization techniques suitable for use with pseudo-spectral and spectral methods. Model systems arising in wave propagation, fluid dynamics, and mathematical biology will be considered.

Math 715 - Mathematical Fluid Dynamics I (3-0-3)

Introduction to the basic ideas of fluid dynamics, with an emphasis on rigorous treatment of fundamentals and the mathematical developments and issues. The course focuses on the background and motivation for recent mathematical and numerical work on the Euler and Navier-Stokes equations, and presents a mathematically intensive investigation of various model equations of fluid dynamics (e.g., the Korteweg-de-Vries equations). Effective From: Fall 2005

Math 716 - Mathematical Fluid Dynamics II (3-0-3)
Continuation of Math 715. Further development of the ideas of fluid dynamics, with an emphasis on mathematical developments and issues. A selection of topics will be developed in some detail, for example: Stokes flow and low-Reynolds-number hydrodynamics; flow at high Reynolds number and boundary layers; shock waves and hyperbolic systems; dynamics of interfacial flows; hydrodynamic stability; rotating fluids.
Effective From: Fall 2005

Math 717 - Inverse Problems and Global Optimization (3-0-3)
Introduction to inverse problems and global optimization. Linear, quasi-linear, and nonlinear inverse problems are studied with emphasis on regularization techniques. Bayesian statistical approaches and Monte Carlo methods are introduced and discussed in the context of inverse problems. The mathematical foundations of simulated annealing, genetic algorithms, and TABU are presented. Effective From: Fall 2006

Math 720 - Tensor Analysis (3 credits)
Prerequisite: Math 613 and Math 631, or departmental approval. Review of vector analysis in general curvilinear coordinates. Algebra and differential calculus of tensors. Applications to differential geometry, analytical mechanics, and mechanics of continuous media. The choice of applications will be determined by the interests of the class.

Math 722 - Wave Propagation (3-0-3)
Derivation of linear wave equations describing acoustic, electromagnetic, elastodynamic and hydrodynamic phenomena. Fundamental solutions and their application to initial value problems. Applications and solution of boundary value problems using Green's functions, image and spectral methods. Related time harmonic problems, including radiation, scattering, diffraction and transmission phenomena. Dispersive waves and the method of stationary phase. Linear waves in anisotropic media. Effective From: Fall 2006

Math 745 - Analysis II (3 credits)
Prerequisite: Math 645. Lebesgue measure and integration, including the Lebesgue dominated convergence theorem and Riesz-Fischer theorem. Elements of Hilbert spaces and Lp-spaces. Fourier series and harmonic analysis. Multivariate calculus.

Math 756 - Complex Variables II (3 credits)
Prerequisite: Math 656. Selected topics from: conformal mapping and applications of the Schwarz-Christoffel transformation, applications of calculus of residues, singularities, principle of the argument, Rouche's theorem, Mittag-Leffler's theorem, Casorati-Weierstrass theorem, analytic continuation, and applications, Schwarz reflection principle, monodromy theorem, Wiener-Hopf technique, asymptotic expansion of integrals; integral transform techniques, special functions.

Math 761 - Statistical Reliability Theory and Applications (3 credits)
Prerequisite: Math 662 or departmental approval. Survival distributions, failure rate and hazard functions, residual life. Common parametric families used in modeling life data. Introduction to nonparametric aging classes. Coherent structures, fault tree analysis, redundancy and standby systems, system availability, repairable systems, selected applications such as software reliability.

Math 762 - Statistical Inference (3 credits)
Prerequisite: Math 662 or departmental approval. Review of sampling distributions. Data reduction principles: sufficiency and likelihood. Theory and methods of point estimation and hypothesis testing, interval estimation, nonparametric tests, introduction to linear models. Effective Until: Spring 2007

Math 767 - Fast Numerical Algorithms (3-0-3)
The course covers state-of-the-art, analysis-based, fast numerical algorithms for computing discrete summations/transforms and for solving differential/integral equations. In particular, this course presents fast multiple methods and their descendants, including fast Fourier transform for nonequispaced data, fast Gauss transform, fast iterative solver and direct solver for elliptic boundary value problems. Effective From: Fall 2008

Math 771 - Asymptotic Methods II (3 credits)
Prerequisite: Math 671. Continuation of Math 671. Asymptotic methods for the solution of PDEs, including: matched asymptotic expansions, multiple scales, the WKB method or geometrical optics, and near-field far-field expansions. Applications to elliptic, parabolic, and hyperbolic problems. Further topics in the asymptotic expansion of integrals and the WKB method. Emphasis on examples drawn from applications in science and engineering.

Math 786 - Large Sample Theory and Inference (3 credits)
Prerequisites: Math 762 and Math 668. Limit theorems, central limit theorem, asymptotic expansions and large deviations, limit theorems in martingales and semi-martingales and stochastic differential equations, asymptotic expansions of functions of statistics, linear parametric estimation, asymptotic efficiency, martingale approach to inference: test for homogeneity and goodness of fit, decomposable statistics, inference

for counting processes and censored data, inference in nonlinear regression, existence and consistency of least squares estimator (LSE), asymptotic properties of LSE, Von Mises functionals, estimation of parameters of stable laws, empirical characteristics function for inference, generalized least squares for linear models.

Math 787 - Non-Parametric Statistics (3 credits)

Prerequisite: Math 662. Wilcoxon signed-ranks test, Mann-Whitney U test, binomial sign test for single sample and two dependent samples, McNemar's test, Cochran Q test, Wilcoxon matched-pairs signed-ranks test, Kruskal-Wallis one-way analysis of variance, Friedman two-way analysis of variance, Siegel-Tukey test for equal variability, chi-squared goodness-of-fit test, test for homogeneity and independence, single-sample runs test and other tests of randomness, correlation tests: Spearman's rank-order correlation, coefficient and Kendall's tau, Kendall's coefficient of concordance, and Goodman and Kruskal's gamma, comparing power efficiency.

Math 790 - Doctoral Dissertation (Credits as designated)

Prerequisite: Excellent performance on the doctoral qualifying examination. A minimum of 36 credits is required of all candidates for the Ph.D. degree. Candidates must register for 6 to12 credits per semester, to be determined by a designated dissertation advisor. After reaching 36 credits, students must continue to register for 3 credits each semester until degree completion.

Math 791 - Graduate Seminar (0 credit)

All master's and doctoral students receiving departmental or research-based awards must register for this course each semester. Effective From: Fall 2006

Math 792 - Pre-Doctoral Research (3 credits)

Prerequisite: Departmental approval. For students admitted to the Ph.D. program in the Mathematical Sciences. Research is performed under the supervision of a designated faculty member. If the work culminates in doctoral research in the same area, up to 6 credits may be counted toward Math 790. See Math 790.

Mechanical Engineering:

UNDERGRADUATE COURSES:

ME 215 - Engineering Materials and Processes (2-2-3)

Prerequisite: Chem 126. Students also must register for the lab component. Combined lecture and laboratory relating to the study of engineering materials. Processes of formation from liquid and particle state, plastic forming, molding deformation, and metal removal. Effects of heat treatment on material properties. Laboratory exercises involve basic machine tools and computer-controlled equipment.

ME 231 - Kinematics of Machinery (3-0-3)

Prerequisites: CIS 101, Mech 234. Design, selection, and evaluation of mechanisms for various applications. Topics include planar and spatial linkages, cams, gears, planetary and non-planetary gear systems, linkage synthesis, linkage dynamics, and an introduction to robotic manipulators using vector, matrix, and complex number methods. Projects involve using mathematics software for analysis and plotting of motion and inertial forces in planar and spatial linkages.

ME 304 - Fluid Mechanics (3-0-3)

Prerequisites: Mech 236, ME 311. Introduction to the basic principles of conservation of mass, momentum, and energy as they apply to engineering systems which utilize fluids. Some of the topics are dimensional analysis, theoretical and empirical analysis of one-dimensional compressible and incompressible flow, empirical analysis of external and internal flows, and elementary boundary layer theory.

ME 305 - Introduction to System Dynamics (3-0-3)

Prerequisites: Math 222, Mech 236, ME 231. Principles of dynamic system modeling and response with emphasis on mechanical, electrical, and fluid systems. Application of computer simulation techniques.

ME 310 - Co-op Work Experience I (3 additive credits)

Prerequisites: completion of sophomore year, approval of department, and permission of the Office of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated by the co-op office and approved by the department. Mandatory participation in seminars and completion of a report.

ME 311 - Thermodynamics I (3-0-3)

Prerequisites: Math 211, Phys 111. Thermodynamic fundamentals. Topics are the first and second laws of thermodynamics, physical properties of pure substances, entropy, ideal and real gases, and gaseous mixtures.

ME 312 - Thermodynamics II (3-0-3)

Prerequisite: ME 311. A continuation of ME 311 including studies of irreversibility and combustion. Thermodynamic principles are applied to the analysis of power generation, refrigeration, and air-conditioning systems. Introduction to solar energy thermal processes, nuclear power plants, and direct energy conversion.

ME 315 - Stress Analysis (3-0-3)

Prerequisites: Math 222, Mech 237, ME 215. Problems related to mechanical design. Topics include two-dimensional elasticity, transformation of stress and strain, plane stress problems, axisymmetric members, buckling criteria, and failure theories.

ME 316 - Machine Design (3-0-3)

Prerequisites: ME 231, ME 315. Aspects of the design process and design of machine elements. Mini-projects are used to introduce engineering design procedures.

ME 339 - Fundamentals of Mechanical Design (3-0-3)

Prerequisite: Mech 234. For industrial engineering majors. Topics include kinematics of mechanisms, machine components, and a brief intro-duction to mechanical vibrations. Students gain the ability to deal with design problems from the viewpoint of a non-specialist.

ME 343 - Mechanical Laboratory I (2-2-3)

Prerequisites: EE 405, Math 225, Mech 236. Corequisite: ME 304. Students also must register for the lab component. Laboratory and lecture in instrumentation and measurement for mechanical engineering students. Applications for the sensing of such variables as pressure, temperature, mass flow, and displacement. Particular attention to the applicability and sensitivity of instruments.

ME 403 - Mechanical Systems Design I (2-1-3)

Prerequisites: ME 304, ME 305, ME 312, ME 316. Corequisite: ME 407. Lectures and projects covering problem solving methodology in the design, analysis, and synthesis of mechanical and thermal systems. The student's academic background combines with engineering principles and topics to serve as a foundation for broad engineering projects. Emphasis on creative thinking and the engineering design process in projects involving the optimal conversion of resources.

ME 405 - Mechanical Laboratory II (1-2-2)

Prerequisite: ME 343, ME 312. Corequisite: ME 407. Laboratory emphasizing the use of fundamental principles and instrumentation systems for the analysis and evaluation of mechanical components within a system.

ME 406 - Mechanical Laboratory III (1-2-2)

Prerequisite: ME 405, ME 407. Laboratory covering the testing and evaluation of complete mechanical systems.

ME 407 - Heat Transfer (3-0-3)

Prerequisites: Math 222, ME 304, ME 311. A study of the three fundamental modes of heat transfer: conduction, convection, and radiation. A physical interpretation of the many quantities and processes in heat transfer using numerical methods. Theory is applied to the analysis and design of heat exchangers and other applications. Where appropriate, computer simulation is used.

ME 408 - Mechanical Systems Design II (1-2-2)

Prerequisite: ME 403, ME 407. A continuation of ME 403 from a more integrated viewpoint, with lectures on special topics. Concepts in optimization and computer simulation are considered in the design and synthesis of mechanical engineering systems. The projects are more comprehensive, emphasizing creative design, and requiring design decisions of a more sophisticated nature.

ME 410 - Co-op Work Experience II (3 credits)

Prerequisites: ME 310, approval of the department, and permission of the Office of Cooperative Education and Internships. Full-time work experience of approximately one semester's duration. Provides major related work experience as co-op/internship. Mandatory participation in seminars and completion of requirements that include a report and project.

ME 415 - Advanced Manufacturing Processes (3-0-3)

Prerequisites: ME 215 and ME 316. A lecture course discussing principles of conversion of liquid and solid materials in products. The notion of the Unit Manufacturing processes is used to analyze advanced technologies of the change of mass, geometry, composition, phases and structure. Effective From: Spring 2009

ME 425 - Finite Element Method in Mechanical Engineering (3-0-3)

Prerequisites: CIS 101, Math 222, and Mech 237. Introduction to central ideas underlying the finite element method in mechanical engineering and its computer implementation. Fundamental concepts such as interpolation functions for one- and two-dimensional elements, bar element method, Galerkin's method, discretization of a model, methods of assembling global matrices, and the final solution techniques for obtaining nodal values. Specific applications to mechanical engineering problems in trusses, beams, torsion, heat transfer, fluid flow, plane stress, and plane strain.

ME 430 - Introduction to Computer-Aided Design (2-2-3)

Prerequisites: CIS 101, Math 222. Introduction to basic concepts of computer-aided design as applied to mechanical engineering design problems. Topics include numerical techniques, computer graphics, geometric modeling, design optimization, and databases for design. The laboratory uses current CAD software packages for mechanical design. Projects involve applications of the basic principles using student's own as well as available software.

ME 431 - Introduction to Robotics and Automation (3-0-3)

Prerequisites: CIS 101, Mech 236. Introduction to mechanics and control of robotic manipulators. Topics include spatial transformations, kinematics, dynamics, trajectory generation, actuators and control, and relations to product design and flexible automation.

ME 432 - Principles of Air Conditioning and Refrigeration (3-0-3)

Prerequisites: ME 304, ME 312; Corequisite: ME 407. A course in the fundamentals of air conditioning and refrigeration. Topics covered are psychometrics, cooling and heat load calculations, air distribution systems, duct design, vapor compression and absorption systems, and the principles of cooling towers.

ME 433 - Vibration Analysis (3-0-3)
Prerequisites: Mech 236, Math 222. An introduction to the fundamental theory of mechanical vibrations. Undamped and damped systems with single and multiple degrees of freedom, transient vibration, vibrations of continuous media, and analog and numerical methods.

ME 435 - Thermodynamics (3-0-3)
Prerequisites: Math 211, Phys 111. Intended for non-mechanical engineering students of all disciplines. Topics include the basic laws of thermodynamics, properties of fluids and solids, analysis of open and closed systems, gas and vapor power cycles, refrigeration and air conditioning, and an introduction to heat transfer. Cannot be taken for credit by mechanical engineering students.

ME 437 - Structural Analysis (3-0-3)
Prerequisite: ME 315. Fundamentals of structural analysis. Consideration of stresses and deflections of beams as well as the design of beams, columns, trusses, and structural connections of steel, reinforced concrete, and timber structures.

ME 438 - Introduction to Physical Metallurgy (3-0-3)
Prerequisites: Chem 126, ME 215. Introduction to metallic microstructures, solid solutions and the mechanical properties of metals and alloys. Physical understanding of diffusion processes is emphasized in covering the relationship between the nature of metals and different heat treating processes.

ME 439 - Principles of Tribology (3-0-3)
Prerequisites: Chem 126, Mech 237. An introduction to the principles of wear resistance of machine parts and tribology. Physical understanding of different mechanisms of wear and friction and methods of increasing durability.

ME 441 * - Computer Simulation and Analysis in Mechanical Engineering (2-2-3)
Prerequisites: ME 430. This course covers various topics in Computer-Aided Design (CAD) and Computer-Aided Engineering (CAE). The course provides an in-depth understanding and skill of constructing 2-D drawings using well-known commercial CAD package, and integrating 3-D solid modeling techniques into simulation, and analysis animation of new designs using commercial CAD/CAE software. The students will have hands-on experience to analyze Structure, Heat Transfer, and Computational Fluid Dynamics problems by using several different software packages. The course also focuses on CAD Product Data Exchange using both Direct Database conversion and International Standards based conversion methods between major CAD/CAE systems. Typical industrial applications will be illustrated.

ME 451 - Introduction to Aerodynamics (3-0-3)
Prerequisites: ME 304, ME 311. Introduction to the basic principles and properties of fluid flow around immersed bodies. Topics include the kinematics and dynamics of fluid fields, the thin airfoil, finite wing theory, and one-dimensional compressible flow.

ME 452 - Dynamics of Space Flight (3-0-3)
Prerequisites: Mech 236, Math 222. An introduction to the mechanics of space flight. After a brief introduction to the physics of the solar system, the dynamics of space flight are developed from the Newtonian viewpoint. Covers the performance and propulsion methods of rocketry.

ME 454 - Compressible Flow (3-0-3)
Prerequisites: ME 304, ME 312, Math 222. Equations of one-dimensional compressible flow. Topics are flows with variable areas, friction, mass addition, heat addition, normal shocks, and combination of these effects. Special topics in two-dimensional flows such as oblique shocks.

ME 455 - Automatic Controls (3-0-3)
Prerequisite: ME 305. Introduction to the principles of automatic controls. Emphasis on systems, considering their mechanical, hydraulic, pneumatic, thermal, and displacement -aspects. First and second order linear systems. Introduction to system analysis techniques such as Nyquist and Bode diagrams and applications in system design.

ME 470 - Engineering Properties of Plastics (3-0-3)
Prerequisites: ME 215, Mech 237. A study of the physical properties of the various commerical thermosetting and thermoplastic resins. An introduction to linear viscoelastic theory and its relationship to measurable mechanical properties of plastics. Also, engineering properties such as flammability, chemical resistance, and electrical properties.

ME 471 - Introduction to Polymer Processing Techniques (3-0-3)
Prerequisites: ME 304, ME 407. A study of the various plastics processing techniques, including extrusion, injection molding, blow molding, compression molding, thermoforming, rotational molding, casting, etc. The relationship between product design and choice of process will be presented.

ME 472 - Introduction to Biomechanical Engineering (3-0-3)
Prerequisites: ME 316 or equivalent; or permission of the instructor. Introduction to biomechanical engineering integrating the principles of

mechanics with the notions of physiology into simple mathematical models consisting of sets of governing equations. Topics include anatomy; basic concepts and definitions of biomechanical engineering; basic solid mechanics such as human force and motion; basic fluid mechanics such as the cardiovascular system and blood circulation; engineering design of general assistive devices.

ME 490 - Mechanical Engineering Project A (3-0-3)
Prerequisites: departmental approval required. One or more individually selected projects. Projects usually require library research, design, cost analysis, planning of testing. Also involves an engineering report and a technical presentation.

ME 490H - Honors Mechanical Engineering Project I (3-0-3)
Prerequisites: member of Honors College and departmental approval required. Similar to ME 490.

ME 491 - Mechanical Engineering Project B (3-0-3)
Prerequisite: ME 490 and departmental approval required. One or more selected projects. Projects usually require library research, design, cost analysis, planning of testing. Also involves an engineering report and a technical presentation.

ME 491H - Honors Mechanical Engineering Project II (3-0-3)
Prerequisites: member of Honors College, and departmental approval required. Similar to ME 491.

