NJIT

New Jersey Institute of Technology
A Public Research University

Department of Electrical and Computer Engineering

Handbook for Graduate Students
Effective 2000 (updates: 2001, 2004)

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Introduction

We are pleased to present out *Handbook for Graduate Students* for students enrolled in programs in the Department of Electrical and Computer Engineering (ECE). This document is a compilation of both Institute and ECE department regulations and procedures of particular interest to M.S. and Ph.D. students. Please note that the Institute's *Graduate Catalog* also contains information you will find helpful. Changes that may occur in ECE department procedures will be posted on the bulletin board near 200 ECEC. We expect to revise this handbook on an annual basis.

Graduate degrees offered by the Department of Electrical and Computer Engineering.

- MS in Electrical Engineering
- MS in Computer Engineering
- MS in Internet Engineering
- MS in Telecommunications (offered jointly with the Computer Science department)
- Ph.D. in Electrical Engineering
- Ph.D. in Computer Engineering

II.   ADMISSIONS

The following sections contain special admission issues of concern to students in the Department of Electrical and Computer Engineering. Please consult the *Graduate Catalog* for other issues regarding admission.

1. GRE and TOEFL

The Graduate Record Examination (GRE) General Section is required of all applicants to doctoral programs, all full-time applicants to master's programs, all applicants seeking financial support, and all applicants whose most recent degree was awarded from an institution outside of the United States.

The Test of English as a Foreign Language (TOEFL) is required for all international students applying to a graduate program, the score of which must be at least 550. Applicants with scores below 550 are not considered for admission.

2. Conditional Admission

Conditional admission 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 graduate courses are calculated in the grade point average (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.

3. Change of Major

Students are admitted to one graduate degree program and not to the university as a whole. Students who wish to change majors must remain and take courses in the original program for a year and then file an application for the new program. There is no guarantee that the new application will be successful. Those on support may risk losing support from the original department and cancellation of a current award. International students and others who must be registered full-time will still be required to have a 12-credit registration.

4. Change of Degree Level

Students who wish to change the level of the degree program in which they are enrolled must file an application for admission to the new degree level. There is no guarantee that the application will be successful. Students who wish to drop down to a master's degree program from a doctoral program should be aware of the impact of this action on current and future financial support.

5. Non-Degree (Non-Matriculated) Students

Non-matriculated students may be permitted to take a maximum of 9 graduate-level credits over three registration periods, except students seeking a graduate certificate. These students may take a maximum of 12 graduate-level credits 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 for 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 Associate Chair for Graduate Studies and 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 clusters of courses in concentrated areas for students who wish to obtain a certificate of completion. In general, these require completion of 12 credits at the graduate level. Students in these programs are considered to be non-matriculated students for the duration of the certificate program.

Upon completion of the certificate program, the student may apply for admission to matriculated status. In the event that the petition is approved, some or all of the courses taken in the certificate may be applied toward satisfying the M.S. degree requirements. The courses must be applicable to the M.S., and the grade in each accepted course must be B or better.

III. REGISTRATION AND OTHER ACADEMIC POLICIES

1. Approval of Course of Study

Students are required to arrange a conference with their graduate advisor as soon as possible after notification of admission (international students should do so immediately after arrival in the United States) 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.

2. Continuous Registration Requirement

Once admitted to a degree program, students must be continuously registered each semester until they complete degree requirements. Students are not permitted to register for Maintaining Registration (MR) if their project, thesis or dissertation is unfinished without approval for a Leave of Absence by the Dean of Graduate Studies. Students who complete work for Master's Projects or Theses over several semesters receive a final grade (A, B, C) in the semester in which the work is completed and the final document is approved. The final grade of a completed doctoral dissertation is P. An interim grade of S or U is given for semesters other than the final semester.

3. Transfer of Credits from Outside NJIT

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 U.S. educational institutions may be transferred and applied to degree requirements at NJIT. Credits from educational institutions outside the United States cannot be transferred. On a case by case basis, up to 9 credits may be waived for non-collegiate based instruction. The university does not grant transfer credit for work experience or other non-instructional activities. 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 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. Grades that are transferred will not be calculated in cumulative grade point averages.

4. Enrollment Status

Full-time Students: Students registered for 12 credits or more throughout an entire semester are considered full-time. International students and students receiving financial awards must have full-time status each semester.

Part-Time Students: Students registered for fewer than 12 credits during a semester, unless certified as full-time by the Office of Graduate Studies.

5. Full-time Certification

Graduate students must be registered for not less than 12 credits each semester in order to be accorded full-time status. The Office of Graduate Studies may certify certain students as full-time even if they are not registered for 12 credits, as follows:

- Students who have fewer than 12 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 students preparing for qualifying examinations or research proposal presentations register for at least 9 credits. Course credit possibly includes 3 credits of pre-doctoral research.

- Doctoral candidates who have completed all course work, other degree and credit requirements, and who are registered in Dissertation Research and Seminar for at least 3 credits each semester.

- Students who originally registered for 12 credits but now have substantial extenuating circumstances requiring a reduction in course load. Normally this certification applies only in cases of medical or similar emergencies which 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.

- Students on a full-time cooperative education assignment and registered in the Co-op Work Experience or equivalent course. When students are in their final semester of study, they may be certified as full-time and approved for co-op. The Office of Graduate Studies should be consulted for limits on cooperative education, as it has an impact 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.

6. Grade Point Average Calculation

In order to obtain a graduate degree, candidates must have a cumulative grade point average of at least 3.0 in all graduate-level courses, exclusive of grades in Master's Project or Master's Thesis. All 500-level or higher courses are included in the cumulative grade point average, regardless of applicability to a specific degree. Only the initial grades for graduate courses that have been repeated once are excluded from GPA calculations. In addition, the cumulative grade point average for all courses counted for the degree, exclusive of Master's Project or Master's Thesis, must be 3.0 or better.

7. 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 are considered in evaluating these requests.

8. Grades

The Registrar issues a grade report to each student at the end of each semester. Grade point averages are calculated for each semester and cumulatively for the entire graduate record. Undergraduate credits taken by graduate students are not counted. The following grades are used:

Grade	GPA	
A	4.0	Excellent
B+	3.5	Good
B	3.0	Acceptable
C+	2.5	Fair
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 (interim grades for thesis and dissertation and final grade for Co-op)
P		Passing for Doctoral Dissertation and Defense

9. Incomplete Grades

A grade of I (Incomplete) is given when courses cannot be completed because of special circumstances. Students on academic probation are not permitted incompletes 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. A letter grade must be assigned or a grade of "F" will be given. 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. This grade cannot be changed. A grade of "I" cannot be given for thesis, project, dissertation, seminar, pre-doctoral research courses, or ESL courses.

10. Course Withdrawals

Withdrawal from graduate courses, without academic penalty, is permitted until the end of the ninth week of the semester. A notation of W on the student's transcript signifies an approved withdrawal. Withdrawal forms may be obtained from the Office of the Registrar. Approved withdrawal takes effect when the Registrar receives the completed withdrawal form from the student within the designated nine-week period. A failing grade will be issued to students who do not notify the Registrar of withdrawal in this manner. Students who do not obtain an approved withdrawal are obligated to pay full tuition and fees. Any refunds for approved withdrawals follow the refund schedule established by the Registrar. Withdrawals that affect conditions for retention of financial awards or support, continued full-time status, academic probation, progress toward a degree, admission, ESL, or participation in special programs must be approved by the Office of Graduate Studies. After the ninth week of the semester, students may withdraw from a course only for extenuating circumstances with the approval of the Dean of Graduate Studies and by the graduate program advisor.

11. 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.

12. 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 will receive a U grade. Credits for courses in which U is received cannot count toward a degree.

13. 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 grade point average, but the first grade still appears on the transcript. A maximum of two courses may be repeated in graduate studies. Students may not repeat a course without prior approval from the department and the Office of Graduate Studies. 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.

14. Project, Thesis and Dissertation

Theses and dissertations submitted for graduate degrees must follow a prescribed format. A manual outlining the university requirements for thesis and dissertation submission is available in NJIT's bookstore. The Office of Graduate Studies should be consulted for more information.

Letter grades are given for satisfactory completion of the Master's Project, and P is used as a final grade after successful defense of the Master's thesis. Projects and theses must be submitted first, before a grade can be given. 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 is completed. Letter grades cannot be given for an unfinished project or thesis, nor for work not submitted. A grade of P is given for satisfactory completion of a doctoral dissertation and defense. Receipt of two U grades for project, thesis, dissertation, or pre-doctoral research will result in a letter grade of F in place of the second U and dismissal from the program. 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 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 or master's thesis registration must be at least 3 credits during a semester or summer session. Doctoral dissertation registration must be at least 6 credits during a semester, until the 36-credit requirement is reached, at which time 3-credit registrations are permitted. All students must have their

advisor's signature and section identification each time they register for project or thesis. Students must register for thesis, project, or dissertation work within the deadlines established by the Registrar. Doctoral dissertation registration may be 3 credits during a summer session. 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. Once a student has begun the master's project, the master's thesis, or the doctoral dissertation, he or she 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. A final grade is assigned by the advisor for thesis or dissertation 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 must maintain continuity of registration for theses and dissertations (implies registration for fall or spring, but not for summer). If a master's project is not completed after two semesters of registration, a final grade of F is given. Failure to complete a master's project by students who receive financial support may result in dismissal. 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 F, 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 F 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 department, and the Office of Graduate Studies. If the appeal for an extension is denied, the student may appeal further in the following order: department chairperson, dean of the school or college, and finally to the Committee on Graduate Appeals. Appeals may be accompanied by any material that the student believes appropriate. Appeals to the Committee on Graduate Appeals should be directed to the Dean of Graduate Studies. All decisions of the Committee on Graduate Appeals are final.

15. Deadline Waiver

Applications for January or May graduation for students 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. 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.

IV.   MASTER OF SCIENCE IN ELECTRICAL ENGINEERING

1. Admission Requirements

Applicants are expected to have excellent 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.

Bridge Program~Students who have earned a Bachelor of Science in Engineering Technology (B.S.E.T.) degree, or who lack an appropriate background, must take the following courses, in addition to the degree requirements, to make up deficiencies. They must obtain 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 program requirements reduced accordingly.

EE 232-Circuits and Systems II
EE 321-Random Signals and Noise
EE 333-Circuits and Systems III
EE 361-Electromagnetic Fields I
EE 362-Electromagnetic Fields II
EE 372-Electronic Circuits II
EE 373-Electronic Circuits III

2. Degree Requirements

Upon entering the program, students select an area of specialization supervised by an area coordinator. The master's program consists of 30 credits. Students should consult with the area coordinator or designee for their area of specialization before registering for courses to make sure they are meeting department requirements. Area coordinators or their designees must approve any additional courses that students wish to be counted towards their degrees. As a requirement for graduation, students must achieve a 3.0 cumulative GPA overall and in graduate-level courses not including the master's thesis or project.

3. Project, Thesis, Seminar

Students who enter the electrical engineering master's program and who receive departmental or research-based awards must complete a master's thesis.

All master's students must register for two semesters of ECE 791 Graduate Seminar. Those with substantial professional experience may have this requirement waived. In order to receive passing credit, the student must attend at least five (5) seminars per semester for two semesters, to be chosen from those sponsored by the areas, the ECE department, the Institute, or other outside seminars approved by the Seminar Supervisor. Please watch the bulletin board labeled *ECE 791 Graduate Seminar*, located in the hall leading to the ECE main office, for information on approved seminars.

Students who enter the program but who did not receive departmental or research-based awards, as well as entering part-time students, have three program options: 24 course credits and 6 credits of ECE 701 Master's Thesis or 27 course credits and 3 credits of ECE 700 Master's Project or 30 course credits not to include ECE 700 Master's Project or ECE 701 Master's Thesis.

4. Areas of Specialization

Entering full-time students must select an area of specialization during their first semester. Entering part-time students must select an area of specialization by the beginning of their second semester. Further Students should contact the MSEE Graduate Advisor for guidance.

Area Members

COMMUNICATIONS, SIGNAL PROCESSING, AND MICROWAVES
Ali Abdi, Ph.D.
Ali Akansu, Ph.D.
Nirwan Ansari, Ph.D.
Yeheskel Bar-Ness, Ph.D. (Area Co-ordinator)
Atam Dhawan, Ph.D.
Hongya Ge, Ph.D.
Haim Grebel, Ph.D.
Richard Haddad, Ph.D.
Alex Haimovich, Ph.D.
Jacob Klapper, Ph.D.
Sven Loncaric, Ph.D.
Edip Niver, Ph.D.
Yun-Qing Shi, Ph.D.
Sirin Tekinay, Ph.D.
Gerald Whitman, Ph.D.
Roy R. You, Ph.D.

COMPUTER ARCHITECTURE AND SYSTEMS
John Carpinelli, Ph.D.
Edwin Hou, Ph.D.
Durga Misra, Ph.D.
Sol Rosenstark, Ph.D.
Jacob Savir, Ph.D. (Area Co-ordinator)
Lev Zakrevski, Ph.D.
Sotirios Ziavras Ph.D.

COMPUTER NETWORKING
Ali Akansu, Ph.D.
Nirwan Ansari, Ph.D.
Edwin Hou, Ph.D.
Constantine Monikopoulos, Ph.D.
Symeon Papavassiliou, Ph.D.
Sirin Tekinay, Ph.D. (Area Co-ordinator)
Lev Zakrevski, Ph.D.
Meng-Chu Zhou, Ph.D.

INTELLIGENT SYSTEMS
Timothy Chang, Ph.D. (Area Co-ordinator)
Edwin Cohen, Ph.D.
Atam Dhawan, Ph.D.
Walid Hubbi, Ph.D.
Sven Loncaric, Ph.D.
Sol Rosenstark, Ph.D.
Yun-Qing Shi, Ph.D.
Meng-Chu Zhou, Ph.D.

SOLID STATE VLSI AND ELECTRO-OPTIC SYSTEMS
Roy Cornely, Ph.D.
Haim Grebel, Ph.D.
Durga Misra, Ph.D. (Area Co-ordinator)
Kenneth Sohn, Ph.D.
Marek Sosnowski, Ph.D.

5. Program Core Requirements

Students are required to take the following core courses :

- ECE 601-Linear Systems (all areas of specialization except Computer Systems)

- Choose at least one out of {ECE 620-Electromagnetic Field Theory, or ECE 673-Random Signal Analysis}

6. 500-Level Courses

500-level courses in electrical engineering are not acceptable for credit toward a degree in electrical engineering. Only one 500-level course outside the department may be applied for credit toward a degree in electrical engineering.

7. Area Requirements

A minimum of 24 credits should be from ECE Department. Students may take up to two courses outside the ECE Department with advisor approval. In addition, every student needs to register ECE 791 for two semesters. Note that elective courses are amended periodically, and students can choose electives outside of the lists below with advisor approval.