GRADUATE COURSES:

ME 590 - Graduate Co-op Work Experience I (3 additive credits)
Prerequisites: permission from Department of Mechanical Engineering and Division of Career Development Services. Cooperative education internship providing on-the-job reinforcement of academic programs in mechanical engineering. Work assignments and projects are developed by the co-op office in consultation with the mechanical engineering department. Work assignments are related to student's major and are evaluated by faculty coordinators in mechanical engineering. Course cannot be used for mechanical engineering degree credit.

ME 591 - Graduate Co-op Work Experience II (3 additive credits)
Prerequisites: permission from Department of Mechanical Engineering and Division of Career Development Services. Course cannot be used for mechanical engineering degree credit.

ME 592 - Graduate Co-op Work Experience III (3 additive credits)
Prerequisites: permission from Department of Mechanical Engineering and Division of Career Development Services. Course cannot be used for mechanical engineering degree credit.

ME 593 - Graduate Co-op Work Experience IV (0 credits)
Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

ME 607 - Advanced Thermodynamics (3 credits)
Prerequisite: undergraduate thermodynamics. Basic laws of thermodynamics are applied to various thermodynamic systems. Topics include: availability, stability requirements, equation of state, property relations, properties of homogeneous mixtures, optimization applied to power generation and refrigeration cycles, and thermodynamic design of system components.

ME 608 - Non-Equilibrium Thermodynamics (3 credits)
Prerequisites: undergraduate thermodynamics and heat transfer, and ME 616. (May be taken concurrently.) Principles and mathematical techniques of non-equilibrium thermodynamics applied to mechanical engineering problems. Topics include field theory, energy and entropy balances, variational principles, and applications to fluid flow, heat exchangers and combustion.

ME 609 - Dynamics of Compressible Fluids (3 credits)
Prerequisites: undergraduate differential equations, fluid mechanics, and thermodynamics. One-dimensional reversible and irreversible compressible fluid flow, including effects of variable area, friction, mass addition, heat addition, and normal shock; two-dimensional reversible subsonic and supersonic flows, and an introduction to the method of characteristics and two-dimensional oblique shock.

ME 610 - Applied Heat Transfer (3 credits)
Prerequisites: undegraduate fluid mechanics, thermodynamics, heat transfer and differential equations. Fundamentals of conduction, convection and radiation heat transfer. Practical engineering applications of heat exchangers including the design approaches by Mean Temperature Difference and Effectiveness-NTU methods, fins, convection fouling factors, and variable property analysis. Effective From: Fall 2006

ME 611 - Dynamics of Incompressible Fluids (3 credits)
Prerequisites: undergraduate fluid mechanics and ME 616. (May be taken concurrently.) An introduction to the hydrodynamics of ideal fluids; two-dimensional potential flow and stream functions; conformal mapping; and differential equations of viscous flow. Boundary layer theory and dimensional analysis are introduced.

ME 612 - Gas Dynamics (3 credits)
Prerequisite: ME 616. (May be taken concurrently.) Physical phenomena of gas dynamics and mathematical methods and techniques needed for analysis. Dynamic and thermodynamic relations for common flow situations are described through vector calculus. The nonlinearity of resulting equations and solutions such as numerical analysis, linearization or small perturbation theory, transformation of variables, and successive approximations are discussed. The method of characteristics is reviewed in detail for shock flows.

ME 613 - Radiation Heat Transfer (3 credits)
Prerequisites: undergraduate differential equations, thermodynamics, heat transfer and ME 616. (May be taken concurrently.) Heat radiation of solid bodies, gases and flames; angle factors; radiative properties of electrical conductors and non-conductors; application of radiative networks to multi-body problems; diffuse specular reflectors: artificial satellites and space vehicles; analogy between heat transfer by radiation and electrical networks; and combined conduction and radiation problems.

ME 614 - Continuum Mechanics (3 credits)
Prerequisites: Undergraduate courses in mechanics, fluid mechanics, solid mechanics, and mathematics (linear algebra, differential equations, and vector calculus) or approval of the instructor. Fundamentals of the mechanics of continuous media. Specific topics include vector and tensor analysis; kinematics associated with finite deformation; the stress tensor; and the conservation laws of mass, linear momentum, angular momentum, and energy. Constitutive equations for linear and non-linear elastic solids and for inviscid and Newtonian fluids are discussed. The role of material invariance under superimposed rigid body motion and material symmetry in the formulation of appropriate constitutive equations are emphasized.

ME 615 - Advanced Mechanical Vibrations (3 credits)
Prerequisites: undergraduate differential equations and system dynamics. One-, Two- and Multiple degree of freedom systems, Lagrange's equation of motion, Runge-Kutta computation, Finite Element Method and classical methods for normal mode analysis, matrix notation and iteration procedure, and Fourier series representation for the solution of vibration problems. Effective From: Fall 2006

ME 616 - Matrix Methods in Mechanical Engineering (3 credits)
Prerequisite: undergraduate differential equations. Applications of matrix algebra and matrix calculus to engineering analysis; matrix methods in solid and fluid mechanics; vibration, elasticity, viscous fluids, and heat transfer. Matrix theory is used to show the basic unity in engineering analysis.

ME 618 - Selected Topics in Mechanical Engineering (3 credits)
Prerequisite: departmental approval. Given when interest develops. Topics may include analysis and/or design of energy or mechanical systems of current interest to mechanical engineers.

ME 619 - Nano-scale Characterization of Materials (3 credits)
The course presents the basics of nanotechnology and the principles and application of advanced instrumentation for the characterization of nanostructures. Topics include atomic force microscopy, near-field optics, dielectric spectroscopy, and light scattering. The significant component of the course is laboratory work at the W. M. Keck Foundation Laboratory and research project. Effective From: Fall 2007

ME 620 - Stress Methods in Mechanical Design (3 credits)
Prerequisites: undergraduate differential equations and strength of materials. Governing equations and solutions for analysis and design of structural and machine elements; appropriate boundary conditions to investigate pipes and rods subjected to shrink and force fits; rotating disks of uniform and variable thickness; beam and plate elements; and thermal stresses and stress concentrations in mechanical design. Effective From: Fall 2006

ME 621 - Energy Methods in Mechanical Design (3 credits)
Prerequisites: undergraduate differential equations and strength of materials. Use of energy methods to design structural and machine elements. Includes approximate solutions for problems using conservation of energy and several variational approaches; the role of energy in failure criteria; combined loads; and the relationship of variational methods to the development of finite element solutions. Effective From: Fall 2006

ME 622 - Finite Element Methods in Mechanical Engineering (3 credits)
Prerequisites: undergraduate differential equations and strength of materials. Using variational formulation and Ritz approximation, element equations for bar, beam, potential flow, heat transfer, torsion of a solid bar and plane elasticity problems are derived and solved with computer programs. Effective From: Fall 2006

ME 624 - Microlevel Modeling in Particle Technology (3 credits)
Presents methodologies for analyzing the macroscopic properties of particulate systems in terms of the underlying microlevel processes. Significant components are the mathematical modeling of particulate systems at the microlevel, analytical and numerical methods for predicting macroscopic properties from microlevel models, and comparison of theoretical predictions with experimental results. Demonstrates the importance of the interaction of these three components in the scientific process. The first part concerns the flow of dry particles where any interstitial fluid can be ignored. The second part considers the flow of particles suspended in an interstitial fluid. Also includes a class project involving development of simulations. Same as ChE 625.

ME 625 - Introduction to Robotics (3 credits)
Prerequisites: undergraduate differential equations, kinematics and demonstrated competence in computer programming and ME 616. (May be taken concurrently.) Introduction to robotics, and computer-controlled programmable robotic manipulators; robot geometries; kinematics of manipulators; differential motion; work space planning and trajectory control; dynamics; robot sensing, and robot programming.

ME 628 - Machine Vision Principles and Applications (3 credits)
Prerequisites: undergraduate differential equations and demonstrated competence in computer programming. Fundamentals of machine vision as applied to inspection, recognition, and guidance in mechanical and manufacturing processes. Emphasis on real-time machine vision algorithms for machine parts inspection and identification. Topics include lighting and optics, camera selection and calibration, image segmentation, edge detection, feature extraction, and pattern classification.

ME 630 - Analytical Methods in Machine Design (3 credits)
Prerequisites: undergraduate differential equations, machine design, and ME 616. (May be taken concurrently.) Theory and analytical methods used in machine design. Comparisons are made between approximate and exact engineering methods for evaluation of the range of applicability of solutions. Topics include advanced analysis of threaded members; keyed, splined, and shrink fits when subjected to torque; preloaded bearings; surging, presetting and buckling of coiled springs; and accurate analysis of impact stresses and stresses beyond the yield point.

ME 631 - Bearings and Bearing Lubrication (3 credits)
Prerequisites: undergraduate differential equations, machine design and ME 616. (May be taken concurrently.) The theoretical and physical aspects of lubrication: hydrostatic and hydrodynamic problems. Reynold's differential equation for pressure distribution applied to slider bearing and journal bearing problems with and without end leakage.

ME 632 - Mechanical Engineering Measurements (3 credits)
This course offers extensive mechanical engineering lab experience, including measurement fundamentals, hands-on experiments, uncertainty analysis, technique comparison, and professional engineering reports. It also focuses on the fundamental principles behind each methodology and relevant applications. The topics cover measurement in major mechanical engineering areas including thermodynamics, thermofluids, and control. Specialized experiments include fluidization, CAD/CAM, and NC machining. Comparisons of experimental results against theoretical or computational results are also required. Effective From: Fall 2009

ME 633 - Dynamics of Machinery (3 credits)
Prerequisites: undergraduate differential equations and matrix analysis. Consideration of kinematics, constraints and Jacobians, linear and angular momentum and potential energy and conservative forces of mechanical systems. Application of principle of virtual work, D?Alembert's principle, method of virtual power and Lagrange's equation to systems of particles and systems of rigid bodies.

ME 635 - Computer-Aided Design (3 credits)
Prerequisites: undergraduate linear algebra (matrices operation) and differential equations. Adaptation of computer for solving engineering design problems; design morphology; simulation and modeling; algorithms; problem-oriented languages; use of available software; computer graphics, and automated design. Effective From: Fall 2006

ME 636 - Mechanism Design: Analysis and Synthesis (3 credits)
Prerequisites: undergraduate kinematics, dynamics and demonstrated competence in computer programming and ME 616. (May be taken concurrently.) Kinematic principles combined with computer-assisted methods for designing mechanisms; complex polar notation; and dynamic and kinetostatic analysis of mechanisms. Kinematic synthesis of planar mechanisms; graphical Burmester theory for plane linkage synthesis; and planar linkage synthesis for function and path generation.

ME 637 - Kinematics of Spatial Mechanisms (3 credits)
Prerequisites: undergraduate kinematics, dynamics, knowledge of matrices and ME 616. (May be taken concurrently.) Advanced techniques for the dual-number coordinate-transformation matrix modeling to perform the displacement, velocity, static and dynamic force analysis of spatial mechanisms. Applications considered will include shaft couplings, skew four-bars, wobble plates, generalized slider-cranks and robotic manipulators.

ME 638 - Computer-Aided Machining (3 credits)

Prerequisites: demonstrated competence in computer programming, ME 305, ME 616 and ME 635 or equivalent. Introduction of computer applications to understand integrated computer-aided machining process. Included in the course are the fundamentals of motion control and NC/CNC/DNC machining, part programming and post-processors, and advances in CAM. Student projects are carried out using appropriate manufacturing software.

ME 641 - Refrigeration and Air Conditioning (3 credits)

Prerequisites: undergraduate differential equations, fluid mechanics and thermodynamics. Refrigeration and air conditioning cycles; comfort analysis, psychometric chart analysis, heat and mass transfer steady and transient processes, heating and cooling design loads, energy loads and standards requirements.

ME 643 - Combustion (3 credits)

Prerequisites: Undergraduate thermodynamics & fluid mechanics. Chemical & physical process of combustion: ideal combustion, actual combustion, mass balance, energy of reaction, maximum adiabatic combustion temperature, chemical equilibrium, heating values of fuels, combustion in furnaces, internal combustion engines & other heat engines, with emphasis on the analysis & control of the products of combustion in light of environmental considerations.

ME 644 - Building Environmental Control Principles (3 credits)

Prerequisites: undergraduate thermodynamics, fluid mechanics, heat transfer and differential equations. Control systems for buildings including control of temperature, moisture and air quality. Optimization of systems for control of building energy use. Modern microprocessor-based control systems, including direct digital control, proportional and integral controllers, predictive control, adaptive control, optimum start controllers and optimal control.

ME 653 - Control of Electro-Mechanical Networks (3 credits)

Prerequisites: undergraduate electrical circuits and mechanical vibrations or equivalent. Electro-mechanical systems; control loops; use of mechanical networks in dynamic systems; and stability and response to various inputs in electro-mechanical networks.

ME 655 - Introduction to Modern Control Methods (3 credits)

Prerequisites: undergraduate system dynamics and automatic controls. Introduction to modern control methods applied to mechanical and manufacturing systems. Topics include state variable feedback, observer theory, nonlinear control, optimal control, and adaptive control for both continuous and discrete systems.

ME 660 - Noise Control (3 credits)

Prerequisites: undergraduate differential equations and physics. Engineering methods for reducing noise pollution; reduction of intensity at the source; limitation of transmission paths and absorption; application to structures, machinery, ground transportation, aircraft, and noise measurement.

ME 664 - Experiments and Simulations in Particle Technology (3 credits)

Prerequisites: gradute standing and consent of the instructor. Covers a particle size analysis using sieves as well as laser diffraction technique, size reduction with ball mill, measurement of powder flow properties and internal angle of friction, measurement of angle of repose, design of mass flow hoppers using Jenike direct shear tester, measurement of minimum sintering temperature of powders, particle sedimentation, powder mixing, dry particle coating, and fluidized beds. Simulations involve various dry and fluid based particle systems, focusing on particle-particle and fluid-particle interactions. Same as ChE 664.

ME 670 - Introduction to Biomechanical Engineering (3 credits)

Prerequisites: undergraduate thermodynamics, statics, and dynamics. Introduction to biomechanical engineering of physiological systems; fluid flow, structural, motion, transport, and material aspects; energy balance of the body, and the overall interaction of the body with the environment.

ME 671 - Biomechanics of Human Structure and Motion (3 credits)

Prerequisites: undergraduate statics, kinematics, and dynamics. Principles of engineering mechanics and materials science applied to human structural and kinematic systems and to the design of prosthetic devices. Topics include anatomy; human force systems; human motion; bioengineering materials; and design of implants, supports, braces, and replacements limbs.

ME 672 - Biomaterials-Characterization (3 credits)

Prerequisites: mechanics of materials, principles of materials science and engineering. Engineering physiology, stress analysis and mechanical laboratory. Fundamental concepts on the methods and rationales used in characterization of metal, ceramic, polymeric, and biologic materials used in biomedical implant fabrication including survey of various techniques and engineering design aspects on biomaterials.

ME 675 - Mechanics of Fiber Composites (3 credits)

Prerequisites: ME 315 (see undergraduate catalog for course description) and demonstrated competence in computer programming. Introduces various design problems using fiber composites. Analysis of general fiber composite laminate and short fiber composites, fracture mechanics, fatigue, creep and viscoelasticity, thermal stresses, special layups and associated optimization problems.

ME 676 - Applied Plasticity (3 credits)
Prerequisite: ME 620 or equivalent. Fundamentals of plasticity applied to mechanical and manufacturing engineering problems. Topics include elastic-plastic analysis for beams, rings and plates. Plastic instability and slip-line fields are considered.

ME 678 - Engineering Design of Plastic Products (3 credits)
Prerequisite: Knowledge of Pro/Engineer (or IDEAS). Structure and properties of plastics including stress-strain behavior and the effect of fillers and reinforcements. Designing for impact, flexure, shear, friction, puncture, creep and fatigue. Case studies of structural, electrical, and optical applications. Effective From: Fall 2006

ME 679 - Polymer Processing Techniques (3 credits)
Prerequisites: undergraduate courses in fluid dynamics and heat transfer. Techniques for processing of plastics: extrusion, injection molding, compression molding, thermoforming, casting.

ME 680 - Polymer Processing Equipment (3 credits)
Prerequisites: ChE 645 or equivalent and undergraduate heat transfer. Application of heat transfer, fluid mechanics, and thermodynamics to the design and control of polymer processing equipment. Detailed consideration of extrusion, collandering, rotational molding, stamping, and injection molding.

ME 700 - Master's Project (3 credits)
Prerequisite: department approval. An extensive paper involving design, construction, and analysis, or theoretical investigation. Further information may be obtained from the graduate advisor.

ME 701 - Master's Thesis (6 credits)
Prerequisite: department approval. Projects involving design, construction, experimental, or theoretical investigation carried out under the supervision of a designated member of the mechanical engineering faculty. The completed written thesis must be defended in a publicly announced oral defense. A student must register for a minimum of 3 credits per semester until completion, although degree credit will be limited to the 6 credits indicated for the thesis.

ME 710 - Conduction Heat Transfer (3 credits)
Prerequisite: ME 610 and ME 616 or equivalent. Heat transfer by conduction: differential and integral forms of the energy equation for isotropic and anisotropic material. Analytical and numerical studies of transient and steady one-, two-, and three-dimensional heat transfer problems for a variety of boundary conditions including phase change. In addition, variational and boundary element methods are applied to heat conduction problems.

ME 711 - Convection Heat Transfer (3 credits)
Prerequisites: ME 610 and ME 616 or equivalent. Development of convective heat transfer theory: currently available methods, analytical and numerical, for predicting heat rates in forced, natural, and mixed convection in laminar and turbulent flow regimes are thoroughly studied. Studied techniques are applied to the thermal design of complex systems.

ME 712 - Mechanics of Viscous Fluids (3 credits)
Prerequisite: ME 611 and ME 616. (May be taken concurrently.) Properties and behavior of real fluids in laminar and turbulent motion. Review of tensor analysis; current mathematical and empirical laws and methods; flows in ducts; exact solutions of Navier-Stokes equations; boundary layers over surfaces and flow past bodies.

ME 713 - Non-Newtonian Fluid Dynamics (3 credits)
Prerequisite: ME611, ME616. Review of Newtonian fluid mechanics. Time dependent response and transport properties of non-Newtonian fluids in simple shear and extensional flows. Experimental techniques for measuring dynamic response and transport properties. Continuum and micromechanical constitutive models; solutions of constitutive equations.

ME 714 - Principles of Particulate Multiphase Flows (3 credits)
Prerequisite: Courses in fluid mechanics or approval of the instructor. This course provides an introduction to the fundamental principles of mass, momentum and heat transfer in particulate multiphase flows. Theories and governing equations for distinctive responses and motions of each phase and the dynamic interactions among phases are formulated. Typical industrial applications will be illustrated.