COMMUNICATIONS, SIGNAL PROCESSING, AND MICROWAVES

Area Requirements (choose at least two):
ECE 642-Communication Systems I
ECE 742-Communication Systems II
ECE 640-Digital Signal Processing
ECE 740-Advanced Digital Signal Processing
ECE 630-Microwave Electronic Systems
ECE 632-Antenna Theory

Suggested Electrical Engineering Electives:
ECE 609-Artificial Neural Networks
ECE 622-Wave Propagation
ECE 623-Fourier Optics
ECE 625-Fiber and Integrated Optics
ECE 626-Optoelectronics
ECE 643-Digital Image Processing I
ECE 644-Intro. to Wireless & Personal Comm. Systs.
ECE 684-Advanced Microprocessor Systems
ECE 746-Adaptive Array Proc. and Interference Canc.
ECE 747-Signal Decomposition Techniques
ECE 749-Compression in Multimedia Engr.
ECE 755-Advanced Topics in Digital Communication
ECE 757-Wireless Communication
ECE 776-Information Theory
ECE 777-Statistical Decision Theory in Communications
ECE 778-Algebraic Coding for Info. Transmission

COMPUTER NETWORKING

Area Requirements:
ECE 683-Computer Network Design and Analysis
ECE 783-Computer Communication Networks

Suggested Electrical Engineering Electives:
ECE 605-Discrete Event Dynamic Systems
ECE 637-Introduction to Internet Engineering
ECE 638-Network Management and Security
ECE 639-Principles of Broadband ISDN and ATM
ECE 642-Communication Systems I
ECE 644-Intro. to Wireless & Personal Comm. Systems
ECE 645-Wireless Networks
ECE 658- VLSI Design
ECE 677-Optimization Techniques
ECE 681-Broadband Packet Switches
ECE 690-Computer Systems Architecture
ECE 742-Communications Systems II
ECE 745- Advanced Wireless Networks
ECE 785-Parallel Processing Systems
ECE 685-Network Interface Design
CIS 610- Data Structures and Algorithms
CIS 665-Algorithmic Graph Theory
Math 661-Applied Statistics
Mgmt 685-Operations Research and Decision Making

COMPUTER ARCHITECTURE AND SYSTEMS

Area Requirements:
ECE 689-Dig. Sys. Design for Machine Arith.
ECE 690-Computer Systems Architecture

Electrical Engineering Electives:
ECE 605-Discrete Event Dynamic Systems
ECE 612-Computer Methods Applied to Power Systems
ECE 640-Digital Signal Processing
ECE 643-Digital Image Processing I
ECE 650-Electronic Circuits
ECE 660-Control Systems I
ECE 664-Real-Time Computer Control Systems
ECE 684-Advanced Microprocessor Systems
ECE 686-Instrumentation Systems and Microprocessors
ECE 687-Design of Medical Instrumentation
ECE 688-Microcontrollers in Instrumentation
ECE 785-Parallel Process Systems

INTELLIGENT SYSTEMS

Area Requirements (choose at least 2):
ECE 605-Discrete Event Dynamic Systems
ECE 609-Artificial Neural Networks
ECE 610-Power System Steady-State Analysis
ECE 660-Control Systems I

Suggested Electrical Engineering Electives:
ECE 611-Transients in Power Systems
ECE 612-Computer Methods Applied to Power Systems
ECE 613-Protection of Power Systems
ECE 614-Dynamics of Electromechanical Energy Conversion
ECE 615-Advanced Electromechanical Energy Conversion I
ECE 616-Power Electronics
ECE 640-Digital Signal Processing
ECE 664-Real-Time Computer Control Systems
ECE 666-Control Systems II
ECE 661-Control System Components
ECE 677-Optimization Techniques
ECE 684-Advanced Microprocessor Systems
ECE 766-Stability Theory of Nonlinear Systems
ECE 768-Optimal Control Theory
ECE 769-Stochastic Estimation and Control
CIS 670-Artificial Intelligence
CIS 672-Expert System Methods and Design

SOLID STATE VLSI AND ELECTRO-OPTIC SYSTEMS

Area Requirements (choose at least two):
ECE 622-Wave Propagation
ECE 626-Optoelectronics
ECE 650-Electronic Circuits
ECE 657-Semiconductor Devices
ECE 658-VLSI Design I
ECE 758-VLSI Design II

Suggested Electrical Engineering Electives:
ECE 605-Discrete Event Dynamic Systems
ECE 623-Fourier Optics
ECE 624-Optical Engineering
ECE 625-Fiber and Integrated Optics
ECE 630-Microwave Electronic Systems
ECE 648-Digital Microelectronics
ECE 659-Fabric.Prin.Elec./Optoelec. Devices
ECE 660-Control Systems I
ECE 677-Optimization Techniques
ECE 684-Advanced Microprocessor Systems
ECE 690-Computer Systems Architecture
ECE 730-Theory of Guided Waves
ECE 739-Laser Systems
ECE 756-Semiconductor Devices II
ECE 785-Parallel Processing Systems
ECE 789-Design for Testability Principle
ECE 677-Optimization Techniques
ECE 768-Optimal Control Theory
Phys 761/787*-Phys. of Sensors & Actuators
MtSE 702-Characterization of Solids
MtSE 650-Physical Metallurgy
MtSE 765-Sci. and Technology of Thin Film

8. Independent Study

For master's students, independent study courses, ECE 725, ECE 726, and ECE 727 will not count towards the master's degree course requirement, but ECE 725 can be used to satisfy the 12-credit full-time requirement. ECE 726 and ECE 727 cannot be used to satisfy the 12-credit full-time requirement.

9. Master's Thesis

Before the end of the final term of thesis registration, a master's thesis committee, consisting of three (3) faculty members, will hear the student present his or her thesis in an open forum (thesis defense). At least two (2) members of the committee must be members of the ECE department. A typed version of the completed thesis should be available to the committee at least three (3) weeks before the oral defense is scheduled and an unbound copy of the thesis should be available in the Department Secretary's office (235 ECEC) three weeks before the defense. The final version is due in the library to meet graduation requirements by the date specified by the Office of Graduate Studies. Written notice of the presentation will be posted. Interested faculty and graduate students are invited to attend.

V. MASTER OF SCIENCE IN COMPUTER ENGINEERING

1. Admission Requirements
Students are expected to have an undergraduate education in engineering or computer science. Students with baccalaureate degrees in areas other than computer engineering will be required to complete a bridge program. Those with undergraduate degrees in other fields should consult the Director of Computer Engineering for bridge requirements. Bridge courses do not count toward degree requirements.

2. Degree Requirements
Students must complete 30 credits—at least half of which are offered through the Department of Electrical and Computer Engineering—including the two-course sequence in at least one of the five areas of concentration. Students in all areas must take the two required core courses indicated below and complete either 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.

Students who enter the computer engineering master's program and who receive departmental or research-based awards must complete a master's thesis.

All master's students must register for two semesters of ECE 791 Graduate Seminar. Those with substantial professional experience may have this requirement waived. In order to receive passing credit, the student must attend at least five (5) seminars per semester, to be chosen from those sponsored by the areas, the ECE department, the Institute, or other outside seminars approved by the Seminar Supervisor. Please watch the bulletin board labeled *ECE 791 Graduate Seminar*, located in the hall leading to the ECE main office, for information on approved seminars.