ME 717 - Selected Topics in Mechanical Engineering I (3 credits)
Prerequisite: department approval. Given when interest develops. Topics may include advanced mechanisms, aerodynamics, analysis of ME systems, design optimization, and case studies in design.

ME 721 - Thermal Stresses (3 credits)

Prerequisites: vector analysis or ME 616 or equivalent and theory of elasticity or ME 785. Thermoelasticity; reduction of thermoelastic problems to constant temperature equivalents; fundamentals of heat transfer; and elastic and inelastic stress analysis.

ME 725, ME 726, ME 727 - Independent Study I, II, III (3 credits)

Prerequisites: written permission from department chairperson plus prerequisite courses prescribed by a supervising faculty member. Areas of study in which one or more students may be interested but which is not of sufficiently broad interest to warrant a regular course offering. A maximum of two independent studies courses may be applied to a degree.

ME 734 - Analysis and Synthesis for Design (3 credits)

Prerequisites: ME 616 and ME 620 or ME 610. Fundamental concepts of advanced mathematics and their application to analysis and synthesis of mechanics, electricity, thermodynamics, fluid mechanics, and heat transfer systems and their components.

ME 735 - Advanced Topics in Robotics (3 credits)

Prerequisite: ME 625. Introduction to advanced topics and techniques in robotics. Subjects covered include differential kinematics, calibration and accuracy, trajectory control, and compliant motion control as well as an in-depth treatment of topics discussed in ME 625.

ME 736 - Advanced Mechanism Design (3 credits)

Prerequisite: ME 636 and ME 616. Advanced methods for the synthesis of mechanisms. Topics include synthesis of planar mechanisms for three, four and five positions, multiloop linages, change of branch and order problems, and optimal synthesis of mechanisms. Synthesis of linkages for special types of motion including straight line motion, cusp points on coupler curves and adjustable mechanisms.

ME 752 - Design of Plates and Shells (3 credits)

Prerequisites: ME 616 or equivalent and ME 620. A study of plates and shells. Mechanical engineering design solutions for typical loading and boundary conditions through analytical and numerical methods. Plate and shell interfaces and vibration are also considered.

ME 754 - Pressure Vessel Design (3 credits)

Prerequisites: ME 616 or equivalent and ME 620. Theories in designing pressure vessels; analysis of circular plates; cylindrical and spherical shells; pressure vessel heads; pipe bends; and attachments. Consideration is also given to pressure vessel materials in fatigue and creep designs.

ME 755 - Adaptive Control Systems (3 credits)

Prerequisite: ME 655. Theory and application of self-tuning and model reference adaptive control for continuous and discrete-time deterministic systems. Topics include model-based methods for estimation and control, stability of nonlinear systems and adaptive laws. Applications of adaptive control in mechanical systems and manufacturing processes.

ME 776 - Dynamics of Polymeric Liquids (3 credits)

Prerequisites: ME 610 and ME 611. An advanced course in fluid dynamics which concentrates on the behavior of polymeric liquids. Topics include constitutive equations of polymeric liquids, fluid dynamics of rheometry and kinetic theory of polymeric fluid dynamics.

ME 785 - Theory of Deformable Solids in Mechanical Engineering I (3 credits)

Prerequisites: ME 616 or equivalent and ME 620. Measure of strain; strain tensor; stress tensor; equilibrium equations; constitutive relations; compatibility conditions; conditions for and formulation of three-dimensional problems; and the relationship of engineering theories for beams, plates, and shells to the equations of elasticity.

ME 786 - Theory of Deformable Solids in Mechanical Engineering II (3 credits)

Prerequisite: ME 785. Solutions for problems formulated in ME 785: eigenfunction solutions; operational methods; complex variables theory; three-dimensional problems; contact problems; wave propagation; and non-linear problems.

ME 790 - Doctoral Dissertation (Credits as designated)

Required of all students working toward the Doctor of Philosophy in Mechanical Engineering. A minimum of 36 credits is required. The student must register for at least 6 credits of dissertation per semester until 36 credits are reached and for 3 credits each semester thereafter.

ME 791 - Graduate Seminar and Professional Presentations (0 credits)

Regular attendance required of all students in the Mechanical Engineering PhD program. Each PhD student is required to make a 15 minute presentation on a topic related to the student's research with an additional 10 minutes to address audience questions. The seminar participants eveluate each speaker. Effective From: Fall 2006

ME 792 - Pre-Doctoral Research (3 credits)

Prerequisite: permission of department chairperson. For students admitted to the doctor of philosophy program in mechanical engineering who have not yet passed the qualifying examination. Research is carried out under the supervision of designated mechanical engineering faculty. If the student's research activity culminates in doctoral research in the same area, up to a maximum of 6 credits may be applied toward the 36 credits required under ME 790.

ME 794 - Mechanical Engineering Colloquium (Non-credit)

Prerequisite: graduate standing and major in mechanical engineering. National and international experts in mechanical engineering discuss their recent research. Required of all students enrolled in mechanical engineering graduate degree programs. Students must register in this course for at least two semesters and attend at least four lectures in each semester. All doctoral students and students with assistantships must register in this course each semester and attend regularly.

Mechanics: Offered by the Department of Civil and Environmental Engineering. See Civil Engineering course list for faculty

UNDERGRADUATE COURSES:

Mech 234 - Engineering Mechanics (2-0-2)
Prerequisites: Phys 111, Math 112. A course for industrial and mechanical engineering students in which the equilibrium of particles and rigid bodies subject to concentrated and distributed forces is studied.

Mech 235 - Statics (3-0-3)
Prerequisites: Phys 111, Math 112.Provides an understanding of equilibrium of particles and rigid bodies subject to concentrated and distributed forces.

Mech 236 - Dynamics (2-0-2)
Prerequisites: Mech 235 (or Mech 234 for IE, ME majors). Provides an understanding of the mathematics of the motion of particles and rigid bodies, and of the relation of forces and motion of particles.

Mech 236H*** - Honors Dynamics (2-0-2)
Prerequisites: Mech 234 or Mech 235 and enrolled in the Honors College. Course material similar to Mech 236 except in addition, the student will be involved in a research project.

Mech 237 - Strength of Materials (3-1-3)
Prerequisites: Mech 235 (or Mech 234 for IE, ME majors) and a working knowledge of statics with emphasis on force equilibrium and free body diagrams. Provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions. Lab should be taken concurrently

Mech 320 - Statics and Strength of Materials (3-0-3)
Prerequisites: Phys 111, Math 112. For chemical engineering and electrical engineering majors. Statics provides an understanding of the equilibrium of particles and rigid bodies, including simple machines, trusses, and frictional forces. Mechanics of materials covers pressure vessels, thermal stresses, torsion of shafts, stresses and deflection in beams, and column action.

Mech 320H** - Honors Status and Strength of Materials (3-0-3)
Prerequisites: Phys 111, Math 112, and enrolled in the Honors College. For chemical engineering, electrical engineering, and biomedical engineering majors. Course material similar to Mech 320 except in addition, the student will design and perform several laboratory tests.

GRADUATE COURSES:

Mech 540 - Advanced Strength of Materials (3 credits)
Prerequisite: mechanics of deformable bodies. Topics beyond the scope of elementary mechanics of deformable bodies are studied with particular emphasis on the assumptions, limitations, and applications to actual problems.

Mech 630 - Theory of Elasticity (3 credits)
Prerequisite: differential equations. Theory of elasticity as basis for both advanced stress analysis and for a critical examination of elementary stress analysis.

Management Information Systems: Offered by the School of Management

UNDERGRADUATE COURSES:

MIS 245 - Introduction to Management Information Systems (3-0-3)

Concepts of information systems, business process, hardware, software, systems analysis, e-commerce, enterprise systems and computer applications in organizations, techniques of systems analysis, systems designs, implementations, and information management (both technical and behavioral)are studied in the organizational context of management information needs. Effective From: Spring 2005

MIS 246 - Tools and Technologies for the Digital Firm (3-0-3)

This course is designed to provide students with an introduction to the applications being used by digital firms, companies that rely extensively on the use of information technology to support all their functions and processes. Although function specific systems (e.g. accounting information systems, financial information systems) are introduced the emphasis is on enterprise wide systems such as those offered by SAP, Oracle and Peoplesoft. A basic introduction to the technologies underlying the applications used in business is also provided.

MIS 345 - Management of Information Systems (3-0-3)

Prerequisites: CIS 103 or CIS 113, MIS 246. Training managers or entrepreneurs to use and manage information systems. The evolution of the computer as a management information tool and a demonstration of how this tool can be used to improve both the effectiveness and efficiency of managers.

MIS 360 - Survey of E-Commerce Tools & Technologies (3-0-3)

Prerequisite: MIS 246. Covers the current technologies behind e-commerce solutions such as dynamic Web sites, database integration, server-side scripting, client-side scripting, and XML.

MIS 363 - Project Management for Managers (3-0-3)

This course covers theories, tools, and techniques to manage projects in organizations. Students will learn how to put together a project charter, define project goals, and develop project teams, schedules, and budgets. The course will illustrate the key aspects of project lifecycles (initiation, planning, execution, monitor and control, and closing). It will also emphasize aspects of team, performance, risk, and quality management. Effective From: Fall 2009

MIS 376 - Information Systems and Operations Management (3-0-3)

This course will integrate information systems with operations management. The role information systems play in the operations management functions for both the goods and services sectors of a global economy. Topics to be covered are mission and strategy development, demand forcasting, capacity planning, facility location, process strategy, inventory management, project management and total quality management. The way information systems integrates these concepts with ERP, SCM, CRM and other business systems will be discussed. Effective From: Spring 2005 Until: Spring 2009

MIS 445 - Decision Support Systems and OLAP (3-1-4)

Prerequisites: MIS 345 and OM 375.Introduces students to the use of decision support systems (DSS) to support management decisions. Topics include: DSS software tools, model management, and DSS design and use.

MIS 463 - Systems Analysis and Design for Managers (3-0-3)

This course focuses on the analysis and development of systems to meet the increasing need for information within organizations. Topics include systems development life cycle, analysis and design techniques, information systems planning and project identification and selection, requirements collection and structuring, process modeling, data modeling, design of interface and data management, system implementation and operation, system maintenance, and change management implications of systems. Effective From: Spring 2005

MIS 485 - Special Topics in Management Information Systems (3-0-3)

The study of new and/or advanced topics in the various fields of business and their application not regularly covered in any other business course. The precise topics to be covered, along with prerequisites, are announced in the semester prior to the offering of the course. Effective

From: Fall 2009

GRADUATE COURSES:

MIS 545 - Management Information Systems (3 credits)

Tools and techniques of management information systems and how they can be used to improve the quality of management decisions. Includes computer-based solutions to management problems in office automation, budgeting, communications, and decision support, major features of hardware and software computer system components and how to design a system, and technical tools ranging from flowcharts and decision tables to automated design.

MIS 620 - E-Commerce Technologies (3 credits)

Intended to develop a basic understanding of the Internet and its underlying technologies as a foundation for e-commerce with an introduction to e-commerce applications. Addresses the technology for MIS managers to effectively manage the launching of e-commerce infrastructures. Covers data communication and networking, EDI, intranets and extranets, bandwidth and security issues.

MIS 625 - Management Strategies for E-Commerce (3 credits)

Prepares students for effective management of internet-based businesses and electronic commerce and oversight of global business activities in an increasingly competitive environment. Introduces Internet concepts and infrastructure. Examines current and proposed Internet services forming the basis of Internet commerce. Covers corporate intranets and extranets and their applications to corporate computing, seamless e-commerce, and other emerging services such as VPN. Issues are discussed, with special emphasis on security.

MIS 635 - Management of Telecommunications (3 credits)

A comprehensive review of current trends in telecommunications with an emphasis on the techniques required by non-technically trained managers to deal with hardware, software, and human interfaces. Specific areas to be covered include the types of telecommunication networks, common network operating systems, and network design strategies.

MIS 636 - Telecommunications: Policies and Regulations (null)

Familiarization with government regulations for all forms of telecommunications, including video and audio. Covers such aspects as the ways in which corporations manage and provide security for telecommunications. Covers briefly: major telecommunications policies and regulations that have made a major impact on the current environment; telecommunications regulations in a global environment.

MIS 645 - Information Systems Principles (3 credits)

Prerequisite: MIS 545. The management of information processing resources, including: role of information processing, estimates of personnel resources and budgets, integration of corporate and MIS plans, organizational alternatives for MIS departments and support staffs, management of computer operations, equipment and general software acquisitions, intermediate and long-range MIS plans, integration of personal computers, minicomputers, and mainframes, and security and controls. Effective From: Fall 2007

MIS 648 - Decision Support Systems for Managers (3 credits)

Prerequisites: MIS 545, Mgmt 580. Covers the use of decision support systems to support management decision making in a real world environment. Topics include: establishing and measuring decision support systems success criteria, software tools, model management, elements of artificial intelligence, and statistics. Justification, design, and use of decision support systems.

MIS 654 - Design of Accounting Information Systems (3 credits)

Management's need for information and design of systems to provide this information. Emphasis on designing controls to ensure that the system meets management's objectives. Comparison of management and technical aspects of information systems. Accounting information systems will be used as models, but the course will incorporate all functions within the organization and provide the student with tools needed to manage the system and safeguard the assets of the organization.

MIS 655 - Information Systems Audit, Control and Security (3 credits)

Emphasizes controls and how an auditor or a manager verifies that controls are in existence and are effective. Security and controls are complementary and should be included in an MIS system environment. Covers the internal controls that should be present in an information system given its environment.

MIS 665 - Introduction to Electronic Commerce (3 credits)

Examines the changes in business processes and organizations enabled by electronic commerce technologies and application. Develops an understanding of the new electronic marketplace based on fundamental economics of the digital economy. Investigates electronic economies, new organizational structures, information systems architectures, and decision analysis.

MIS 680 - Management Science (3 credits)

Introduction to the methodology of decision making applying the techniques of operations research and system analysis to managerial problems. Introduction to the concept of objective functions and constraints, concepts of value and utilities, optimization algorithms, networks and game theories. Elementary mathematical model linear production systems, inventory systems, multi-criteria decision making, project management and transportation planning. Topics will be discussed from the deterministic as well as scholastic points of view.

MIS 690 - Executive Information Systems (3 credits)

Provides decision makers a framework for designing and building systems to gain competitive advantage. Covers executive support systems, executive information systems, and group support systems.

MIS 701 - Thesis in Information Systems Management (6 credits)

Prerequisites: MIS 645, MIS 648, CIS 675, CIS 679 or waived with approval of the Dean. Examines what is research? Why do research? What are the objectives of research? Covers need for research, criteria for good research and research design, concept of measurement, sampling design, primary data collection, experimentation and simulation, statistical and other types of analysis, and reporting of research findings.

Nursing : Offered by the College of Nursing at Rutgers-Newark

UNDERGRADUATE COURSES:

NURS 301 - Theory and Practice of Professional Nursing (3-0-3)
Building on the historical and theoretical foundations of the profession, students explore the theme of health, the continuum of health illness, the sociocultural variations that influence health and response to illness, and the many dimensions of health. Nursing interventions are explored in relation to ethical, social, legal, political, and personal issues as students clarify their own professional identity, responsibility and power.

NURS 302 - Comprehensive Health Assessment (3-0-3)
Focuses on total health assessment with differentiation between normal and abnormal findings. The total health assessment content focuses on individuals across the life span. Emphasis is placed on data collection and analysis through history and physical examination.

NURS 304 - Nursing Informatics (4-0-4)
Computer applications for nursing. Exposes students to PC-based and mainframe computer systems through computer laboratory and field experiences.

NURS 305 - Adaptations and Alterations in Body Functions (3-0-3)
Reviews and extends fundamental concepts of physiology and changes that produce signs and symptoms and the body's remarkable ability to compensate for these illness-related changes. Findings will establish the database for formulating appropriate nursing strategies.

NURS 306 - Pharmacology (2-0-2)
Prerequisite or corequisite: NURS 305. Reviews and extends students? previous knowledge of pharmacological science. Explores mechanisms of actions of drugs used to treat various health conditions at the cellular level.

NURS 307 - Epidemiology in Nursing Practice (2-0-2)
An introduction to population-based approach to health care. Incorporate information on the etiology and predictors of events in order to design health promotion and disease prevention strategies.

NURS 401 - Patterns of Community Health (3-6-6)
Prerequisites: completion of all NURS 300-level courses. Focuses on nursing knowledge and interventions directed to enhance community health for diverse populations. Clinical practicum focusing on clients with diverse needs and in a variety of settings enhances classroom learning.

NURS 402 - Environmental and Occupational Health (4-0-4)
Prerequisites: completion of all NURS 300-level courses. Prepares students to assess changes in health status related to the environment or the workplace. Students are provided with the skills needed to evaluate, and recommend control strategies for the phenomena.

NURS 403 - Nursing Care Delivery Systems (3-6-6)
Prerequisites: completion of all NURS 300-level courses. Focuses on the professional nurse's leadership and management role within health care systems. The multi-faceted aspects of the role of the nurse as a leader and manager are explored in depth, with emphasis on the role of the nurse as change agent. Includes organizational behavior, decision-making, the change process, the management of health care delivery, and nursing care within health care organizations.

NURS 404 - Research Applications in Nursing Practice (3-0-3)
Prerequisites: Completion of all NURS 300-level courses. Prepares students to critically analyze nursing issues from an applied research perspective.

GRADUATE COURSES:

R705:504 - Human Diversity and Social Issues in the Community (3 credits)

For more details go to Rutgers Catalog.

R705:534 - Community Health Nursing Theory II (3 credits)

For more details go to Rutgers Catalog.

Operations Managment : Offered by the School of Management. See Management course list for faculty.

UNDERGRADUATE COURSES:

OM 375 - Management Science (3-0-3)

Prerequisite: Mgmt 216. Introduction to statistical and mathematical techniques used in management decision making. Develop the concepts of management science and use its techniques with unrestricted focus. Operations management applications are made in factory settings, health-care and other service industries, education and government agencies.

OM 475 - Production Planning and Control (3-0-3)

Prerequisites: OM 375, junior or senior standing. The components and functioning of in-production, planning, and control systems. Material, equipment, and labor requirements for optimizing continuous and intermittent manufacturing operations. The use of a computer to simulate such models.

OM 476 - Quality Control (3-0-3)

Prerequisites: OM 375, junior or senior standing. Deals with measuring, and improving the performance of the service and/or production processes being managed. Performance assessment is an important component of any management system's excellence. In managing a service-oriented or a manufacturing-based company, performance measurement and analysis should be built into the management processes of identifying and overcoming problems that are central to continuous improvement. The topics include cost analysis, control and improvement, continuous quality improvement, and the other assessment methods for planning and controlling production and service company-wide.