PLEASE NOTE THAT ECE 684 IS NOT AVAILABLE FOR MSCoE CREDIT.

3. Core
Required for all specializations are ECE 690-Computer Systems Architecture and CIS 610-Data Structures and Algorithms, *and* a project or thesis (3 credits of ECE 700-Master's Project or 6 credits of ECE 701-Master's Thesis).

4. Area Requirements

Microprocessor-Based Systems
Required:
ECE 686-Instrumentation Systems and Microprocessors
ECE 688-Microcontrollers in Instrumentation

Electives (15 to 18 credits):
ECE 605-Discrete Event Dynamic Systems
ECE 612-Computer Methods Applied to Power Systems
ECE 650-Electronic Circuits
ECE 660-Control Systems I
ECE 664-Real-Time Computer Control Systems
ECE 666-Control Systems II
ECE 783-Computer Communication Networks
ECE 785-Parallel Processing Systems
CIS 630-Operating System Design
CIS 631-Data Management System Design
CIS 635-Computer Programming Languages
CIS 637-Real-Time Systems
CIS 641-Formal Languages and Automata
CIS 661-Systems Simulation
CIS 662-Model Analysis and Simulation
IE 605-Engineering Reliability

Parallel Computing Systems
Required:
ECE 689-Dig. Sys. Design for Machine Arith
ECE 785-Parallel Processing Systems

Electives (15 to 18 credits):
ECE 605-Discrete Event Dynamic Systems
ECE 609-Artificial Neural Networks
ECE 640-Digital Signal Processing
ECE 650-Electronic Circuits
ECE 783-Computer Comm. Networks
ECE 785-Parallel Processing Systems
CIS 630-Operating System Design
CIS 631-Data Management System Design
CIS 633-Distributed Systems
CIS 636-Compiling System Design
CIS 637-Real-Time Systems
CIS 665-Algorithmic Graph Theory
CIS 668-Parallel Algorithms
IE 623-Linear Programming

Computer Networking
Required:
ECE 683-Computer Network Design and Analysis
ECE 637-Introduction to Internet Engineering

Electives (15 to 18 credits):
ECE 605-Discrete Event Dynamic Systems
ECE 636-Computer Networking Laboratory
ECE 639-Principles of Broadband Networks
ECE 642-Communication Systems I
ECE 644-Intro. Wireless and Personal Comm. Systs.
ECE 673-Random Signal Analysis
ECE 677-Optimization Techniques
ECE 681-Broadband Packet Switches
ECE 685-Network Interface Design
ECE 742-Communication Systems II
ECE 783-Computer Communication Networks
CIS 630-Operating System Design
CIS 631-Data Management System Design
CIS 633-Distributed Systems
CIS 637-Real-Time Systems
CIS 654-Telecomm. Networks Performance Anal.
CIS 665-Algorithmic Graph Theory

VLSI System Design
Required:
ECE 658-VLSI Design I
ECE 758-VLSI Design II

Electives (15 to 18 credits):
ECE 605-Discrete Event Dynamic Systems
ECE 683-Computer Network Design and Analysis
ECE 650-Electronic Circuits
ECE 657-Semiconductor Devices
ECE 659-Fabric.Prin. Elec./Optoelec. Devices
ECE 783-Computer Comm. Networks
ECE 789-Design for Testability Principles
CIS 630-Operating System Design
CIS 631-Data Management System Design
CIS 641-Formal Languages and Automata
CIS 665-Algorithmic Graph Theory
IE 605-Engineering Reliability

Machine Vision Systems

Required:
ECE 601-Linear Systems *and* ECE 643-Digital Image Processing I *or*
CIS 659-Image Processing and Analysis *and* CIS 780-Computer Vision

Electives (15 to 18 credits):
ECE 605-Discrete Event Dynamic Systems
ECE 609-Artificial Neural Networks
ECE 640-Digital Signal Processing
ECE 783-Computer Communication Networks
ECE 785-Parallel Processing Systems
CIS 630-Operating System Design
CIS 631-Data Management System Design
CIS 657-Prin. of Interactive Computer Graphics
CIS 665-Algorithmic Graph Theory
CIS 670-Artificial Intelligence
CIS 672-Expert System Methods and Design
CIS 759-Advanced Image Processing and Analysis
IE 605-Engineering Reliability
ME 628-Machine Vision Principles and Applications

Computer Architecture and Systems

Required:
ECE 658-VLSI Design I
ECE 692- Embedded Computing Systems
Electives:
ECE 605-Discrete Event Dynamic Systems
ECE 609-Artificial Neural Networks
ECE 648-Digital Microelectronics
ECE 650-Electronic Circuits
ECE 657-Semiconductor Devices
ECE 683-Computer Network Design and Analysis
ECE 685-Network Interface Design
ECE 686-Instrumentation Sys. and Microprocessors
ECE 689-Digital Sys. Design for Machine Arithmetic
ECE 758-VLSI Design II
ECE 785-Parallel Processing Systems
ECE 789-112: Design for Testability Principles
CIS 630-Operating System Design
CIS 633-Distributed Systems
CIS 636-Compiling System Design
CIS 641-Formal Languages and Automata
CIS 661-Systems Simulation
CIS 665-Algorithmic Graph Theory
CIS 668-Parallel Algorithms

Other courses may be used as electives with the permission of MS CoE Program Advisor.

5. Master's Thesis

Before the end of the final term of thesis registration, a master's thesis committee, consisting of three (3) faculty members, will hear the student present his or her thesis in an open forum (thesis defense). At least two (2) members of the committee must be members of the ECE department. A typed version of the completed thesis should be available to the committee at least three (3) weeks before the oral defense is scheduled and an unbound copy of the thesis should be available in the Department Secretary's office (235 ECEC) three weeks before the defense. The final version is due in the library to meet graduation requirements by the date specified by the Office of Graduate Studies. Written notice of the presentation will be posted. Interested faculty and graduate students are invited to attend.

6. Research Opportunities

Computer engineering faculty research areas include

Computer networking
Multiprocessor system architecture
Parallel and distributed processing
Scheduling
Image processing
Neural networks and genetic algorithms
Infrared imaging
Discrete event system models and tools

Computer embedded control and intelligent automation
Robotics
VLSI design and micro-engineering
Computer-aided instruction
Fault-tolerant computing
Digital testability
Computer-aided design

VI.   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.

Admission Requirements

Applicants should have an undergraduate degree in Computer Engineering, Electrical Engineering or other relevant discipline from an accredited institution (or its equivalent). A minimum GPA of 3.0 on a 4.0 scale is required. These students should have taken EE321 (Random Signal and Noise), or another equivalent course; EE333 (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 (EE 333), basic communication systems (EE 481), programming (CIS 112 or C++ programming), data structures and algorithms (CIS 505), and computer organization (CoE 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.
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.

Core Courses (9 Credits):

ECE 637   Introduction to Internet Engineering
ECE 683   Computer Network Design and Analysis
CIS 602   Java Programming

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 636   Computer Networking Laboratory
ECE 638   Security & Network Management
ECE 639   Principles of Broadband Networks
ECE 649   Compression in Multimedia Engineering
ECE 645   Wireless Networks
ECE 673   Random Signal Analysis
ECE 681   Broadband Packet Switches
ECE 685   Computer Network Interface Design
ECE 783   Computer Communication Networks
ECE 745   Wireless Internet
ECE 738   Communications Network Routing
ECE 788   Selected Topics in Internet Engineering
CIS 604   Client/Server Computing

[†] Other (new) courses related to Internet Engineering may be selected as electives with approval from the Graduate Advisor.

Mgmt 620	Management of Technology
MIS 625	Internet for Managers
MIS 636	Telecommunications: Policies & Regulations

Project, Thesis (optional)

| ECE 700 | Master's Project in Internet Engineering (3 Credits) |
| ECE 701 | Master's Thesis in Internet Engineering (6 Credits) |

VII.   MASTER OF SCIENCE IN TELECOMMUNICATIONS

Offered by the Department of Electrical and Computer Engineering (ECE) and the Department of Computer and Information Science (CIS)

Graduate Advisors: ECE~Prof. Alex Haimovich, (973) 596-3534, e-mail haimovic@njit.edu
                      CIS~Prof. Dennis Karvelas, (973) 596-2987, e-mail karvelas@njit.edu

1. Admission Requirements

Students can apply for admission to the program through either the Department of Electrical and Computer Engineering or the Department of Computer and Information Science. All applicants must submit scores on the Graduate Record Examinations (GRE) verbal, quantitative, and analytical aptitude tests. 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. It is expected that these students have taken CIS 333, EE 321 and EE 333 (or their equivalents). Applicants having degrees in other fields will be considered for admission on an individual basis. These students will be required to complete a bridge program.

Bridge Program~The curriculum for the M.S. in Telecommunications requires a basic knowledge of computer fundamentals such as programming, data structures, computer architecture, signals and systems, and basic communication systems. Bridge courses do not count toward the degree. Completion of the preparatory courses with a 3.0 cumulative GPA or better is required for transfer to matriculated status. The bridge courses are selected from the following list depending on individual background.

EE 321-Random Signals and Noise*
EE 333-Circuits and Systems III*
EE 481-Communications Systems
CIS 251/EE 352/CoE 353-Computer Organization/Architecture/Microprocessors
CIS 332-Operating Systems
CIS 333-UNIX Operating Systems
CIS 505-C++ Data Structures

* EE 321 and EE 333 may be substituted with ECE 501, Linear Systems and Random Signals.

2. Degree Requirements

Candidates must complete a minimum of 30 credit hours of course work, with a minimum overall average of 3.0. In addition, a minimum 3.0 GPA is required in the 5 core courses indicated below. Students with an exceptionally strong telecommunications background may be allowed to replace required courses with advanced electives. Permission of the Graduate Advisor from the Department of Electrical and Computer Engineering or the Department of Computer and Information Science is required.

All master's students must register for two semesters of ECE 791 Graduate Seminar. Those with substantial professional experience may have this requirement waived. In order to receive passing credit, the student must attend at least five (5) seminars per semester, to be chosen from those sponsored by the areas, the ECE department, the Institute, or other outside seminars approved by the Seminar Supervisor. Please watch the bulletin board labeled *ECE 791 Graduate Seminar*, located in the hall leading to the ECE main office, for information on approved seminars.

3. Core Courses (15 credit hours):
ECE 642-Communication Systems I
ECE 644-Introduction to Wireless and Personal Communications Systems
CIS 630-Advanced Operating System Design
CIS 651-Data Communications
CIS 652-Comp. Network-Arch. Protocol Standards *or* ECE 683 Comp. Network Design & Analysis

4. Elective Courses (15 credit hours):
ECE 638/CIS 696-Networks Management and Security
ECE 639/CIS 697-Principles of Broadband ISDN and ATM
ECE 646-Introduction to Data Communication
ECE 673-Random Signal Analysis I
ECE 685-Network Interface Design
ECE/CIS 700-Project in Telecomm. (3 cr.) *or* ECE/CIS 701-Thesis in Telecomm. (6 cr.)
ECE 742-Communication Systems II
ECE 755-Digital Communications
ECE 757-Wireless Communications
ECE 783-Computer Communication Networks
ECE 785-Parallel Processing Systems
CIS 604-Introduction to Client-Server Computing
CIS 631-Data Management System Design I
CIS 633-Distributed Systems
CIS 637-Real-Time Systems
CIS 650-Computer Architecture *or* ECE 690 Computer Systems Architecture
CIS 654-Telecommunication Networks Performance Analysis
CIS 656-Internetworking and Higher Layer Protocols
CIS 658-Multimedia Systems *or* ECE 649 Compression in Multimedia Engineering
CIS 665-Algorithmic Graph Theory
CIS 668-Parallel Algorithms
CIS 679-Management of Computer and Information Systems
CIS 752-Communication Protocol Synthesis and Analysis
MIS 635-Management of Telecommunications
MIS 636-Telecommunications: Policies and Regulation

5. Areas of Specialization
The following areas of specialization are suggested, but are not the limit of possibilities. They are given
to provide a general framework for students.

Management and Administration:	ECE 638/CIS 696-Networks Management and Security
	CIS 679-Management of Computer and Information Systems
	MIS 635-Management of Telecommunications
	MIS 636-Telecommunications: Policies and Regulation
Communication Systems:	ECE 639/CIS 697-Principles of Broadband ISDN and ATM
	ECE 646-Introduction to Data Communication

ECE 649-Compression in Multimedia Engineering *or* CIS 658-Multimedia Systems
ECE 673-Random Signal Analysis I
ECE 685-Network Interface Design
ECE 742-Communications Systems II
ECE 755-Digital Communications
ECE 757-Wireless Communications

Networking: ECE 638/CIS 696-Networks Management and Security
ECE 639/CIS 697-Principles of Broadband ISDN and ATM
ECE 673-Random Signal Analysis
ECE 783-Computer Communication Networks
CIS 604-Introduction to Client-Server Computing
CIS 633-Distributed Systems
CIS 637-Real-Time Systems
CIS 650-Computer Architecture *or* ECE 690-Computer Sys. Architecture
CIS 654-Telecommunication Networks Performance Analysis
CIS 656-Internetworking and Higher Layer Protocols
CIS 665-Algorithmic Graph Theory

Information: CIS 604-Introduction to Client-Server Computing
CIS 631-Data Management Systems Design
 CIS 658-Multimedia Systems *or* ECE 649-Compression in Multimedia
 Engineering
CIS 696/ECE 638-Networks Management and Security

Other ECE/CIS courses related to telecommunications may be selected as electives with written approval from the appropriate department Graduate Advisor.

VIII.   DOCTOR OF PHILOSOPHY IN ELECTRICAL ENGINEERING

This program is intended for superior students with master's or bachelor's degrees in electrical engineering, computer engineering, computer science, or other related fields, who wish to pursue advanced research in electrical engineering.
During the first year of doctoral study, students should seek an academic faculty advisor in their area of concentration to advise on their program of study, including course registration and preparation for the qualifying examination. Students should also speak to area faculty to choose a research advisor and the research topic they will begin after passing the qualifying examination. The academic advisor and the research advisor could be the same person. Students can always visit the Associate Chair for Graduate Studies to discuss any issues regarding their program.

1. Degree Requirements
Requirements are determined in consultation with department advisors. Students holding a master's degree will require a minimum of 60 graduate credits beyond the master's degree. In addition to overall credit requirements, the program includes the following requirements.

- 24 credits of course work beyond the master's degree
- at least 12 credits of course work must be at the 700 level (excluding department core courses and other basic area courses).
- 500 level. ECE department core courses, ECE 601, ECE 620, ECE 673, and ECE 684, cannot be used to satisfy the 24-credit course requirement.
- In addition, the entry-level courses in the student's major area cannot be used to satisfy the 24-credit course requirement.
  The entry-level courses for each area are as follows:
  - Communications and Signal Processing: ECE 640 and ECE 642
  - Computer Architecture and Systems: ECE 684;
  - Computer Networking: ECE 683;
  - Intelligent Systems: ECE 660;
  - Solid State, VLSI and Electro-Optics Systems: ECE 657.
- No more than two independent study courses may be used to satisfy this requirement.