GRADUATE COURSES:

R711:585 - Control Models (3 credits)

For more details go to Rutgers Catalog.

Optical Science and Engineering Courses: Offered by the Physics Departments of NJIT.

UNDERGRADUATE COURSES:

OPSE 301 - Introduction to Optical Science and Engineering (3-0-3)

Prerequisites: Phys 121. Laboratory and lecture introduces optics and photonics principles with their elementary applications for applied physics, engineering, computer science, or biology majors. Topics include speed at light, reflection, refraction, geometric optics, interference and interferometry, polarization, dispersion, birefringence, fiber-optics, diffraction, introduction to spectroscopy and ray tracing.

OPSE 310 - Virtual Instrumentation (3-0-3)

Prerequisites: CS 113 or CS 115. Intended for all engineering, computer science, and science majors. Covers the basics of virtual instrumentation including use of IEEE GPIB, RS232 interfaces, and data acquisition boards. Interface a computer to various instruments for data acquisition and instrument control using a state-of-the-art software platform such as National Instrument's LABVIEW. Emphasis is on the practical aspects of interfacing a computer to various instruments including timing issues, real-time data acquisition and instrument control, instrument status, and acquisition speed.

OPSE 402 - High Power Laser and Photonics Applications (3-0-3)

Prerequisite: Phys 121. Open to all engineering, computer science, and science majors with junior or senior standing. Advanced combined laboratory and lecture course emphasizing photonics and high power laser applications. Topics include Maxwell's equations, principles of lasers, electro-optics, non-linear optics, absorption and transmission of light, bio-optics, fiber-optic communications, chemiluminescence, scattering from periodic surfaces and colloids, sensors. Topics and experiments change on a semester basis depending on interests of enrolled students.

OPSE 410 - Biophotonics (3-0-3)

Prerequsite: Phys 121. An introduction to the interaction of light with biological tissues. Biophotonics for diagnostic and therapeutic applications will be discussed. Topics include propagation of light in turbid tissues, absorption, scattering, laser surgery, and optical rotation.

GRADUATE COURSES:

OPSE 601 - Advanced Topics in Optical Science and Engineering (3 credits)

In small groups or as an individual, students conduct three complete research experiments in the available topics of interest, from preliminary background research through data analysis. Use of modern optical research tools under close guidance of faculty and associated research team members in the faculty member's lab.

OPSE 610 - Virtual Instrumentation (3 credits)

Prerequisites: A college level programming course. Intended for all engineering, computer science, and science majors. Covers virtual instrumentation including use of IEEE, GPIB, RS232 interfaces, and data acquisition boards. Interface a computer to various instruments for data acquisition and instrument control using a state-of-the-art software platform, such as, National Instrument's LABVIEW. Emphasis is on the practical aspects of interfacing a computer to various instruments including timing issues, real-time data acquisitions and instrument control, instrument status, and acquisition speed. Effective From: Spring 2007

Pharmaceutical Bioprocessing: Offered by the Otto H. York Department of Chemical, Biological and Pharmaceutical Engineering

GRADUATE COURSES:

PhB 505 - Principles of Pharm. Microbiology and Biochemistry (3 credits)

Prerequisites: Graduate standing. This course covers major concepts of cell biology including cell physiology and structure, molecular biology, and genetics. Cellular chemistry, life cycles, and regulation are discussed as well as the fundamentals of biochemistry related to physical organic chemistry, including buffers, blood proteins, enzymes, carbohydrates, fats, and nucleic acids. This is a required course for PhB students with no or limited knowledge of biology. Effective From: Spring 2010

PhB 590 - Graduate Co-op Work Experience I (3 additive credits)

Prerequisites: Permissions from Pharmaceutical Bioprocessing Graduate Advisor and Career Development Services. Cooperative education internship provides on-the-job reinforcement of the academic program by placement in major-related work situations at pharmaceutical companies or companies serving the pharmaceutical industry. Work assignment developed or approved by the co-op office and evaluated by the department. Cannot be used for degree credit. Effective From: Spring 2010

PhB 591 - Graduate Co-op Work Experience II (3 additive credits)

Prerequisites: Permissions from Pharmaceutical Bioprocessing Graduate Advisor and Career Development Services. Same range of activities as in PhB 590. Cannot be used for degree credit. Effective From: Spring 2010

PhB 592 - Graduate Co-op Work Experience III (3 additive credits)

Prerequisites: Permissions from Pharmaceutical Bioprocessing Graduate Advisor and Career Development Services. Same range of activities as in PhB 590 and PhB 591. Cannot be used for degree credit. Effective From: Spring 2010

PhB 593 - Graduate Co-op Work Experience IV (0 credits)

Prerequisites: Permissions from Pharmaceutical Bioprocessing Graduate Advisor and Career Development Services. Same range of activities as in PhB 590, PhB 591 and PhB 592. Cannot be used for degree credit. Effective From: Spring 2010

PhB 610 - Biotechnology-Biopharmaceutical, Processes and Products (3 credits)

Prerequisites: PhB 505, if required and PhEn 601. This course covers biological processes used in the pharmaceutical and biotechnology industry to obtain pharmaceutical products, including biochemical processes for antibiotic production and peptide extraction, and biopharmaceutical process to obtain recombinant proteins, monoclonal antibodies, cytokines, hormone and blood products, therapeutic enzymes, antibodies, vaccines, and nucleic acid therapeutics. Effective From: Spring 2010

PhB 615 - Bioseparation Processes (3 credits)

Prerequisites: If required, PhEn 500, PhEn 501, PhEn 502 and PhB 505; PhEn 601. This course covers the principles, methods and unit operations for the separation and recovery of biologically obtained molecules and especially proteins. Also studied here is the relationship between the chemistry of biological molecules and efficient separation and preservation of biological activity, with special emphasis on separation of biomolecules. Effective From: Spring 2010

PhB 630 - Pharmaceutical Bioprocess Engineering (3 credits)

Prerequisites: If required, PhEn 500, PhEn 501, PhEn 502 and PhB 505; Phen 601. This course covers the principles and methods to develop and operate bioprocess engineering systems, with emphasis on pharmaceutical bioprocessing and the use of chemical engineering principles to obtain products of therapeutic values. Topics include cell line selection, cell growth kinetics, substrate utilization, product formation, transport phenomena in biosystems, and bioreactors. Effective From: Spring 2010

PhB 698 - Special Topics in Pharmaceutical Bioprocessing I (3 credits)

Prerequisites: Graduate standing and permission of the instructor. Topics of current interest in Pharmaceutical Bioprocessing. Effective From: Spring 2010

PhB 699 - Special Topics in Pharmaceutical Bioprocessing II (3 credits)

Prerequisites: Graduate standing and permission of the instructor. Topics of current interest in Pharmaceutical Bioprocessing. Effective From: Spring 2010

PhB 701B - Master's Thesis (3 credits)

Prerequisites: Matriculation in the MS program in PhB and approval of PhB Program Advisor. Original research under the guidance of a Thesis Advisor. A written thesis must be approved by a three-member Thesis Committee including the primary advisor and at least one member of the CBPE faculty. A student must continue to register for at least 3 credits per semester until at least 6 credits have been completed and a written thesis is approved. Only a total of 6 credits will count toward the degree. Effective From: Spring 2010

PhB 701C - Master's Thesis (6 credits)

Prerequisites: Matriculation in the MS program in PhB and approval of PhB Program Advisor. Original research under the guidance of a Thesis Advisor. A written thesis must be approved by a three-member Thesis Committee including the primary advisor and at least one member of the CBPE faculty. A student must continue to register for at least 3 credits per semester until at least 6 credits have been completed and a written thesis is approved. Only a total of 6 credits will count toward the degree. Effective From: Spring 2010

PhB 725 - Independent Study I (3 credits)

Prerequisites: Permission from the Program Advisor in PhB (not the Thesis Advisor), as well as completion of courses prescribed by a supervising faculty member (who cannot be the student's Thesis Advisor). This special course covers areas of study in which one or more students may be interested, but which is not of sufficiently broad interest to warrant a regular course offering. Students may not register for this course more than once with the same supervising faculty member. Effective From: Spring 2010

PhB 726 - Independent Study II (3 credits)

Prerequisites: Permission from the Program Advisor in PhB (not the Thesis Advisor), as well as completion of courses prescribed by a supervising faculty member (who cannot be the student's Thesis Advisor). This special course covers areas of study in which one or more students may be interested, but which is not of sufficiently broad interest to warrant a regular course offering. Students may not register for this course more than once with the same supervising faculty member. Effective From: Spring 2010

PhB 791 - Graduate Seminar (Non-Credit)

Prerequisites: Graduate standing. Required, when offered, of all PhB graduate students receiving departmental or research-based awards. The student must register each semester until completion of the degree, if the Graduate Seminar is offered. Outside speakers and department members present their research for general discussion. Effective From: Spring 2010

Pharmaceutical Engineering: Offered by the Department of Chemical Engineering.

GRADUATE COURSES:

PhEn 500 - Pharmaceutical Engineering Fundamentals I (3 credits)

Prerequisite: undergraduate calculus. This is a required bridge course for those students who are admitted to the Pharmaceutical Engineering MS program without an undergraduate engineering degree. This course is not counted toward degree credit related to the Pharmaceutical Engineering MS program. The course covers the fundamentals of calculus, differential equations, probability and statistics, and finance business mathematics applied to pharmaceutical engineering problems and illustrated through pharmaceutical engineering examples.

PhEn 501 - Pharmaceutical Engineering Fundamentals II (3 credits)

Prerequisite: If needed, PhEn 500 (which can also be taken concurrently with this course), as well as an undergraduate course in physical chemistry. This course is a required bridge course for those students who are admitted to the Pharmaceutical Engineering MS program without an undergraduate engineering degree or with an engineering background that did not include the topics covered in this course. The course is not counted toward degree credit related to the Pharmaceutical Engineering MS program. The course covers the fundamentals of pharmaceutical engineering calculations related to material and energy balances applied to pharmaceutical facilities and systems; estimation of thermophysical properties, phase and reaction equilibrium; and chemical kinetics and basic reactor design.

PhEn 502 - Pharmaceutical Engineering Fundamentals III (3 credits)

Prerequisite:If needed, PhEn 500 and PhEn 501, as well as undergraduate course in physical chemistry. This is a required bridge course for those students who are admitted to the Pharmaceutical Engineering MS program without an undergraduate engineering degree or with an engineering background that did not include the topics covered in this course. The course is not counted toward degree credit related to the Pharmaceutical Engineering MS program. The course covers the fundamentals of fluid mechanics, heat transfer, mass transfer and the design of unit operations involving these principles.

PhEn 590 - Graduate Co-op Work Experience I (3 additive credits)

Prerequisite: permission from Pharmaceutical Engineering Program Advisor and Division of Career Development Services. Cooperative education internship provides on-the-job reinforcement of the academic program by placement in major-related work situations at pharmaceutical companies or companies serving the pharmaceutical industry. Work assignment developed or approved by the co-op office and evaluated by the department. Cannot be used for degree credit.

PhEn 591 - Graduate Co-op Work Experience II (3 additive credits)

Prerequisite: permission from Pharmaceutical Engineering Program Advisor and Division of Career Development Services. Same range of activities as in PhEn 590.

PhEn 592 - Graduate Co-op Work Experience III (3 additive credits)

Prerequisite: permission from Pharmaceutical Engineering Program Advisor and Division of Career Development Services. Same range of activities as in PhEn 590 and PhEn 591.

PhEn 593 - Graduate Co-op Work Experience IV (0 credits)

Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

PhEn 601 - Principles of Pharmaceutical Engineering (3 credits)

This course provides an overview of the pharmaceutical industry, including basic information about drug discovery and development, FDA requirements and approval processes, drug dosage forms, and the role of key operational units in drug manufacturing processes. This course enables the students to: understand the role of the pharmaceutical industry in the global market and its implications; learn the fundamentals of the drug development cycle and the investment required to bring a drug to market; learn the most important drug manufacturing processes and the key elements of dosage formulation.

PhEn 602 - Pharmaceutical Facility Design (3 credits)
Prerequisite: PhEn 601, PhEn 603; undergraduate courses in differential equations and fluid flow or completion of bridge program for students who are required to take it. This course provides instruction in design of state-of-the art pharmaceutical facilities for both manufacturing and R&D, by identifying key functional requirements and design concepts necessary to pharmaceutical processes. Interdisciplinary training will be provided in appropriate areas of facility design.

PhEn 603 - Pharmaceutical Unit Operations: Processing of Liquid and Dispersed Phase Systems (3 credits)
This course examines methodologies, both applied and fundamental, to analyze and scale up manufacturing pharmaceutical processes involving liquid and dispersed-phase systems, such as liquid and multiphase mixing, sterilization and sanitation, lyophilization, filtration, centrifugation and others. The emphasis is primarily on the engineering aspects of the parmaceutical processes examined in the course. Effective From: Fall 2006

PhEn 604 - Validation and Regulatory Issues in the Pharmaceutical Industry (3 credits)
This course is focused on the development of a working knowledge of the Federal Code of Regulations and its impact on the pharmaceutical and allied industries. The history of the Federal Government's regulation of the pharmaceutical industry is studied. Also covered is the industry's response and the methodologies it uses to comply with these regulations.

PhEn 605 - Pharmaceutical Packaging Technology (3 credits)
Prerequisite: PhEn 601, PhEn 603, and completion of the bridge program for students who are required to take it. This course focuses on developing a working knowledge of the machinery and unit operations used in transferring a drug substance in the bulk final form to a finished product ready for sale to the consuming public. Packaging of both liquid and solid forms in various types of delivery containers such as vials/ampoules, blister packs, individual packets, bottles, pouches and syringes is examined. The cleaning, sterilization and scaling/capping required for each dosage form is discussed, as well as freeze-drying, tableting capsule filling, and form/fill/seal, and proper labeling of final drug forms.

PhEn 606 - Pharmaceutical Unit Operations: Solids Processing (3 credits)
This course examines methodologies, both applied and fundamental, to analyze and scale up manufacturing pharmaceutical processes involving solids processing, such as solids characterization, blending, milling, granulation, tableting, coating, and others. The emphasis is primarily on the engineering aspects of the pharmaceutical processes examined in the course.

PhEn 612 - Pharmaceutical Reaction Engineering (3 credits)
Prerequisite: PhEn 601, PhEn 603; undergraduate courses in differential equations and chemical engineering kinetics, or completion of bridge program for students who are required to take it. This course examines a variety of reactions and reactors typically encountered in the pharmaceutical industry, including single/multiphase systems (e.g., crystallization), chemical synthesis, enzymatic, bio-reactions (fermentation), and others. The course then focuses on quantitative pharmaceutical reactor design and scale-up issues.

PhEn 614 - Pharmaceutical Separation Processes (3 credits)
This course covers separation processes in general and pharmaceutical separations in particular. Specific processes to be studied include distillation, extraction, crystallization, adsorption, ion exchange, chromatography, moving bed processes, electrophoresis, freeze drying, microfiltration/ultrafiltration, reverse osmosis, and pervaporation.

PhEn 618 - Principles of Pharmacokinetics and Drug Delivery (3 credits)
The course covers the basic principles of pharmacokinetics, including drug transport, parenteral and enteral routes of drug administration, and factors affecting drug absorption, distribution, metabolism, and excretion. Mathematical pharmacokinetic models and drug delivery processes are also presented and quantitatively studied.

PhEn 698 - Special Topics in Pharmaceutical Engineering I (3 credits)
Prerequisite: graduate standing and permission of the instructor. Topics of current interest in pharmaceutical engineering.

PhEn 699 - Special Topics in Pharmaceutical Engineering II (3 credits)
Prerequisite: graduate standing and permission of the instructor. Topics of current interest in pharmaceutical engineering.

PhEn 700 - Master's Thesis (3 credits)
Prerequisite: matriculation for the Master's degree in pharmaceutical engineering. Approval of thesis advisor is necessary for registration. Original research under the guidance of a departmental advisor. The final product must be a written thesis approved by at least three faculty members: the primary advisor, another from the pharmaceutical engineering faculty, and one other faculty member. A student must continue to register for at least 3 credits per semester until at least 6 credits have been completed and a written thesis is approved. Only a total of 6 credits will count toward the degree.

PhEn 701 - Master's Thesis (6 credits)

Prerequisite: matriculation for the Master's degree in pharmaceutical engineering. Approval of thesis advisor is necessary for registration. Original research under the guidance of a departmental advisor. The final product must be a written thesis approved by at least three faculty members: the primary advisor, another from the pharmaceutical engineering faculty, and one other faculty member. A student must continue to register for at least 3 credits per semester until at least 6 credits have been completed and a written thesis is approved. Only a total of 6 credits will count toward the degree.

PhEn 702 - Selected Topics in Pharmaceutical Engineering (3 credits)

Prerequisite: graduate standing and permission of the instructor. Topics of current interest in pharmaceutical engineering.

PhEn 725 - Independent Study (3 credits)

Prerequisites: permission from the graduate advisor (not the thesis advisor) in pharmaceutical engineering, as well as courses prescribed by a supervising faculty member (who is not the student's thesis advisor). This special course covers areas of study in which one or more students may be interested, but which is not of sufficiently broad interest to warrant a regular course offering. Students may not register for this course more than once with the same supervising faculty member.

PhEn 791 - Graduate Seminar (non-credit)

Required, when offered, of all pharmaceutical engineering graduate students receiving departmental or research-based awards. The student must register each semester until completion of the degree, if the Graduate Seminar is offered. Outside speakers and department members present their research for general discussion.

Physics: Offered by the Physics Departments of NJIT and Rutgers-Newark

UNDERGRADUATE COURSES:

Phys 102 - General Physics (3-0-3)

Prerequisite: None. Intended for students in architecture, computer science (B.A. only), STS and other disciplines requiring laboratory science electives. Elementary statics and dynamics. Subjects discussed are kinematics, Newton's laws of motion, energy, momentum, conservation principles, and mechanical properties of matter. Lab must be taken concurrently.

Phys 102A - General Physics Laboratory (0-2-1)

Prerequisite: same as Phys 102. This course is the laboratory component of Phys 102 and must be taken concurrently.

Phys 103 - General Physics (3-0-3)

Prerequisite: Phys 102 with grade of C or better. A continuation of Phys 102 for students in architecture, computer science (B.A. only), STS and other disciplines requiring laboratory science electives. Topics discussed are heat, thermodynamics, sound, wave motion, illumination, geometric and physical optics, and color. Lab must be taken concurrently.

Phys 103A - General Physics Laboratory (0-2-1)

Prerequisite: Prerequisite: Phys 102 with grade of C or better. This course is the laboratory component of Phys 103 and must be taken concurrently.

Phys 105 - Physics A (3-0-3)

Corequisite: Math 108. First semester of a two-semester sequence with Phys 106. The sequence is equivalent to Phys 111. Placement is determined by performance on standardized entrance examinations. A study of elementary mechanics with emphasis on the fundamental laws of mechanics and conservation laws. Topics include scalar and vector quantities, rectilinear motion, equilibrium and Newton's laws of motion, friction, work and energy, impulse, and momentum. Lab must be taken concurrently.

Phys 105A - Physics A Laboratory (0-2-1)

Corequisite: Math 108. Placement in this course is determined by performance on standardized entrance examinations. This course is the laboratory component of Phys 105 and must be taken concurrently.

Phys 105W - Physics A Workshop (0-1-0)

Corequisite: Math 108. Workshop for Physics 105A.

Phys 106 - Physics B (3-0-3)

Prerequisite: Prerequisite: Phys 105 and Math 108 or Math 109 or Math 110, with grade of C or better. Second semester of a two-semester sequence with Phys 105. An extension of Phys 105 in the area of mechanics. Topics include rotational motion, torque, inertia and angular momentum, static equilibrium, gravity, and a full review of mechanics at the level equivalent to Phys 111. Lab must be taken concurrently.
Effective From: Fall 2008

Phys 106A - Physics B Laboratory (0-2-1)

Prerequisite: same as Phys 106. This course is the laboratory component of Phys 106 and must be taken concurrently.

Phys 111 - Physics I (3-0-3)

Corequisite: Math 111. Elementary mechanics with an emphasis on the fundamental concepts and laws of mechanics, especially the conservation laws. Topics are scalar and vector quantities of mechanics; rectilinear and circular motion; equilibrium and Newton's laws of motion; work, energy, momentum; the conservation laws. Lab must be taken concurrently. See Phys 111A.

Phys 111A - Physics I Laboratory (0-2-1)

Prerequisite: same as Phys 111. Corequisite: Math 111. Laboratory component of Phys 111 and Phys 111H. Lab must be taken concurrently with Phys 111 or Phys 111H.

Phys 111H - Honors Physics I (3-0-3)
Corequisite: Math 111 or 111H. Admission to this course is by invitation, based on class standing and standardized entrance exams. First semester of a three-semester program in Honors Physics. Covers the material in Phys 111, but topics are treated more comprehensively and in greater depth. More extensive use of mathematics. Lab must be taken concurrently. See Phys 111A.

Phys 111W - Physics I Workshop (0-1-0)
Corequisite: Math 111 or 111H. Workshop for Phys 111.

Phys 114 - Introduction to Data Reduction with Applications (3-0-3)
Prerequisite: None ? Physics majors only. An introduction to both the theory and application of error analysis and data reduction methodology. Topics include the binomial distribution and its simplification to Gaussian and Poisson probability distribution functions, estimation of moments, and propagation of uncertainty. Forward modeling, including least-squares fitting of linear and polynomial functions are discussed. The course enables students to apply the concepts of the data reduction and error analysis using data analysis software to real data sets found in the physical sciences. Effective From: Spring 2008

Phys 121 - Physics II (3-0-3)
Prerequisites: Phys 111 or Phys 111H or Phys 106 and Math 111 or Math 111H all with grade of C or better. Corequisite: Math 112. This course deals with an introduction to electricity and magnetism. Topics include simple dc circuits, the electric field, the magnetic field, electric potential, capacitance relationships between electric and magnetic fields, inductance, and simple ac circuits. Lab must be taken concurrently. See Phys 121A.

Phys 121A - Physics II Laboratory (0-2-1)
Prerequisites: Phys 111 or Phys 111H or Phys 106 and Math 111 or Math 111H all with grade of C or better. Corequisite: Math 112.

Phys 121H - Honors Physics II (3-0-3)
Prerequisites: Phys 111 or Phys 111H or Phys 106 and Math 111 or Math 111H all with grade of C or better. Corequisite: Math 112. This is the second semester of a three-semester program in Honors Physics. The course covers the material given in Phys 121. Greater use is made of vector analysis. In addition, an introduction to Maxwell's equations for the electromagnetic field and their application to physical problems is given. Lab must be taken concurrently.See Phys 121A.

Phys 202 - Introductory Astronomy and Cosmology (3-0-3)
Prerequisite: None. A non-mathematical presentation of contemporary views of the origin, evolution, and structure of the solar system, stars, galaxies, and the universe. Special topics include neutron stars, black holes, gravitationally strange objects, and the ?big bang.?

Phys 202A - Astronomy and Cosmology Laboratory (0-2-1)
Corequisite: Phys 202. Includes demonstration of physical principles applicable to astronomy. Use of telescope for lunar, solar and planetary observations.

Phys 203 - The Earth in Space (3-0-3)
Prerequisite: None. Introduces fundamental phenomena, such as plate tectonics, erosion, volcanism, and glaciation. Studies the interaction between the Earth's four major reservoirs?atmosphere, hydrosphere, biosphere and solid earth; investigates the dependence of the Earth on the Sun; the effect of the Moon on the Earth. Extends knowledge gained from studying the Earth to other planets in this solar system.

Phys 203A - The Earth in Space Laboratory (0-2-1)
Corequisite: Phys 203. Optional laboratory course associated with Phys 203.

Phys 204 - Concepts in Physics (3-0-3)
This course is intended for B.S. in Management students. BSET students may take this course with permission of advisor. A survey course in physics emphasizing fundamentals in mechanics, heat, sound, light, electricity, and modern physics. Special emphasis given to the nature of scientific analysis and the physics underlying modern technologies. Lab must be taken concurrently. Effective Until: Spring 2008

Phys 231A - Physics III Laboratory (0-2-1)
Prerequisite: Phys 121 or Phys 121H and Math 112 or Math 112H, all with grade of C or better.

Phys 231H - Honors Physics III (4-0-4)
Prerequisite: Phys 121 or Phys 121H and Math 112 or Math 112H, all with grade of C or better. Third semester of a three-semester program in Honors Physics. Physical optics is treated in greater detail. Modern physics includes a greater number of topics, with special emphasis on the wave-particle duality in nature. Lab must be taken concurrently. See Phys 231A. Effective Until: Spring 2008

Phys 233 - Physics III (3-0-3)
Prerequisite: Phys 121. Intended for students in chemical engineering only. Topics include elements of simple harmonic motion, wave motion, interference and diffraction, quantum mechanics, semiconductor models, carrier distribution, Fermi functions, and selected topics. Effective From: Spring 2002 Until: Spring 2008

Phys 234 - Physics III (3-0-3)
Prerequisite: Phys 121 or Phys 121H and Math 112 or Math 112H, all with grade of C or better. Elements of simple harmonic motion, wave motion, geometric and physical optics are considered. The wave and particle duality of nature is emphasized and made plausible by an examination of the important experiments and theories which lead to the modern concepts of matter and radiation. The conservation laws are broadened to include the equivalence of mass and energy. Effective From: Fall 2008

Phys 234H - Honors Physics III (3-0-3)
Prerequisites: Phys 121 or Phys 121H and Math 112 or Math 112H, all with grade of C or better. Third semester of a three-semester program in Honors Physics. Physical optics is treated in greater detail. Modern physics includes a greater number of topics, with special emphasis on the wave-particle duality in nature. Lab must be taken concurrently.

Phys 235 - Physics III (4-0-4)
Prerequisites: Phys 121 and 121A. Intended for students in computer engineering. Topics include simple harmonic motion, wave motion, interference and diffraction, photons, electrons, and the wave particle duality. Thermodynamics and heat transfer are introduced. Effective Until: Spring 2008

Phys 310 - Introduction to Atomic and Nuclear Physics (3-0-3)
Prerequisites: Phys 234 or Phys 234H; Math 222 or Math 222H, all with grade of C or better. Selected topics in atomic physics including the Pauli Exclusion Principle and the Atomic Shell Model. In nuclear physics, the two-body problem, nuclear models, alpha, beta, and gamma radiation, acclerators, and nuclear detectors are studied. 21&62:750:403 may be substituted for this course.

Phys 311 - Co-op Work Experience I (3 credits)
Prerequisite: acceptance into the co-op program. Students gain major-related experience and reinforcement of the academic program. Work assignments are facilitated and approved by the Office of Cooperative Education and Internships. Participation in seminars and a final report/project is mandatory.

Phys 320 - Astronomy and Astrophysics I (3-0-3)
Prerequisites: Phys 121 or Phys 121H, with grade of C or better. A quantitative introduction to the astronomy of the sun, earth, and solar system, with an emphasis on the physical principles involved. Includes celestial mechanics, planetary atmospheres and the physics of comets, asteroids and meteorites.

Phys 321 - Astronomy and Astrophysics II (3-0-3)
Prerequisite: Phys 320, with grade of C or better. A quantitative introduction to the astronomy of the stars, the galaxy, and cosmology, with an emphasis on the physical principles involved. Includes stellar interiors, stellar evolution, galactic dynamics, large-scale structure and early history of the universe.

Phys 322 - Observational Astronomy (3-0-3)
Prerequisite: Phys 320, with grade of C or better. Most class time is spent in an observatory performing observations of celestial objects such as the Sun, Moon, planets, stars, stellar clusters, and galaxies. Experimental projects include charting the skies, asterophotography (film and CCD), measuring masses of planets, rotational period of the Sun, topography of the Moon, H-R diagrams of stellar clusters, etc.

Phys 335 - Introductory Thermodynamics (3-0-3)
Prerequisites: Chem 126 with a grade of C or better, Physics 234 or 234H or 231H and Math 211 or 213 or 213H, all with grade of C or better. Corequisites: Math 222, Math 238 or Math 335. Introductory thermodynamics, kinetic theory, statistical physics. Topics include equations of state, the three laws of thermodynamics, reversible and irreversible processes. 21&62:750:315 may be substituted for this course.

Phys 350 - Biophysics I (3-0-3)
Prerequisite: Phys 121 or Phys 121H. This course is an introduction to biophysics. It emphasizes applying physics concepts to the cell. Topics covered include Brownian motion and diffusion in cells, membrane potential friction and viscous drag, entropy and electrostatic forces on living cells. This course is designed for physics, chemistry, math, life sciences, and engineering students in which formulas are a means, not an end, to understand cell's nature. Effective From: Fall 2008

Phys 390 - Selected Topics of Current Interest in Physics (1-0-1)

Prerequisite: Phys 234 or Phys 234H, with grade of C or better. Seminar covering topics that are currently in the forefront of physics. The lecture series offers exposure to such topics as nuclear physics, solid state physics, plasma physics, the special and general theories of relativity, and the history and philosophy of science.

Phys 411 - Co-op Work Experience II (3 credits)

Prerequisites: Phys 311, with grade of C or better, and acceptance into the co-op program. Provides for co-op work assignments which must be approved by the Office of Cooperative Education and Internships. Participation in seminars and a final -report/project are mandatory.

Phys 418 - Fundamentals of Optical Imaging (2-2-3)

Prerequisites: Phys234 or Phys 234H or Phys 231H, with grade of C or better. This is a course with both lectures and experiments and the emphasis is on the hands-on experiences. Upon completion of the course, students should not only grasp the basic concepts involved in imaging science, but also be able to work on simple real world imaging systems. The main content of the lecture part of this course can be summarized as the following: Optical sources, detectors and their working mechanism; Image formation and transmission; Optical imaging system and their characteristics; Imaging processing and algorithms. This course is developed in close collaboration with Edmund Optics Inc. Effective From: Fall 2008

Phys 420 - Special Relativity (3-0-3)

Prerequisites: Phys 234 or Phys 234H or Phys 231H and Math 222 or Math 222H, all with grade of C or better. An introduction to Einstein's Special Theory of Relativity at the advanced undergraduate level. Topics include invariance of the speed of light, relativity of time and space, the Lorentz transformations, space-time diagrams, the twin paradox and time travel, relativistic mechanics, rotating reference frames, laser gyroscopes, superluminal motion, phase and group velocities, and applications in high-energy physics, relativistic engineering, nuclear physics, astrophysics, and cosmology. Effective From: Fall 2008

Phys 421 - General Relativity (3-0-3)

Prerequisites: Phys 234 or Phys 234H or 231H and Math 222 or Math 222H, all with grade of C or better. An introduction to Einstein's General Theory of Relativity at the advanced undergraduate level. Topics include review of Newton's Theory of Gravitation, review of Einstein's Special Theory of Relativity, tensor calculus on both flat and curved manifolds, the covariant derivative, curvature, Einstein's Gravitational Field Equations, the weak-field limit, gravitational radiation, the black hole solution, Hawking radiation, the No-Hair Theorem, cosmology, and a history of the Universe.

Phys 430 - Classical Mechanics I (3-0-3)

Prerequisites: Phys 234 or Phys 234H or Phys 231H and Math 222 or Math 22H and Math 328 or Math 335, all with grade of C or better. Newtonian mechanics of particles and systems. Lagrange's and Hamilton's approaches. Continuous systems. 21&62:750:361 may be substituted for this course. Effective From: Fall 2008

Phys 431 - Classical Mechanics II (3-0-3)

Prerequisites: Phys 430, with grade of C or better. Theory of small oscillations and mechanical waves. Rigid bodies. Topics include stability, linearization methods, forced vibrators and perturbation theory, fluids and mechanics of continuous media. 21&62:750:362 may be substituted for this course. Effective From: Fall 2008

Phys 432 - Electromagnetism I (3-0-3)

Prerequisite: Phys 234 or Phys 234H or Phys 231H and Math 222 or Math 222H and Math 328 or Math 335, all with grade of C or better. Electrostatics and magnetostatics, Maxwell's equations with applications, and electrodynamics. Effective From: Fall 2008

Phys 433 - Electromagnetism II (3-0-3)

Prerequisite: Phys 432, with grade of C or better. Maxwell's equations with applications and electrodynamics.

Phys 441 - Modern Physics (3-0-3)

Prerequisites: Phys 234 or Phys 234H or Phys 231H and Math 222 or Math 222H, all with grade of C or better. Topics include wave-particle duality, wave mechanics, two-state quantum systems, the motion of an electron in a periodic lattice, band theory of solids, electrical, thermal and magnetic properties of solids, and plasmas and super fluid systems. 21&62:750:316 may be substituted for this course.

Phys 442 - Introduction to Quantum Mechanics (3-0-3)

Prerequisite: Phys 430, with grade of C or better. Wave-particle duality, the Schrodinger and Heisenberg formulations of quantum mechanics. The hydrogen atom, perturbation theory, and concepts of degeneracy, composite states and general properties of eigenfunctions. 21&62:750:404 may be substituted for this course. Effective From: Fall 2008

Phys 443 - Modern Optics (3-0-3)

Prerequisites: Physics III; Math 222.. Electromagnetic theory of light, interference, diffraction, polarization, absorption, double refraction, scattering, dispersion, aberration, and an introduction to quantum optics. Other topics include holography, lasers, information retrieval, spatial filtering, and character recognition. Effective Until: Spring 2006

Phys 444 - Fluid and Plasma Dynamics (3-0-3)
Prerequisites: Phys 234 or Phys 234H or Phys 231H and Math 222 or Math 222H, all with grade of C or better. Introduces the basics of plasma physics. Covers the following plasma parameters, single particle motions, plasma as fluid, waves, diffusion and resistivity, equilibrium and instability, kinetic theory, nonlinear effects. Applications in three areas: controlled fusion, astrophysics, and interaction between light and plasma.

Phys 446 - Solid State Physics (3-0-3)
Prerequisite: Math 222, with grade of C or better. Corequisite: Phys 442. An introduction to modern concepts of the solid state. Topics include crystal structure and diffraction, crystal binding and elastic properties, thermal properties, dielectric phenomena, band theory of solids and Fermi surfaces, electrical conductors, semiconductors, magnetism, and super-conductivity. 21&62:750:406 may be substituted for this course.

Phys 448 - Semiconductor Physics (3-0-3)
Prerequisites: Phys 234 or Phys 234H or Phys 231H and Math 222 or Math 222H, all with grade of C or better. The physics of semiconductors is examined and applied to problems of interest to the engineer. The course includes the following topics: the band theory of solids, conduction in solids, hole and electron statistics, and P-N junction theory with emphasis placed upon low-level and high-level injection. Metal semiconductor contacts and P-N-P transistor theory are also discussed.

Phys 450 - Advanced Physics Laboratory (1-4-3)
Prerequisites: Phys 335, Phys 430, Phys 432, all with grade of C or better. Introduction to electrical measurements; instrumentation; theoretical and applied electronics, solid state electronic devices, digital circuitry; computer design; experiments in modern physics. Effective From: Fall 2008

Phys 451 - Biophysics II (3-0-3)
Prerequisite: Phys 350, with grade of C or better. This course is the second semester of a two semester Biophysics sequence in which basic theoretical physics analysis and engineering design are emphasized. Topics include application of physical principles ion pumping, enzymes and molecular effects, nerve impulses and mitochondrial factories. Application of physical principles to optical medical devices is also discussed. The course will particularly address physics, chemistry, biomathematics and biomedical engineering without prerequisite requirements except introductory physics. Effective From: Spring 2008

Phys 452 - Atomic and Nuclear Physics (3-0-3)
Prerequisites: Phys 234 or Phys 234H or Phys 231H and Math 222 or Math 222H, all with grade of C or better. Topics include atomic spectra, atomic structure, and nuclear physics.

Phys 456 - Introduction to Solid State Physics (3-0-3)
Prerequisites: Phys 234 or Phys 234H or Phys 231H and Math 222 or Math 222H, all with grade of C or better. Treats the same topics as Phys 446 while introducing the necessary modern physics. Designed for students choosing a minor in applied physics. Students majoring in applied physics are ineligible. Effective Until: Spring 2008

Phys 461 - Mathematical Methods of Theoretical Physics (3-0-3)
Prerequisites: Phys 430, Phys 432, Phys 433, all with grade of C or better. Topics include vector and tensor analysis, matrix methods, complex variables, Sturm-Liouville theory, special functions, Fourier series and integrals, integral equations, and numerical solutions of differential equations.

Phys 480 - Topics in Applied Physics (3-0-3)
Prerequisite: Permission of instructor. Current topics and interests in applied physics and physics. Emphasis is on research and scientific development in microelectornics, optoelectronics, optical physics, materials science, surface science, solar physics, and modern physics. Effective From: Fall 2008

Phys 481 - Applied Solid State Physics: Microelectronics I (3-0-3)
Prerequisite: Phys 446, with grade of C or better. Topics include physics of bipolar and field effect devices, Phonon and optical spectra, unipolar devices, and thermal and high field properties of semiconductor devices.

Phys 482 - Applied Solid State Physics: Microelectronics II (3-0-3)
Prerequisite: Phys 446, with grade of C or better. Topics include large-scale integrated circuits, device characteristics, charge-coupled devices, LED and semiconductor lasers, photodetectors, and electrical and optical properties of materials.