- 36 credits of doctoral dissertation research. With department approval, well-qualified students may register for up to a maximum of 9 credits of ECE 792 Pre-Doctoral Research before completing the qualifying examination. A maximum of 6 credits of ECE 792 may be applied toward ECE 790.

- All doctoral students must register for six semesters of ECE 791 Graduate Seminar. In order to receive passing credit, the student must attend at least five (5) seminars per semester, to be chosen from those sponsored by the areas, the ECE department, the Institute, or other outside seminars approved by the Seminar Supervisor. Please watch the bulletin board labeled *ECE 791 Graduate Seminar*, located in the hall leading to the ECE main office, for information on approved seminars.

- Students who wish to change majors may do so only once. If students receiving ECE department financial support wish to change majors, their applications for financial aid will be re-evaluated, at the time of switching, as if they were new applicants.

B.S. to Ph.D. Program

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, plus an interview with the ECE department Graduate Studies Committee. Students in this program must complete a total of 87 credits, consisting of 51 course credits and 36 dissertation research credits. At least 12 course credits must be at the 700 level.

2. Qualifying Examination

Full-time students must <u>take the qualifying exam for the first time within one year of beginning active study</u> and <u>must pass it completely by the next time</u> it is offered. Part-time students must take the qualifying exam 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. For students admitted into the Ph.D. program at the B.S. level, the qualifying examination must be taken within one and one half years of admission and must be passed within two years. Students are only permitted to take the examination twice. The passage of the qualifying examinations is reported to the Office of Graduate Studies.

<u>The doctoral qualifying examination currently consists of two portions.</u>

- The **major examination** is taken by the student on a single day and covers predefined subjects in the student's major area of study.
- The **minor area requirement** is satisfied when the student has received grades of B or better in two predefined courses for the chosen minor area.

(*Please, see the Qualifying Examination brochure for more information.*)

3. Doctoral Candidacy

Students become doctoral candidates when they pass the qualifying examination. Status as a doctoral candidate does not imply candidacy for the degree. Registration for doctoral research is permitted only to doctoral candidates. Doctoral students who are not yet doctoral candidates may register for pre-doctoral research.

4. Dissertation Committee

A dissertation committee must be formed within twelve months after passing the qualifying examination. The dissertation committee must be approved by the ECE department Graduate Affairs Committee at the time of its formation and before the presentation of the research proposal. The dissertation committee chairperson typically is the doctoral candidate's program advisor, but other faculty may be selected, provided that they are from the ECE department. The committee consists of a minimum of five members, one of whom is external to the ECE department or to NJIT, and at least three of whom are members of the ECE department. The dissertation advisor must be a tenure-track or tenured faculty member at NJIT. If the dissertation advisor is an ECE department faculty member, then the chair of the student's dissertation committee may be any tenure-track or tenured faculty member in the ECE department at NJIT. If the dissertation advisor is not a member of the ECE department at NJIT, then the chair of the student's dissertation committee must be a tenured faculty member in the ECE department at NJIT. If the dissertation advisor is not an ECE department faculty member, there must be a co-advisor who is a tenure-track or tenured faculty member in the ECE department at NJIT.

5. Research Proposal

Doctoral candidates must prepare a written research proposal for approval by their dissertation committee. The proposal must be presented after formation of the committee but within twelve months after passing the qualifying exam. The proposal should show that facilities are available to do the work. 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 these criteria and is approved by the dissertation committee. The research proposal would normally include title and goal of the proposed dissertation; a detailed discussion of background material, including a literature search; a summary of work accomplished to date; a statement of how the residency requirement will be met; and a proposed time table for completion of research.

6. Residency

Doctoral candidates must spend at least one academic year in full-time residence (defined as full-time registration for two consecutive semesters). This requirement is sometimes waived with the approval of the dissertation committee and the Office of Graduate Studies. Such waivers are granted when a candidate's dissertation research requires use of research facilities at an approved off-campus site.

7. Dissertation and Defense

A dissertation should demonstrate original research that contributes to knowledge in the field. The dissertation should result in scholarly publication and must be defended in a publicly-announced oral defense. A typed version of the completed dissertation should be available to the committee at least three (3) weeks before the oral defense is scheduled and an unbound copy of the thesis should be available in the Department Secretary's office (235 ECEC) three weeks before the 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. In regard to format, the standard reference is the latest edition of the Estrin/Roche manual *Guidelines for Scientific and Professional Theses*. The Office of Graduate Studies policies on number of copies, deadlines, and submission of dissertation and abstracts are also to be followed. Every member of the dissertation committee must sign the approval page of the final dissertation document. Students cannot be certified by the ECE department for the doctoral degree until the student submits **at least one paper for publication in a peer-reviewed journal** deemed of acceptable quality by the dissertation advisor.

8. Grade Point Average

In order to obtain the Doctor of Philosophy degree, candidates must achieve a cumulative grade point average of at least 3.0 in all graduate courses. The 3.0 minimum does not include the grade assigned for completion of the doctoral dissertation. Completion of the dissertation and its defense will be assigned a grade of P for "Passing." The P grade is for dissertation credits taken in the student's final semester.

9. ECE Department Financial Support for Doctoral Students

Doctoral students who are receiving financial support (GA or TA) from the ECE department must adhere to the following policies.

At the completion of the first year of support, the student must submit a progress report to the ECE department Doctoral Studies Committee indicating progress in courses, research, and qualifying examinations. In addition, the student's dissertation advisor must write a request for continued financial support.

Support after the second year is contingent upon satisfying the requirements for qualifying exams, committee formation, and proposal presentation as defined on pages 26 and 27 of this document.

Support for the fourth year, which must be the last year for a TA or GA, will be granted if the student is assured to successfully graduate after this period.

Students who wish to apply for financial aid must be recommended by a faculty member who will submit a letter to the chair of the ECE Graduate Affairs Committee on behalf of the doctoral student. Preference is given to students who have passed the qualifying examination.

IX.   DOCTOR OF PHILOSOPHY IN COMPUTER ENGINEERING

This program is intended for superior students with master's or bachelor's degrees in computer engineering, computer science, electrical engineering, or other related fields, who wish to pursue advanced research in computer engineering.

During the first year of doctoral study, students should seek an academic faculty advisor in their area of concentration to advise on their program of study, including course registration and preparation for the qualifying examination. Students should also speak to area faculty to choose a research advisor and the research topic they will begin after passing the qualifying examination. The academic advisor and the research advisor could be the same person. Students can always visit theAssociate Chair for Graduate Studies to discuss any issues regarding their program.

1. Admission Requirements
Applicants are expected to have a master's degree in computer engineering, computer science, electrical engineering, or other related fields.

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, plus an interview with the ECE department Graduate Affairs Committee.

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. Foreign students must also achieve a minimum TOEFL score of 550.

Students who lack an appropriate background will be required to take additional bridge courses that cannot be applied as degree credits.

2. Degree Requirements
Requirements are determined in consultation with department advisors. Students holding a master's degree will require a minimum of 60 graduate credits beyond the master's degree. In addition to overall credit requirements, the program includes the following requirements.