Phys 483 - Applied Solid State Physics (0-6-3)
Prerequisite: Phys 446, with grade of C or better. Introduction to digital concepts; binary circuits and microprocessor architecture. Applications of discrete solid-state devices and integrated circuits are explored both in theory and practice. The laboratory also serves as an introduction to

hardware and software components of a typical microcomputer.

Phys 485 - Computer Modeling of Applied Physics Problems (3-0-3)
Prerequisites: Phys 234 or Phys 234H or Phys 231H and Math 222 or Math 222H, all with grade of C or better. General computer programming modeling methods and techniques. Numerical solutions to integro-differential equations. Eigenvalues problems. Application of computer-aided-design and other packages. 21&62:750:461 may be substituted for this course.

Phys 490 - Independent Study (3-0-3)
Prerequisite: Departmental approval. Undertake individual research or a project under the supervision of a member of the physics department. 21&62:750:485, 486 may be substituted for this course.

Phys 490H - Honors Independent Study (3-0-3)
By arrangement with a physics faculty member. Fulfills Honors College capstone course requirement.

R750:315 - Introductory Thermodynamics (3)
For more details go to Rutgers Catalog.

R750:316 - Introduction to Modern Physics (3)
For more details go to Rutgers Catalog.

R750:333 - Applications of Mathematics to Physics (3)
For more details go to Rutgers Catalog.

R750:403 - Introduction to Atomic and Nuclear Physics (3)
For more details go to Rutgers Catalog.

R750:404 - Quantum Mechanics (3)
For more details go to Rutgers Catalog.

R750:406 - Introductory Solid-State Physics (3)
For more details go to Rutgers Catalog.

R750:407 - Advanced Physics Laboratory I (1)
For more details go to Rutgers Catalog.

R750:408 - Advanced Physics Laboratory II (1)
For more details go to Rutgers Catalog.

R750:461 - Computational Methods in Applied Physics (3)
For more details go to Rutgers Catalog.

R750:485 - Individual Research in Physics (BA,BA)
For more details go to Rutgers Catalog.

R750:493 - Readings in Physics (BA,BA)
For more details go to Rutgers Catalog.

GRADUATE COURSES:

Phys 555 - Physics Laboratory Techniques (3 credits)
Prerequisite: B.S. or B.A. with course emphasis in a pure science or major engineering discipline. A training workshop in principles in mechanics, electricity and magnetism, wave motion, geometric and physical optics, and modern physics; experiments involving hands-on use of laboratory apparatus to solve numerous practical physics problems.

Phys 593 - Graduate Co-op Work Experience IV (0 credits)
Prerequisites: One immediately prior 3-credit registration for graduate co-op work experience with the same employer. Requires approval of departmental co-op advisor and the Division of Career Development Services. Must have accompanying registration in a minimum of 3 credits of course work. Effective From: Fall 2006

Phys 601 - Mechanics I (3 credits)
Concepts and basic methods for the treatment of equilibrium and accelerated motion; Newton's Laws and the Free Body Diagram applied to problems in statics and dynamics; vectors, vector quantities, and their application in mechanics.

Phys 602 - Mechanics II (3 credits)
Prerequisite: Phys 601 or equivalent. Laws of conservation of energy and conservation of momentum in work and energy, power, impulse and momentum, collisions, recoil, and rocket propulsion. Angular motion, torque, moment of inertia, work and energy in rotational motion, and the application of Newton's laws and the law of conservation of angular momentum to problems in rotational dynamics are studied.

Phys 603 - Electricity and Magnetism I (3 credits)
Prerequisite: Phys 602 or equivalent. Electric charge, electric field, Gauss's law, electric potential, potential energy difference, current, resistance, and emf are studied. Also considers the law of conservation of charge and Kirchoff's laws, direct current circuits and instrumentation. Class includes demonstration lectures, related supervised computation problems, and recitations.

Phys 604 - Electricity and Magnetism II (3 credits)
Prerequisite: Phys 603 or equivalent. Magnetic field, force on moving charges, force on current-carrying conductor, and torque on a current-carrying coil; the Hall effect, magnetic field due to moving changes, induced emf, Faraday's and Lenz's laws, mutual and self-inductance, R-L, L-C, and R-L-C circuits, ferromagnetism and permanent magnets. Also considers alternating currents, circuits with resistance, inductance, and capacitance, average and RMS values, phasors, power, resonance, and transformers. Class includes demonstration lectures, supervised computation problems, and recitation.

Phys 607 - Topics in Astronomy and Cosmology (3 credits)
Prerequisites: college-level physics and mathematics. A survey of recent progress in astronomy, the physical principles involved, and the impact these new discoveries have on our understanding of the universe. Includes results from recent and ongoing planetary probes of our solar system, discovery of planetary systems around other stars, the evolution of stars, exotic objects such as neutron stars and black holes, the formation of galaxies, and current understanding of the birth and final fate of the universe. Observing sessions familiarize students with the sun, moon, and night sky.

Phys 687 - Physics of Materials (3 credits)
Prerequisite: Phys 441 or equivalent (see undergraduate catalog for description). Fundamentals of quantum mechanics; energy bands in crystals; electrical conduction in metals and alloys, semiconductors; optical properties of materials; quantum mechanical treatment of optical properties; magnetic properties of materials; thermal properties, heat capacity, and thermal expansion in solids.

Phys 688 - Mathematical and Statistical Methods in Materials Science (3 credits)
More emphasis on analytical methods and statistics. Course will be required for Ph.D. students in Materials Science. Effective From: Fall 2006

Phys 700 - Master's Project (3 credits)
Prerequisite: Written approval from graduate advisor. For students admitted to the Master of Science program in applied physics who do not take Phys 701 Master's Thesis. An extensive paper involving experimental or theoretical investigation of a topic in microelectronics or other applied physics area is required. Cooperative projects with industry or government agencies may be acceptable. The project is carried out under the supervision of a designated physics graduate faculty member.

Phys 701 - Master's Thesis (3 credits)
Prerequisite: Written approval from graduate advisor. For students admitted to the Master of Science program in applied physics. Experimental or theoretical investigation of a topic in microelectronics or other applied physics area. Cooperative projects with industry or government agencies may be acceptable. The thesis is written under the supervision of a designated physics graduate faculty member. The completed written thesis should be of sufficient merit to warrant publication in a scientific or technical journal. The student must register for a minimum of 3 credits per semester. Degree credit is limited to 6 credits indicated for the thesis.

Phys 721 - Classical Electrodynamics II (3 credits)

Prerequisite: Phys 621 or equivalent; basic knowledge of tensor analysis. Simple radiating systems, scattering and diffraction; special theory of relativity; dynamics of relativistic particles and electromagnetic fields; collisions between charged particles, energy loss, and scattering; radiation from accelerated charge, synchrotron radiation, and bremsstrahlung. Effective From: Fall 2009

Phys 725 - Independent Study (3 credits)

Prerequisites: permission from the graduate advisor (not thesis advisor) in Physics, as well as courses prescribed by a supervising faculty member (who is not the student's thesis advisor). This special course covers areas of study in which one or more students may be interested, but which isn't of sufficiently broad interest to warrant a regular course offering. Students may not register for this course more than once with the same supervising faculty member.

Phys 728 - Radio Astronomy (3 credits)

Prerequisites: Phys 621and 641 or the equivalent, or approval of the instructor. An introduction to radio emission processes, radiative transfer, radio diagnostics, and radio instrumentation. Topics include radio flux measurements with single antenna, radio imaging with interferometer arrays (Fourier Transform imaging), and image reconstruction techniques (CLEAN, MEM). Application is to astronomical objects with special emphasis on the Sun.

Phys 731 - Quantum Mechanics II (3 credits)

Prerequisite: Phys 631 or equivalent. Review of quantum mechanics and theory of special relativity; second quantization; relativistic one-particle problem; Klein-Gordon equation and Dirac equation; canonical field theory; relativistic scattering theory; introduction to quantum electrodynamics and quantum field theory; Feynman diagrams and applications. Effective From: Fall 2009

Phys 774 - Fundamentals of Spectroscopy (3 Credits)

The major objectives of this course are to integrate theory and practice and to bring together different branches of Academic Studies and Industrial Research through the presentation of critical aspects of modern Spectroscopy. The course will provide a valuable theoretical introduction and an overview of modern topics in spectroscopy, which are of current interest and importance in Semiconductor Industry and Biomedicine. A wide range of techniques is considered, including optical Near field spectroscopy, X-ray, Raman, Neutron scattering, and FT-IR spectroscopy. Effective From: Fall 2006

Phys 789 - Physics of Advanced Semiconductor Device Processing (3 credits)

Prerequisites: NJIT: EE 657, 26:755:687; or equivalent. Intended for doctoral students in applied physics, electrical engineering, and materials science. (Rutgers = 26:755:789)Silicon and GaAs technologies: crystal growth methods, epitaxy, oxidation, lithography, dry and wet etching techniques, polysilicon, diffusion, ion implantation, metallization (including silicidation), process integration, analytical characterization techniques, assembly and packaging, and yield and reliability. Effective From: Fall 2009

Phys 790 - Doctoral Dissertation and Research (Credits as designated, 1st and 2nd sem.)

Prerequisites: passing grade on departmental qualifying examination and approval of doctoral candidacy. Corequisite: Phys 791. A minimum of 36 credits is required. The student must register for at least 6 credits of dissertation per semester. Registration for additional credits, up to 12 per semester, is permitted with the approval of the department graduate advisor. Experimental or theoretical investigation of a topic in applied physics, including microelectronics, materials science, and laser physics. Cooperative projects with industry or government agencies may be acceptable. Research and writing are carried out under the supervision of a designated graduate faculty member. The completed written dissertation should be a substantial contribution to the knowledge of the topic under research, and should be of sufficient merit to warrant publication in a leading scientific or technical journal.

R755:611 - Advanced Classical Mechanics (3 credits)

For more details go to Rutgers Catalog.

R755:621 - Classical Electrodynamics (3 credits)

For more details go to Rutgers Catalog.

R755:631 - Quantum Mechanics (3 credits)

For more details go to Rutgers Catalog.

R755:641 - Statistical Mechanics (3 credits)

For more details go to Rutgers Catalog.

R755:651 - Atomic and Molecular Physics (3 credits)

For more details go to Rutgers Catalog.

R755:654 - Nuclear and Particle Physics (3 credits)
For more details go to Rutgers Catalog.

R755:661 - Solid-State Physics (3 credits)
For more details go to Rutgers Catalog.

R755:667 - Modern Experimental Techniques for Materials Processing and Characterization (3 credits)
For more details go to Rutgers Catalog.

R755:671 - Applied Optics (3 credits)
For more details go to Rutgers Catalog.

R755:675 - Cellular Biophysics (3 credits)
For more details go to Rutgers Catalog.

R755:687 - Physics of Materials (3 credits)
For more details go to Rutgers Catalog.

R755:689 - Simulations of Electronic Device Structures (3 credits)
For more details go to Rutgers Catalog.

R755:690 - Directed Study of Applied Physics (3 credits)
For more details go to Rutgers Catalog.

R755:700 - Master's Project (3 credits)
For more details go to Rutgers Catalog.

R755:701 - Master's Thesis (6 credits)
For more details go to Rutgers Catalog.

R755:721 - Classical Electrodynamics II (3 credits)
For more details go to Rutgers Catalog.

R755:731 - Quantum Mechanics II (3 credits)
For more details go to Rutgers Catalog.

R755:732 - General Relativity and Gravitation (3 credits)
For more details go to Rutgers Catalog.

R755:761 - Solid-State Theory (3 credits)
For more details go to Rutgers Catalog.

R755:762 - Electronic Structure of Solids (3 credits)
For more details go to Rutgers Catalog.

R755:763 - Surface and Interface Physics (3 credits)
For more details go to Rutgers Catalog.

R755:771 - Quantum Electronics (3 credits)
For more details go to Rutgers Catalog.

R755:772 - Applied Plasma Physics (3 credits)
For more details go to Rutgers Catalog.

R755:773 - Particle-Solid Interactions (3 credits)
For more details go to Rutgers Catalog.

R755:774 - Principles of Spectroscopy (3 credits)
For more details go to Rutgers Catalog.

R755:775 - Electrical Properties of Polymers (3 credits)
For more details go to Rutgers Catalog.

R755:780 - Current Topics of Applied Physics (3 credits)
For more details go to Rutgers Catalog.

R755:781 - Physics of Advanced Semiconductor Devices (3 credits)
For more details go to Rutgers Catalog.

R755:787 - Physics of Sensors and Actuators (3 credits)
For more details go to Rutgers Catalog.

R755:789 - Physics of Advanced Semiconductor Device Processing (3 credits)
For more details go to Rutgers Catalog.

R755:790 - Doctoral Dissertation (Credits as designated)
For more details go to Rutgers Catalog.

R755:791 - Applied Physics Seminar (Non-credit)
For more details go to Rutgers Catalog.

R755:792 - Pre-Doctoral Research (3 credits)
For more details go to Rutgers Catalog.

Political Science: Offered by the Department of Political Science at Rutgers-Newark. Hill Hall (973/353-5105)

UNDERGRADUATE COURSES:

R790:201 - American National Government (3)
For more details go to Rutgers Catalog.

R790:304 - Introduction to Law and Legal Research (3)
For more details go to Rutgers Catalog.

R790:310 - Science, Technology, and Public Policy (3)
For more details go to Rutgers Catalog.

R790:321 - World Politics (3)
For more details go to Rutgers Catalog.

R790:330 - Eastern European Governments and Politics (3)
For more details go to Rutgers Catalog.

R790:334 - International Relations of the Middle East (3)
For more details go to Rutgers Catalog.

R790:338 - Political Economy of Government-Business Relations (3)
For more details go to Rutgers Catalog.

R790:356 - Sex, Law, and Public Policy (3)
For more details go to Rutgers Catalog.

R790:360 - Urban Politics and Public Policy (3)
For more details go to Rutgers Catalog.

R790:367 - Jurisprudence and Legal Theory (3)
For more details go to Rutgers Catalog.

R790:371 - Early Political Theory (3)
For more details go to Rutgers Catalog.

R790:372 - Modern Political Theory (3)
For more details go to Rutgers Catalog.

R790:377 - Ideology and Politics (3)
For more details go to Rutgers Catalog.

R790:387 - International Law (3)
For more details go to Rutgers Catalog.

R790:395 - Contemporary American Foreign Policy (3)

For more details go to Rutgers Catalog.

R790:417 - Problems in International Relations (3)
For more details go to Rutgers Catalog.

R790:435 - The American Presidency (3)
For more details go to Rutgers Catalog.

R790:436 - Legislatures and the Legislative Process (3)
For more details go to Rutgers Catalog.

R790:441 - Civil Liberties (3)
For more details go to Rutgers Catalog.

Professional and Technical Communication:

GRADUATE COURSES:

PTC 601 - Advanced Professional and Technical Communication (3 credits)

Provides the foundation and direction for all Professional and Technical Communication coursework. This course introduces students to the profession and the academic discipline of technical/professional communication. Modules include usability analysis; visual information; ethics; global communication; report writing; information literacy; communicating with new technologies; and technical writing style. Students begin development of the MSPTC ePortfolio. Effective From: Spring 2007

PTC 603 - Cultural and Technological Change (3 credits)

Prerequisite or corequisite: PTC 601. Examines the complex ways in which technology constructs and is constructed by society, with emphasis on interrelationships between technology and communication. Discussions focus on how technological change is expressed in social and political movements, literature, art, architecture, and philosophy and how they, in turn, influence the future direction of technology. Design and updating of the MSPTC ePortfolio will be required in this seminar. Effective From: Spring 2007

PTC 604 - Communication Theory and Research (3 credits)

Prerequisite or corequisite: PTC 601Reviews the major theories of communication and provides strategies for research in the field of Professional and Technical Communication. The course focuses on these research methods: problem statement and hypothesis formulation derived from theory; research design and data generation; existing information sources and their acquisition; and analytic techniques. Students develop analytic methods necessary to create a well-considered thesis proposal. Design and updating of the MSPTC ePortfolio will be required in this seminar. Effective From: Spring 2007

PTC 605 - Elements of Visual Design (3 credits)

Prerequisite or corequisite: PTC 601. Provides an understanding of and competency in the visual presentation of information. Course integrates theories of design, techniques of composition, and technologies of electronic and print publishing. Modules include both design principles and hands-on practice in visual literacy, layout and design, and graphic tools. Design and updating of the MSPTC ePortfolio will be required in this seminar. Effective From: Spring 2007

PTC 606 - Advanced Online Design (3 credits)

Prerequisite: PTC 605 Elements of Visual Design. Develops online visual communication strategies and community building. The course will cover the design and creation of multimedia objects, usability heuristics, navigation theory, contemporary design practices and online community building. Students will be required to create media-rich multidimensional online projects that encourage and facilitate interaction and team-building in the online environment. Design and updating of the MSPTC ePortfolio will be required for this seminar. Effective From: Spring 2007

PTC 610 - Usability: User and Task Analysis (3 credits)

Prerequisite: PTC 601. Guides students in conducting research to understand user requirements and analyze user tasks. Covers the complex tasks needed to create user-centered material: audience assessment, task analysis, scenario development, and evaluation. This is a writing intensive course that focuses on creating effective goal-oriented products. Effective From: Spring 2009

PTC 612 - Theory and Practice of Text Encoding (3 credits)

Prerequisite: PTC 605 or equivalent . In the beginning, IBM created "Script," a series of low-level commands that formatted text on a page. Then came Generalized Markup Language (GML) a series of macros for Script. Today we have Standard Generalized Markup Language (SGML) Hypertext Markup Language (HTML) and Extensible Markup Language (XML), all of which rely on the same basic concepts. Students will learn XHTML in order to gain a solid understanding of the theory of text encoding, while looking into the past (when technical writers wrote the code behind the text) and into the future (when VoiceXML enables unified messaging in a single interface). Each student will also create a website.
Effective From: Spring 2006

PTC 620 - Proposal Writing (3 credits)

Prerequisite or corequisite: PTC 601 . Provides an understanding of and practice in proposal writing for corporations, foundations, and government agencies. Students build skills to create a range of persuasive documents including proposals for research grants, responses to requests for proposal, and government proposals. Effective From: Spring 2006

PTC 622 - Working in Teams: Collaborative and Interpersonal Communications (3 credits)

Prerequisite or corequisite: PTC 601 . Uses case studies and simulations to provide both the theoretical foundations and the hands-on practice needed to work effectively in and among heterogeneous corporate groups. Includes collaborative writing, interviewing, and conflict resolution, and computer-mediated group work. Effective From: Spring 2006

PTC 624 - Professional and Technical Editing (3 credits)

Prerequisite or corequisite: PTC 601 . Presents the theory and practice of editing professional and technical writing. Topics include correctness and conciseness, hard copy and on-line editing, editing graphics, document management, editor-author relationships, and ethical considerations in editing. Students edit writing samples from a variety of technical fields. Effective From: Spring 2006

PTC 626 - Hypertext Design Studio (3 credits)

Prerequisite: PTC 605 or equivalent. Integrates language, image, linking and thinking in a studio approach to advanced HTML projects. Students work in computer laboratory with instructor on designing individual projects using current audio and video design applications. Effective From: Spring 2006

PTC 631 - Communication and Environmental Problem Solving (3 credits)

Prerequisite or corequisite: PTC 601. Develops critical thinking on ecological issues for problem solving by integrating technical information, human values, and communication with environmental change. Students combine theory, research and models, case studies, visual thinking, and scientific inquiry for application in individual decision-making course project. Effective From: Spring 2006

PTC 632 - Content Management and Information Architecture (3 credits)

Prerequisite or Corequisite: PTC 601. Today's complex systems often produce complex information needs that require new technical communication methods and tools. This course will focus on the use of Information Architecture methodologies (such as, DITA or DocBook) to develop a structure for presenting technical information and on Content Management tools for creating a single source repository for this information. Students will also use theory and practical applications to design and develop a structured online Help module. Effective From: Fall 2007

PTC 640 - Health Communications (3 credits)

This course will focus on the use of communication strategies to inform and influence individual and community decisions regarding health. The course will cover: the multidimensional nature of health communication, research in health communication, behavioral theories in health communication, rhetorical theories in health communication, legal and ethical concerns in health communication, the communication of risk and uncertainty, and the design of health campaigns. Students will be required to (a) research and prepare a health communication strategy for use in a specific context and (b) to design an accompanying print or hypertext document to be used in that context. Effective From: Spring 2006

PTC 642 - Corporate Communication (3 credits)

Prerequisite or corequisite: PTC 601 . Develops communication skills for modern global corporate and business markets. Business documents may include mission/vision statements, business plans, financial statements/plans, marketing plans, and corporate policies and procedures. Effective From: Spring 2006

PTC 644 - Communication in Technology Transfer and Innovation (3 credits)

In order to help prepare students for careers in a market-oriented productive economy, this course builds on the understanding that communication is essential to innovation development and technology transfer. Students first review the principles of successful technical communication and the models and literature of communication in technology transfer. Then, students apply this knowledge in team-based projects to develop Technology Transfer Communication Strategy (TTCS) for technology start-up companies as needed (business plans, documentation, technical reports, etc.) Effective From: Fall 2007

PTC 650 - Web Based Training Design (3 credits)

Prerequisite or corequisite: PTC 601 and PTC 605 . Web-based Training (WBT) is at the forefront of the recent 'e-learning' boom. However, while WBT use is on the rise, specific skills and tools are required to ensure a successful WBT implementation. Based on proven instructional design concepts, this course provides the student with the skills necessary to create effective web-based training programs. Effective From: Spring 2006

PTC 691 - ePortfolio Capstone Seminar (0)

This course is taken in the student's final semester before graduation. Students complete final revisions of the ePortfolio of work completed in MSPTC seminars (may also include professional and service projects). Student ePortfolios must successfully demonstrate MSPTC core competencies and be presented in an oral presentaiton for faculty and other students. Effective From: Fall 2008

PTC 698 - Selected Topics in Professional and Technical Communication (3 credits)

Prerequisite or corequisite: PTC 601 Effective From: Spring 2006

PTC 700 - Master's Project (3 credits)

Prerequisites: Approval of graduate advisor, and completion of core courses. Requires demonstration of student's ability to conceive and execute an extended writing project with professional graphics and to make an oral and visual presentation of the work. Based on experiential research (internship, co-op, work experience) student submits a proposal, develops a project (e.g., guidebook, manual, online documentation, website, video, podcast) and completes a paper describing the theory and methodology supporting the project application. Submission of the MSPTC ePortfolio demonstrating proficiency is required for graduation. Effective From: Spring 2006

PTC 701 - Master's Thesis (6 credits)

Prerequisites: approval of graduate advisor; completion of core courses. Demonstrates ability to conceive and execute an extended writing project with professional graphics and to make an oral and visual presentation of the work. The completed written thesis should warrant publication in a technical journal. Thesis Committee consists of program-approved faculty advisor, one other faculty member, and external reviewer. A student must register continuously for a minimum of 3 credits per semester until thesis in completed. Total will be limited to 6 credits. Effective From: Spring 2006

PTC 725 - Independent Study in Professional and Technical Communication (3 credits)

Prerequisite: approval of graduate advisor and supervising faculty.Allows development of areas of specialization for Master's Project or for areas of study in communication in which one or more students may be interested but which are not of sufficiently broad interest to warrant a regular course offering. Effective From: Spring 2006

Public Administration: Offered by the Department of Public Administration at Rutgers-Newark

GRADUATE COURSES:

R834:521 - Technology and Public Administration (3 credits)
For more details go to Rutgers Catalog.

R834:523 - Human Resources Administration (3 credits)
For more details go to Rutgers Catalog.

R834:524 - Strategic Planning and Management (3 credits)
For more details go to Rutgers Catalog.

R834:541 - Political Economy and Public Administration (3 credits)
For more details go to Rutgers Catalog.

R834:542 - Government Budgeting Systems (3 credits)
For more details go to Rutgers Catalog.

R834:562 - Policy and Program Assessment (3 credits)
For more details go to Rutgers Catalog.

R834:582 - Health Care Management (3 credits)
For more details go to Rutgers Catalog.

R834:584 - Health Care Finance (3 credits)
For more details go to Rutgers Catalog.

R834:585 - Health Care Policy (3 credits)
For more details go to Rutgers Catalog.

R834:586 - Violence in the United States (3 credits)
For more details go to Rutgers Catalog.

R834:602 - Decision Making and Policy Analysis (3 credits)
For more details go to Rutgers Catalog.

Public Health: Offered by the Department of Humanities and Social Sciences

GRADUATE COURSES:

MPH 601 - Introduction to Epidemiology (3 credits)
Epidemiology and its uses. Occurrence, distribution and dynamic behavior of disease and public health problem in human population. Descriptive epidemiology, observation cross-sectional study, longitudinal study and analytic epidemiologic study. Principles and methods of epidemiologic investigation. Evaluate the efficacy of preventive and therapeutic modalities and of new pattern of health care delivery. Measurement and interpretion of the morbidity and mortality indices. Application of findings to public policy. Evaluating public policy.

MPH 602* - Introduction to Biostatistics (3 credits)
Introduction to biostatistical concepts and methods utilizing a lecture format followed by computer laboratory sessions to apply statistical methods to problems commonly encountered by public health professionals.

MPH 603 - Principles of Environmental Health (3 credits)
Examines the environmental, occupational, residential factors and agents that have an impact on the health of people and the community. Structural and non-structural intervention to prevent, mitigate and minimize the impact as well as intervention benefits and limitations such as the role of biodiversity; ecological influences and impact; community perceptions; behavior impact; the role of culture, tradition and education; legal and regulatory remedies; government agencies; monitoring and technological interventions.

MPH 604 - Introduction to Health Care Systems and Policy (3 credits)
History, organization, financing and regulation of U.S. medical and public health services, particularly among under-served and urban populations. Social and behavioral factors that shape health and health services.

MPH 605* - Health Education and Public Health Issues (3 credits)
Consists of five sessions on health education; one each on public health, history, ethics, nutrition and Newark health problems; and ten half sessions devoted to emerging infections, health promotion, aging, tuberculosis, malaria, sexually transmitted diseases, HIV/AIDS, alcohol and drugs, the genetic revolution, and violence.

MPH 632 - Behavioral Research Design and Analysis (3 credits)
Provides an understanding of human behavior through research tools. Students learn how to make meaning of structured inquiry through observation, modeling, sampling plan design, and surveys. Emphasis is on document or website users. Effective From: Spring 2000

MPH 644 - Social Foundations of Urban Health (3 credits)
Theory used to explain and predict individual and aggregate behavior from the operationalization standpoint. Theories from economics, psychology, sociology, social psychology and geography. Theories of rational and habitual behavior under certain and uncertain outcomes. Statistical models in the estimation of structural models. Simulations using Resampling Stats.

MPH 645 - Society, Chronic Illness, and Disability: An Urban Perspective (3 credits)
Extend and intensity of chronic illness and disability with emphasis on urban populations. Conduct functional status assessments. Prepare sickness impact profiles. Perform physical performance tests. Depression and costs of several forms of long term care.

MPH 646 - Urban Child in a Global Perspective (3 credits)
Protective, rehabilitative and preventive strategies addressing the failure to meet the survival, nurturing and participatory rights of children as specified in the U.N. Convention on the Rights of the Child, the UNICEF programs for children in especially difficult circumstances, and the human capability approach of Amartya Sen. Covers the social and economic conditions that affect the care taking arrangements for infants, young children and adolescents at one or more epochs of their physical and psychosocial development.

MPH 647 - Perinatal Health and Family Planning (3 credits)
Extent of perinatal health problems in the United States particularly inner city populations. Etiology including chemical and behavioral factors.

Clinical specialists discuss current issues. Covers clinical solutions and public policy initiatives. Team project includes preparation and presentation of a major project.

MPH 648 - Community and Environmental Approaches to Health Behavior Change in Urban Disadvantaged Populations (3 credits)

Socio-environmental factors influencing health-related behavior, role of groups, institutions and social structures in encouraging healthy or unhealthy behavior. Intervention designed to improve health behavior through changes in the social environment; economic, social and political structures and practices creating barriers to effective interventions. Examples include environmental characteristics affecting alcohol and tobacco use, diet, and injury control.

MPH 650 - Medical Geography (3 credits)

Organization of society and the elaboration of disease; spatial vocabulary; geographic concepts related to disease distribution and adaptability; disease as an initiator of social and economic change in geographic constructs, economic development and population; contemporary health policy in the United States and its geographic influences and determinants.

MPH 660 - Health Economics (3 credits)

Explores questions of policy with regard to quality, cost and distribution of personal health care services and the proper role of government. Involves microeconomic and macroeconomic issues, theories and analysis tools.

MPH 698/699 - Special Topics in Public Health I, II (3 credits each)

Special area course given when suitable interest develops. Topics are announced in advance.

MPH 725 - Independent Study (3 credits)

Prerequisite: approval of track coordinator. Covers a topic that is either not offered in the master of public health degree program curriculum or is offered but the student wishes to study the topic in greater depth and or breadth. Work is supervised by a public health faculty member.

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* pending approval

Quantitative Method: Offered by the UMDNJ-New Jersey Medical School

GRADUATE COURSES:

QM 611 - Design of Epidemiological Studies and Clinical Trials (3 credits)

Prerequisites: biostatistics and epidemiology core courses, or equivalent. Principles of exper-imental design; recognize a well-designed study in the literature; identify and explain inadequacies in study designs and suggest improvements; prepare and submit a protocol for a well-designed study.

QM 612 - Linear Models: Regression and Analysis of Variance (3 credits)

Prerequisites: biostatistics core course or equivalent. Practical introduction to the linear statistical methods that are so commonly used in public health research. A statistical computer package such as SAS, STATA or SPSS is used for exercises. Apply regression, correlation and analysis of variance to data. Apply principles of study design and sample size planning. Provide statistically valid interpretation of output from data analysis.

Statistics: Offered by the Department of Management at Rutgers-Newark

GRADUATE COURSES:

R960:577 - Introduction to Statistical Linear Models (3 credits)

For more details go to Rutgers Catalog.

Transportation: Offered by the Interdisciplinary Program in Transportation

GRADUATE COURSES:

Tran 552 - Geometric Design of Transportation Facilities (3 credits)

Prerequisite: CE 350 or equivalent. Design principles and criteria related to highways and railroads resulting from requirements of safety, vehicle performance, driver behavior, topography, traffic, design, speed, and levels of service. Elements of the horizontal and vertical alignments and facility cross-section, and their coordination in the design. Computer-aided design procedures including COGO, CADAM, Digital Terrain Modeling. Same as CE 552.

Tran 553 - Design and Construction of Asphalt Pavements (3 credits)

Importance of designing asphalt pavements. Topics include the origin of crude, refining crude, types of asphalts, desired properties of asphalt cement, specification and tests for asphalt cement, aggregates for asphalt mixtures, aggregate analysis, gradation and blending, hot-mix asphalt (HMA) mix design, manufacture of HMA and HMA-paving, hot and cold recycling. Same as CE 553.

Tran 592 - Graduate Co-op Work Experience (3 additive credits)

Prerequisites: permission from Transportation Program and Division of Career Development Services. Work assignments and projects are developed by the co-op office in consultation with the transportation program. Work assignments are related to student's major and are evaluated by Transportation Program faculty coordinators. Credits for this course may not be used to fulfill any transportation degree requirements.

Tran 602 - Geographic Information Systems (3 credits)

Prerequisite: course or working knowledge of CADD or permission of instructor. Geographical/Land Information System (GIS/LIS) is a computerized system capable of storing, manipulating and using spatial data describing location and significant properties of the earth's surface. GIS is an interdisciplinary technology used for studying and managing land uses, land resource assessment, environmental monitoring and hazard/toxic waste control, etc. Introduces emerging technology and its applications. Same as CE 602.

Tran 603 - Introduction to Urban Transportation Planning (3 credits)

Urban travel patterns and trends; community and land activity related to transportation study techniques including survey methods, network analysis, assignment and distribution techniques. Case studies of statewide and urban areas are examined. Same as CE 603.

Tran 604 - Public and Private Financing of Urban Areas (3 credits)

Ties government's budget, tax, policy, allocation of resources between public and private sectors, with the structure, development, and growth needs of urban metropolitan areas. Focuses on problems of poverty, transportation, land-use, economic base, relation between central cities and suburban areas, and alternative engineering and economic solutions. Same as Fin 618 and MIP 618.

Tran 608 - Behavioral Issues in Transportation Studies (3 credits)

Behavioral science concepts and principles such as perception, learning, motivation, and information processing as they relate to: transportation, consumer use of mass transit, automobiles, ridesharing and intelligent transportation systems. Same as HRM 608.

Tran 610 - Transportation Economics (3 credits)

Prerequisite: undergraduate course in economics. Principles of engineering economy. Cost of highway and public transportation facilities. Economic comparisons and evaluations. Financing approaches, tax allocation theory. Programming highway and public transit improvements. Same as IE 610.

Tran 615 - Traffic Studies and Capacity (3 credits)

Prerequisite: elementary probability and statistics. Presentation of the characteristics of the traffic stream, road users, and of vehicles, and a review of traffic flow relationships. Students are exposed to the principal methodologies followed by transportation practices to perform volume, speed, travel time, delay, accident, parking, pedestrian, transit and goods movement studies. Presentation of the principal methodologies used to perform transportation facility capacity analyses for: basic freeway sections, weaving areas, ramps and ramp junctions, multi-lane and two lane roadways, signalized and unsignalized intersections. Students get hands on experience using highway capacity software (HCS) and SIDRA.

Same as CE 660.

Tran 625 - Public Transportation Operations and Technology (3 credits)
Prerequisite: graduate standing in civil or industrial engineering or instructor approval. Presentation of the technological and engineering aspects of public transportation systems. Historical development of public transportation technologies. Vehicle and right-of-way characteristics, capacity and operating strategies. Public transportation system performance. Advanced public transportation systems. Same as CE 625.

Tran 640 - Distribution Logistics (3 credits)
Prerequisite: EM 602 or Tran 650 or equivalent. Distribution logistics emphasizing systems engineering techniques used to optimize corporate profit and customer service: transportation modes; inventory policies; warehousing and order processing; and the best logistics gross margin. Same as EM 640.

Tran 643 - Transportation Finance (3 credits)
Prerequisite: undergraduate course in economics. Balance sheets and income statements. Asset and liability management, sources and costs of debt and equity financing. Financial performance measures in the private sector (airlines, railroads, trucking and bus companies). Financing issues associated with the public sector (highways and mass transit). Equity and efficiency in pricing. Subsidy allocation formulae. Innovative financing schemes in the public sector. Same as IE 643.

Tran 650 - Urban Systems Engineering (3 credits)
Prerequisite: computer programming background. Identifies the various urban problems subject to engineering analysis, and modern techniques for their solution, including inductive and deductive mathematical methods, mathematical modeling and simulation, and decision making under uncertainty. Same as CE 650.

Tran 653 - Traffic Safety (3 credits)
Prerequisite: Tran 615 or equivalent. System behavioral principles are applied to safety aspects of highway operation and design, and improvements of existing facilities. Solutions are evaluated on the basis of cost effectiveness. Same as CE 653.

Tran 655 - Land Use Planning (3 credits)
Spatial relations of human behavior patterns to land use; methods of employment and population studies are evaluated; location and spatial requirements as related to land use plans; and concepts of urban renewal and recreational planning are investigated by case studies. Same as CE 655 and MIP 655.

Tran 659 - Flexible and Rigid Pavements (3 credits)
Prerequisite: CE 341 or equivalent. Types of rigid (Portland cement) and flexible (bituminous pavements). Properties of materials, including mineral aggregates. Design methods as functions of traffic load and expected life. Importance and consequences of construction methods. Maintenance and rehabilitation of deteriorated pavements. Same as CE 659.

Tran 700 - Master's Project (3 credits)
Prerequisite: written approval of project advisor. An independent project demonstrating the student's professional competence in an area of specialization. Oral examination and written report required.

Tran 701 - Master's Thesis (6 credits)
Prerequisite: written approval of thesis advisor. A comprehensive project, usually in the form of substantial study and analysis, a functional design project or control-operations systems study.

Tran 702 - Selected Topics in Transportation (3 credits)
Prerequisite: advisor's approval. Topics of special or current interest.

Tran 705 - Mass Transportation Systems (3 credits)
Prerequisite: Tran 610 or IE 610. Investigation of bus, rapid transit, commuter railroad, and airplane transportation systems. Existing equipment, economics, capacity, and terminal characteristics are discussed, as well as new systems and concepts. Long- and short-range transportation systems are compared. Same as CE 705.

Tran 720 - Discrete Choice Modeling for Travel Demand Forecasting (3 credits)
Prerequisite: Tran 610 or equivalent. Discrete choice modeling describes a class of theoretical and analytical models essential for most advanced planning and forecasting efforts in transportation analysis. Includes logit, multi-nominal, and probit models. Develops theoretical and analytical skills needed to design, estimate and apply both revealed and stated preference models to appropriate travel demand forecasting problems.

Tran 740 - Management of Transportation Carriers (3 credits)

Prerequisites: Tran 610 or equivalent and Tran 650 or EM 602 or equivalent. Presents theory and practice of managing transportation carriers, including the concepts of costing, pricing, designing and marketing transportation service; the concepts of financial efficiency and resource productivity with application to the selected freight carriers in each mode of transportation. Selected case studies of carriers? operations management practices in various modes. Comparative studies of service characteristics, market share, cost structures both within a particular transportation mode and between modes. Same as EM 740.