- 24 credits of course work beyond the master's degree
- at least 12 credits of course work must be at the 700 level (excluding department core courses and other basic area courses).
- 500 level. ECE department core courses, ECE 601, ECE 620, ECE 673, and ECE 684, cannot be used to satisfy the 24-credit course requirement.
- In addition, the entry-level courses in the student's major area cannot be used to satisfy the 24-credit course requirement.
  The entry-level courses for each area are as follows:
  - Communications and Signal Processing: ECE 640 and ECE 642
  - Computer Architecture and Systems: ECE 684;
  - Computer Networking: ECE 683;
  - Intelligent Systems: ECE 660;
  - Solid State, VLSI and Electro-Optics Systems: ECE 657.
- No more than two independent study courses may be used to satisfy this requirement.

- 36 credits of doctoral dissertation research. With department approval, well-qualified students may register for up to a maximum of 9 credits of ECE 792 Pre-Doctoral Research before completing the qualifying examination. A maximum of 6 credits of ECE 792 may be applied toward ECE 790.

- All doctoral students must register for <u>six semesters of ECE 791 Graduate Seminar</u>. In order to receive passing credit, <u>the student must attend at least five (5) seminars per semester</u>, to be chosen from those sponsored by the areas, the ECE department, the Institute, or other outside seminars approved by the Seminar Supervisor. Please watch the bulletin board labeled *ECE 791 Graduate Seminar*, located in the hall leading to the ECE main office, for information on approved seminars.

- Students who wish to <u>change majors</u> may do so only once. If students receiving ECE department financial support wish to change majors, their applications for financial aid will be re-evaluated, at the time of switching, as if they were new applicants.

3. Qualifying Examination

Full-time students must take the qualifying exam for the first time within one year of beginning active study and must pass it completely by the next time it is offered. Part-time students must take the qualifying exam 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. For students admitted into the Ph.D. program at the B.S. level, the qualifying exam must be taken within one and one-half years of admission and must be passed within two years. Students are only permitted to take the examination twice. The passage of the qualifying examinations is reported to the Office of Graduate Studies.

4. Doctoral Candidacy

Students become doctoral candidates when they pass the qualifying examination. Status as a doctoral candidate does not imply candidacy for the degree. Registration for doctoral research is permitted only to doctoral candidates. Doctoral students who are not yet doctoral candidates may register for pre-doctoral research.

5. Dissertation Committee

A dissertation committee must be formed within twelve months after passing the qualifying examination. The dissertation committee must be approved by the ECE department Graduate Affairs Committee at the time of its formation and before the presentation of the research proposal. The dissertation committee chairperson typically is the doctoral candidate's program advisor, but other faculty may be selected, provided that they are from the ECE department. The committee consists of a minimum of five members, one of whom is external to the ECE department or to NJIT, and at least three of whom are members of the ECE department. The dissertation advisor must be a tenure-track or tenured faculty member at NJIT. If the dissertation advisor is an ECE department faculty member, then the chair of the student's dissertation committee may be any tenure-track or tenured faculty member in the ECE department at NJIT. If the dissertation advisor is not a member of the ECE department at NJIT, then the chair of the student's dissertation committee must be a tenured faculty member in the ECE department at NJIT. If the dissertation advisor is not an ECE department faculty member, there must be a co-advisor who is a tenure-track or tenured faculty member in the ECE department at NJIT.

6. Research Proposal

Doctoral candidates must prepare a written research proposal for approval by their dissertation committee. The proposal must be presented after formation of the committee but within twelve months after passing the qualifying exam. The proposal should show that facilities are available to do the work. 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 these criteria and is approved

by the dissertation committee. The research proposal would normally include title and goal of the proposed dissertation; a detailed discussion of background material, including a literature search; a summary of work accomplished to date; a statement of how the residency requirement will be met; and a proposed time table for completion of research.

7. Residency
Doctoral candidates must spend at least one academic year in full-time residence (defined as full-time registration for two consecutive semesters). This requirement is sometimes waived with the approval of the dissertation committee and the Office of Graduate Studies. Such waivers are granted when a candidate's dissertation research requires use of research facilities at an approved off-campus site.

8. Dissertation and Defense
A dissertation should demonstrate original research that contributes to knowledge in the field. The dissertation should result in scholarly publication and must be defended in a publicly-announced oral defense. A typed version of the completed dissertation should be available to the committee at least three (3) weeks before the oral defense is scheduled and an unbound copy of the thesis should be available in the Department Secretary's office (235 ECEC) three weeks before the 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. In regard to format, the standard reference is the latest edition of the Estrin/Roche manual *Guidelines for Scientific and Professional Theses*. The Office of Graduate Studies policies on number of copies, deadlines, and submission of dissertation and abstracts are also to be followed. Every member of the dissertation committee must sign the approval page of the final dissertation document. Students cannot be certified by the ECE department for the doctoral degree until the student submits **at least one paper for publication in a peer-reviewed journal** deemed of acceptable quality by the dissertation advisor.

9. Grade Point Average
In order to obtain the Doctor of Philosophy degree, candidates must achieve a cumulative grade point average of at least 3.0 in all graduate courses. The 3.0 minimum does not include the grade assigned for completion of the doctoral dissertation. Completion of the dissertation and its defense will be assigned a grade of P for "Passing." The P grade is for dissertation credits taken in the student's final semester.

10. ECE Department Financial Support for Doctoral Students
Doctoral students who are receiving financial support (GA or TA) from the ECE department must adhere to the following policies.

At the completion of the first year of support, the student must submit a progress report to the ECE department Graduate Affairs Committee indicating progress in courses, research, and qualifying examinations. In addition, the student's dissertation advisor must write a request for continued financial support.

Support after the second year is contingent upon satisfying the requirements for qualifying exams, committee formation, and proposal presentation as defined on pages 30 and 31 of this document.

Support for the fourth year, which must be the last year for a TA or GA, will be granted if the student is assured to successfully graduate after this period.

Students who wish to apply for financial aid must be recommended by a faculty member who will submit a letter to the chair of the ECE Graduate Affairs committee on behalf of the doctoral student. Preference is given to students who have passed the qualifying examination.

X. FACULTY RESEARCH AREAS/INTERESTS

Ali N. Akansu
(Communications and
Signal Processing)

Signal and transform theories and applications in multimedia and digital communications, multimedia networks and internet engineering.

Nirwan Ansari
(Communications and
Signal Processing)

Broadband and high speed networks, wireless ATM, distributed and adaptive detection in CDMA, computational intelligence, nonlinear signal processing.

Yeheskel Bar-Ness
(Communications and
Signal Processing)

Adaptive signal processing, array processing and interference cancelers, fast adaptive algorithms, co-channel interference cancellation for mobile communication, coherent communication and phase locked loop application, source encoding for data compression.

John Carpinelli
(Computer Systems)

Interconnection networks, multiprocessor system design, computer architecture, educational computing, distance learning, collaborative filtering.

Bill Carr
(Solid State)

Micro-engineering, solid state device design and simulation, microelectronics processing and fabrication, VLSI design and circuit analysis, mems, sensors, micromachines, micro-actuators, smart sensors, microtransducers, BAA, CRDA.

Timothy Chang
(Control Systems)

Large-scale system theory, real-time computer control, distributed and resonant systems, control, robotics, and precision systems.

Edwin Cohen
(Power)

Maximum power import into an electric power network, load flow algorithms for radial power networks.

Roy Cornely
(Solid State)

Thin film materials and devices, design and fabrication of micro-sized 3-D structures for optoelectronic packaging and other applications, micromechanical photonic devices in silicon.