Tran 751 - Transportation Design (3 credits)
Prerequisite: Tran 603. Design problems for airports, terminals, and highway intersections and interchanges are undertaken. Same as CE 751.

Tran 752 - Traffic Control (3 credits)
Traffic laws and ordinances; regulatory measures; traffic control devices; markings, signs and signals; timing of isolated signals; timing and coordination of arterial signal systems; operational controls; flow, speed, parking; principles of transportation system management/ administration; highway lighting; and state-of-the-art surveillance and detection devices and techniques. Hands-on experience with TRAF/NETSIM and FREESIM. Same as CE 752.

Tran 753 - Airport Design and Planning (3 credits)
Prerequisites or corequisites: Tran 610 or EM 693 and Tran 615. Planning of individual airports and statewide airport systems. Functional design of air and landside facilities. Orientation, number and length of runways. Concepts of airport capacity. Passenger and freight terminal facility requirements. Airport access systems. FAA operating requirements. Financial, safety and security issues. Same as CE 753 and IE 753.

Tran 754 - Port Design and Planning (3 credits)
Prerequisites: Tran 610 or EM 693 and Tran 615. Functional design of the water and landsides for general cargo, liquid and dry bulk, and container operations. Yard and storage systems. Port capacity in an intermodal network. Economic, regulatory, and environmental issues. Same as CE 754 and IE 754.

Tran 755 - Intelligent Transportation Systems (3 credits)
Prerequisite: Tran 752. Techniques used to improve the safety, efficiency and control of surface transportation systems. Emphasis on technological and operational issues of these systems and using them for incident detection and for traffic management through route and mode diversion.

Tran 760 - Urban Transportation Networks (3 credits)
Prerequisites: elementary probability and statistics and Tran 650 or equivalent. Provides analytical techniques for the analysis of transportation problems in an urban environment. Principal components include applications of models for the analysis of transportation problems, advanced static, dynamic, and stochastic traffic assignment procedures and transportation network design exact and heuristic solution algorithms. Offers hands-on experience with existing software in traffic assignment and transportation network design.

Tran 765 - Multi-modal Freight Transportation Systems Analysis (3 credits)
Prerequisites: Tran 610 or equivalent and Tran 650 or EM 602 or equivalent. Quantitative methods for the analysis and planning of freight transportation services. The supply-performance-demand paradigm for freight transportation systems. Cost and performance as determined by system design and operations. Relationship of traffic and revenue to service levels and pricing. Optimal service design and redesign for transportation enterprises and operations planning. Fleet and facility investment planning. Applications to various modes. Same as EM 765 and CE 765.

Tran 790 - Doctoral Dissertation and Research (Credits as designated)
Corequisite: Tran 791. Required of all candidates for the Doctor of Philosophy in Transportation. A minimum of 36 credits is required. Students may register for 6 to 15 credits of dissertation per semester. If 36 credits are achieved prior to completion of the doctoral dissertation and research, students must register for 3 credits per semester thereafter.

Tran 791 - Doctoral Seminar (Non-credit)
Corequisite: Tran 790. A seminar in which faculty, students, and invited speakers will present summaries of advanced topics in transportation. Students and faculty will discuss research procedures, dissertation organization, and content. Students engaged in research will present their own problems and research progress for discussion and criticism.

Tran 792 - Pre-Doctoral Research (B = 3 credits, or, C = 6 credits)
Prerequisite: Permission of program director. For students admitted to the Doctor of Philosophy Program in Transportation who have not yet passed the qualifying examination. Research is carried out under the supervision of a faculty member in the program. Up to 6 credits may be applied toward the required dissertation credits for the program. Effective From: Fall 2007

Adjunct Faculty

(Partial Listing)

Addabbo, Raymond
Adjunct Professor, Mathematical Sciences (2001).
Fairleigh Dickinson University, B.S., 1992.
New Jersey Institute of Technology, M.S., 1998.
New Jersey Institute of Technology, Ph.D., 2001.

Albano, Mark
Adjunct Professor, Computer Science

Alexander, Elena
Adjunct Professor, Hum (2003).
Long Island University, B.A., 1966.
Goddard College, M.F.A., 2002.

Alvi, Jamal
Adjunct Professor, Computer Science (2003).

Ambrosio, Christina
Adjunct Professor, Math (2004).
College of New Jersey, B.S., 1999.
New Jersey Institute of Technology, M.S., 2001.

Ammicht, Egbert
Adjunct Professor, Mathematical Sciences (2001).

Anwar, Tariq
Adjunct Professor, Engineering Technology (2004).
City University of New York, M.S.E., 1992.

Ariyan, Zaven
Adjunct Faculty

Assadipour, Fatiha
Adjunct Professor (2004).

Assadipour, Hossein
Adjunct Professor, Engineering Technology (1997).
Abadan Institute of Technology, B.Sc., 1972.
Michigan Technological University, M.Sc., 1977.
Michigan Technological University, Ph.D., 1980.

Bales, Ervin
Research Professor (1984).
University of South Carolina, B.S., 1957.
Bradley University, M.S., 1962.
University of Illinois, Ph.D., 1967.

Bartle, Andrew
Adjunct Professor, Arch (1991).
Bennington College, B.A.
Princeton University, M.Arch., 1980.

Batour, Amado
Adjunct Professor

Bergen, Michael
Adjunct Professor, Biomedical Engineering (2001).
New Jersey Institute of Technology, B.S., 1990.
New Jersey Institute of Technology, M.S., 1999.

Bernier, Craig
Adjunct Professor (2000).

Bhoraniya, Chandula
Adjunct Faculty

Biolsi, William
Adjunct Faculty

Bishof, Edward
Associate Vice President, Budget
Adjunct Professor

Biswal, Bharat
Adjunct Professor, Biomedical Engineering (2002).
Utkal University, B.S., 1989.
Michigan Technological University, M.S., 1996.
Medical College of Wisconsin, Ph.D., 1996.

Blanchard, Harry
Adjunct Professor (2001).

Blinder, Alexander
Adjunct Professor, Engineering Technology (2003).
New Jersey Institute of Technology, B.S., 2001.
Stevens Institute of Technology, M.S. Cert., 2002.

Bobenhausen, William
Adjunct Faculty

Bokhari, Syed
Adjunct Professor, Engineering Technology (2002).
New Jersey Institute of Technology, B.S., 2000.

Bong, Joohee
Adjunct Faculty

Booth, Victoria
Associate Research Professor (2003).
Smith College, B.A., 1986.
Northwestern University, M.S., 1990.
Northwestern University, Ph.D., 1993.

Brodowski, Thomas
Adjunct Professor (2003).

Brown, Eleanor
Adjunct Professor, Hum (1999).
Boston University, B.S.
Kean College, M.A.

Browne, Charles
Adjunct Professor, Engineering Technology (2004).
Yale University, B.A., 1965.

Burgess, Peter
Adjunct Professor, Engineering Technology (2004).
Rutgers University, B.S., 1979.
Rutgers University, M.S., 1985.

Burris, Douglas
Adjunct Professor (2000).

Canter, Jeffrey
Adjunct Professor, Electrical & Computer Engineering (2001).
New Jersey Institute of Technology, B.S.E.E., 1995.

Captain, Emile
Adjunct Professor, Engineering Technology (2001).
New Jersey Institute of Technology, B.S., 2001.

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Princeton University, Ph.D., 1952.

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Director , Health Servcies

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Director, University Learning Center

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Acting Assistant Dean and Director, Campus Center

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Coordinator, Testing and Placement

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Director, Institutional Research and Planning

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Senior Institutional Research Systems Manager

Kamal Joshi
HRS Database Manager

Oleksandr Rudniy
Assessment Analyst

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Director, University Web Services

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Web Systems Administrator and Trainer

Patricia M. Damm
Web Content Manager

Robert Florida
Web Content Manager

John Krane
Assistant Director

James E. Marko
New Media Producer

Ryan Walton
Web Developer

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Johnson & Johnson PPWW

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MAC Products

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General Devices, Inc.

Saralee Pinder
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AeA, Advancing the Business of Technology

Jim Danielson
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Dale Robinson Anglin
New Community Corporation

Ed Babula
Viewpoint

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George J. Landers
NACME-Vanguard Scholarship

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State of New Jersey Board of Public Uitilities

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Joseph Branco, `74

Luis DeOliveira, `91

Seymour "Zoom" Fleisher, '51
Pilot

Bernard Lubetkin, '49
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Hamilton College, B.A., 1954.
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Brooklyn College, B.A., 1944.
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University of Michigan, B.S., 1928.
University of Michigan, M.S., 1931.
University of Michigan, Ph.D., 1937.

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St. Peter's College, B.S., 1951.
Columbia University, M.A., 1956.

Camp, James E.
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Stevens Institute of Technology, M.S., 1950.

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Yale University, B.S., 1957.
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Columbia University, M.S.E.E., 1960.
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Gage, Howard
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City College of New York, B.M.E., 1960.
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Massachusetts Institute of Technology, B.Arch., 1952.
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Harvard University, Ed.M., 1975.

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Oregon State University, PhD, 1974.
University of Wisconsin, MS, 1972.
University of Illinois at Urbana-Champaign, BS, 1968.

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City College of New York, B.S., 1948.
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New School for Social Research, Ph.D., 1957.

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Polytechnic Institute of Brooklyn, Ph.D., 1964.

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Vassar College, A.B., 1963.
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Columbia University, M.S., 1941.
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Columbia University, M.A., 1931.

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Montclair State College, M.A., 1951.
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Rosemont College, B.S., 1960.
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Columbia University, B.A., 1932.
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City College of New York, B.A., 1956.
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University of Oslo, B.A.Eng., 1943.
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City College of New York, B.S.E., 1935.
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Louisiana State University, B.S., 1942.
California Institute of Technology, M.S., 1950.
Newark College of Engineering, Ph.D., 1970.

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Stevens Institute of Technology, M.S., 1949.

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Northwestern University, M.S., 1958.
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Newark College of Engineering, B.S.M.E., 1951.
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Cornell University, M.S., 1945.
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Newark College of Engineering, B.S.C.E., 1958.
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University of Michigan, B.S., 1949.
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University of Pennsylvania, A.B., 1949.
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Cornell University, B.S., 1948.
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DePauw University, B.A., 1956.
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Cambridge University, B.A., 1947.
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Newark College of Engineering, B.S., 1956.
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Associate Director, Center for Engineered Particulates, Chemistry and Environmental Science (2000).
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Brooklyn Polytechnic Institute, PhD, 1974.
Massachussetts Institute of Technology, MS, 1963.
Brooklyn Polytechnic Institute, BS, 1962.

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Associate Professor Emeritus, Physics (1955).
Rutgers University and University of Medicine and Dentistry of New Jersey, Ph.D.; joint degree, 2000.
City College of New York, B.M.E., 1944.
Newark College of Engineering, M.S.E.E., 1960.

Rich Jr., Joseph A.
Professor Emeritus, Industrial and Manufacturing Engineering (1941).
Rutgers University, B.S., 1941.
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Rutgers University, D.Jur., 1952.

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Newark College of Engineering, M.S., 1956.

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American University of Beirut, Ph.D., 1945.
Columbia University, M.S., 1953.
Columbia University, M.A., 1957.
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Davidson College, B.S., 1926.
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Stephans, Clarence H.
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Boston University, B.A., 1951.

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University of California, B.A., 1958.
Brandeis University, Ph.D., 1965.

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Newark College of Engineering, B.S.E.E., 1962.
Newark College of Engineering, M.S.E.E., 1964.
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Northwestern University, B.A., 1947.
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Wayne State University, B.F.A., 1967.
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Massachusetts Institute of Technology, B.S., 1943.
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New York University, Ph.D., 1955.

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Carnegie Institute of Technology, B.Arch., 1958.
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Program Director, Industrial and Manufacturing Engineering (1961).
City College of New York, B.B.A., 1951.
Columbia University, M.S., 1954.
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University of Rome and Padua, Ph.D., 1944.

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Brooklyn College, B.S., 1954.
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Ohio State University, B.S., 1942.
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National Planning Institute (Cairo), Diploma, 1970.
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University of Science and Technology, B.S., 1991.
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University of Science and Research (Iran), MS, 1999.
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Punjab University, B.A., 1952.
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University of Rome, Laurea in Ingeneria Chimica, 1977.
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Technion, Israel Institute of Technology, B.Sc., 1958.
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Rutgers University, Ph.D., 1998.

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Wilfrid Laurier University, B.A., 1969.
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Professor, Electrical & Computer Engineering (1995).
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National Technical University of Athens, Diploma, 1984.
Ohio University, M.S., 1985.
George Washington University, D.Sc., 1990.

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New Jersey City University, B.S., 1999.
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Head Coach, Men's and Women's Tennis (2002).
New Jersey Institute of Technology, B.S., 1984.

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Rutgers College, BA, 1982.
Pratt Institute, BArch, 1987.

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Eastern College, B.A., 1972.
Princeton Theological Seminary, M.S., 1975.
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Rutgers University, B.A., 1959.
American University, M.A., 1976.
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Bowen Lusk, Kim
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Southern Connecticut State University, B.A., 2000.
University of New Haven, M.B.A., 2001.

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United States Military Academy, B.S., 1968.
University of Hawaii, M.A., 1976.
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St. Peter's College, B.S., 1996.
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Tulane University, B.S., 1977.
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New York University, B.A., 1964.
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St. Peter's College, B.A., 1971.
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University of Utah, B.A., 1975.
Harvard University, A.M., 1977.
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Purdue University, B.S.Met.Eng., 1970.
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Esche, John
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Southwestern College, B.A., 1969.
Georgetown Law School, J.D., 1972.

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State University of Samar Island, B.S., 1969.
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University of Minnesota, MSCS, 1975.
University of Minnesota, BS, 1968.

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University of Virginia, M.Arch., 1979.

Nicholson, Theodore
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New York University, B.A., 1987.
Syracuse University College of Law, J.D., 1990.

O'Sullivan, William
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City College of New York, M.A., 1995.

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Reed College, B.A., 1964.
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Cornell University, Ph.D., 1972.
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Piatek, Slawomir
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New Jersey Institute of Technology, B.S., 1988.
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Quinn, Richard E.
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Massachusetts Institute of Technology, B.S.E.E., 1956.
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New York University, Ph.D., 1975.

Ratnaswamy, Jeyakuma
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Brunel University, Ph.D., 1993.

Redling, Judith
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Stevens Institute of Technology, B.E., 1989.
Rutgers University, M.S., 1992.
Rutgers University, Ph.D., 1995.

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Rutkowski, Wallace
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Stevens Institute of Technology, B.S., 1974.
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University of Maryland, Ph.D., 1981.

Schesser, Joel
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City University of New York, B.E., 1968.
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City University of New York, Ph.D., 1976.

Senesy, Stanley
Senior University Lecturer, Information Technology (2001).
McKendree College, B.A., 1994.
New Jersey Institute of Technology, M.S., 2000.

Sequeira, Marc
University Lecturer, Information Technology (2003).
New Jersey Institute of Technology, B.S., 2002.

Serico, Benjamin
University Lecturer, Mechanical Engineering (1994).
Newark College of Engineering, B.S., 1973.
New Jersey Institute of Technology, M.S., 1975.
Central Michigan University, M.A., 1978.

Shneidman, Vitaly
Senior University Lecturer, Physics (1999).
Kharkov State University, B.S., 1977.
Kharkov State University, M.S., 1979.
Physico-Technological Institute of Metals and Alloys, Ph.D., 1987.

Skawinski, William
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Stevens Institute of Technology, B.S., 1970.
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Rutgers University, Ph.D., 1991.

Sonnema, Jeffrey
Physical Education Specialist (1999).
Assistant Coach, Men's Basketball (1999).
New Jersey Institute of Technology, B.S., 1999.

Spirollari, Junilda
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Spottswood, Richard
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University of Mobile, B.S., 1999.

Statica, Robert
Senior University Lecturer, Information Technology (2005).
New Jersey Institute of Technology, B.S., 1996.
New Jersey Institute of Technology, M.S., 2000.

Surjanhata, Herli
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Triskati University, B.S., 1976.
New Jersey Institute of Technology, M.S., 1984.

Taher, Rima
University Lecturer, Architecture (1989).
Institut National des Sciences Appliquees de Lyon, B.C.E., 1982.
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New Jersey Institute of Technology, MS, 1999.

Venkateswaran, Venkat
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Walsh, Diana
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Visiting Scholar (1989).
William Paterson University, M.A., 1987.
Seton Hall University, J.D., 1996.

Wang, Haimin
Distinguished Professor, Physics (1995).
Associate Director of Center for Solar-Terrestrial Research and Big Bear Solar Observatory, Physics
Nanjing University, B.S., 1982.
California Institute of Technology, Ph.D., 1988.

Weiss, Julian
University Lecturer, Architecture (1982).
Visiting Scholar (1982).
Pennsylvania State University, B.Arch., 1963.
Columbia University, M.Arch., 1980.
Columbia University, M.U.D., 1980.

Wiggins, John
University Lecturer, Engineering Technology (1993).
Newark College of Engineering, B.S.C.E., 1973.
Seton Hall School of Law, J.D., 1980.
New Jersey Institute of Technology, M.S.C.E., 1981.

Wolf, Carl
Professor, Industrial and Manufacturing Engineering (1961).
Program Director, Industrial and Manufacturing Engineering (1961).
City College of New York, B.B.A., 1951.
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New York University, Ph.D., 1971.

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University Lecturer, Architecture, Architecture
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Cornell University, B.Arch., 1966.
Princeton University, M.F.A., 1969.

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Adjunct Professor
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Visiting and Research Professors and Others

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Visiting Professor, Electrical & Computer Engineering (2004).
N-W.F.P. University of Engineering & Technology, B.Sc., 1979.
University of Strathclyde, M.Sc., 1994.
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Jawaharlal Nehru Technological University, B.Tech., 1977.
Indian Institute of Technology, M.Tech., 1979.
George Mason University, Ph.D., 1994.

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Research Associate, Electrical & Computer Engineering (2004).

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Chinese Academy, M.S., 1992.
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University of Sao Paolo, B.S., 1979.
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Punjab University, B.A., 1952.
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New Jersey Institute of Technology, Ph.D., 1999.

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National Taiwan University, M.S., 1987.
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East China University of Science, B.S., 1989.
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University of Idaho, B.S., 1983.

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Ecole Nationale Polytechnique d'Alger, B.S., 1976.
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Princeton University, B.S., 1961.
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University of Michigan, B.S.E., 1952.
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Russian Academy of Science, Ph.D., 2001.

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Seoul National University, B.S., 1985.
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