Peter Engler
analysis
(Biomedical)

Clinical applications of heart-rate variability, development of telemedicine,

of cell-membrane ion-channel currents.

Joseph Frank
(Communications and
Signal Processing)

Spread-spectrum techniques, digital data transmission, detection and estimation, delta modulation, digital signal processing, digital filter design.

Bernard Friedland
(Control Systems)

Control theory, especially methods for control of linear and nonlinear systems with data sources of multiple types; applications to friction modeling, compensation, and traction control; rapid thermal processing; robotic vehicle navigation and control.

Hongya Ge
(Communications and
Signal Processing)

Statistical and digital signal processing, detection theory, estimation theory, communications, numerical analysis, approximation theory.

Haim Grebel
(Microwave/Lightwave,
Solid State)

Integrated optical waveguides, optical devices and systems, laser processing of semiconductor materials.

Richard A. Haddad
(Communications and
Signal Processing)

QMF-wavelet filter realizations, properties, extensions, and implementation of Binomial Hermite filters for parallel processing; adaptive subband signal coding using variable tree structures; time-frequency localization and quantization effects in M-band structures; rank-order filters; special purpose adaptive subband filters; enhanced DCT algorithms.

Alex Haimovich
(Communications and
Signal Processing)

Adaptive signal processing for interference rejection in wireless communications, signal processing for personal communications systems, smart antennas for cellular wireless systems, adaptive signal processing for radar.

Edwin Hou
(Computer Systems)

Genetic algorithms, infrared imaging, robotics, neural networks.

Walid Hubbi
(Power)

Power system analysis and power electronics.

Jacob Klapper
(Communications and
Signal Processing)

Phase-locked loops, principles and applications; noise in FM systems.

Marshall Kuo
(Control Systems)

Optimal control, differential games.

Raashid Malik
(Computer Systems)

Computer vision, object recognition, pattern recognition, scene analysis, image processing.

C.N. Manikopoulos
(Computer Systems)

Neural networks, computer networks, computer vision.

Andrew Meyer
(Control Systems,
Biomedical)

Biomedical system dynamics, modeling and control, nonlinear control systems.

Durga Misra
(Solid State,
Computer Systems)

VLSI design/processing, micro-engineering, integrated sensors, semiconductor devices.

Edip Niver
(Microwave/Lightwave)

Wave propagation in homogeneous media, microwave device modeling and measurement, numerical methods, CAD of microwave components and systems, characterization in R/F optical systems.

S. Papavassiliou
(Computer Systems)

Computer and communication networks, especially wireless communications and high-speed networks, network design and management, TCP/IP and internetworking, mobile ad-hoc networks, resource allocation and management, computer network modeling and performance evaluation, optimization of stochastic systems.

Stanley Reisman
(Biomedical)

Biomedical systems modeling and signal processing in the endocrine, cardiovascular and nervous systems; rehabilitation engineering.

Sol Rosenstark
(Computer Systems)

Interconnection of high-speed digital circuits, feedback amplifiers.

Jacob Savir
(Computer Systems)

VLSI design for testability, test generation, fault simulation, computer-aided design, built-in self-test, data compression for test purposes, fault diagnosis, delay test.

Yun-Qing Shi
(Communications and Signal Processing)

Multidimensional systems and signal processing, computer vision image (sequence) processing, video coding, pattern recognition, infrared machine vision, applications in industrial automation and biomedical engineering.

Kenneth Sohn
(Solid State)

Superconductors/superconducting devices, solid-state devices.

Marek Sosnowski
(Solid State)

Materials and structures for micro-electronic and optoelectronic applications, thin film deposition, ion beam modification of materials.

Joseph Strano
(Biomedical,
Control Systems)

Biomedical systems, simulation, instrumentation.

Sirin Tekinay
(Communications and Signal Processing)

Telecommunication networks; wireless and multimedia networks: RF environment modeling, wireless geolocation, teletraffic modeling, resource allocation, mobility management, information handling algorithms, capacity and performance analyses, queuing models, signaling, analysis of algorithms, database systems.

Gary Thomas
(Solid State)

Electronic materials and devices, and multimedia in educational systems.

Gerald Whitman
(Microwave/Lightwave)

Radiation, propagation and scattering of electromagnetic waves; specific applications include scattering from periodic and random rough surfaces; guidance and radiation from integrated dielectric structures; multiscattering in random media (vegetation) using transport theory; indoor radiowave propagation; transients in dispersive media; ray optics; quasi-optical resonators.

MengChu Zhou
(Computer Systems,
Control Systems)

Discrete event systems, petri nets, computer networks, intelligent automation, computer-integrated manufacturing, multilifecycle engineering, embedded control, robotics, computational methods, flat-panel display.

Sotirios Ziavras
(Computer Systems)

Parallel processing architecture and algorithms, supercomputing and massively-parallel systems, image processing and computer vision, systems modeling and performance evaluation.

NJIT

STUDY PLAN FOR MASTER OF SCIENCE IN COMPUTER ENGINEERING

USE OF THIS FORM: to be completed by the student and approved by the Director of Computer Engineering Programs.

NAME OF STUDENT:_____
LAST   FIRST
NJIT I.D. OR SOCIAL SECURITY #:_____

AREA OF CONCENTRATION   ○ Microprocessor-based systems   Semester Admitted: _____

○ Parallel computing systems   Revision #: _____

○ Computer networking   Date: _____

○ VLSI system design   Approved by: _____

○ Machine vision systems

	Course	Semester	Grade
Required Courses	**ECE 690**		
	CIS 610		
Project/thesis	**ECE 70**		
Area Required Courses			
Elective Courses			
Required Bridge Courses			
Non-degree Courses			

STUDENT SIGNATURE:_____ DATE:_____

DIRECTOR OF COE PROGRAMS APPROVAL SIGNATURE: _____ DATE:_____

NJIT
New Jersey Institute of Technology

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ECE M.S. THESIS DEFENSE REPORT

USE OF THIS FORM: This form must be completed by the Thesis Committee Chair, approved by the ECE Associate Chair for Graduate Studies immediately after the defense, and submitted to the Office of Graduate Studies.

M.S. PROGRAM:_____

NAME OF M.S. STUDENT:_____
                                   LAST   FIRST

NJIT I.D. OR SOCIAL SECURITY #:_____

FINAL TITLE OF THESIS:_____

_____

DATE OF DEFENSE:_____

NAME, FACULTY RANK, DEPARTMENT/AFFILIATION OF THESIS COMMITTEE CHAIR:

_____, _____, _____, _____
NAME   RANK   DEPARTMENT/AFFILIATION   SIGNATURE/DATE

NAME, FACULTY RANK, DEPARTMENT/AFFILIATION OF COMMITTEE MEMBERS:

NAME   RANK   DEPARTMENT/AFFILIATION   SIGNATURE/DATE

_____, _____, _____, _____

_____, _____, _____, _____

_____, _____, _____, _____

RESULTS OF DEFENSE: PASS _____   FAIL _____

CONDITIONS/COMMENTS:_____

SIGNATURE OF THESIS COMMITTEE CHAIR:_____ DATE:_____

SIGNATURE OF ECE ASSOCIATE CHAIR FOR GRADUATE STUDIES:_____ DATE:_____

RECEIVED BY OFFICE OF GRADUATE STUDIES:_____ DATE:_____

NJIT

New Jersey Institute of Technology

ECE Ph.D. DISSERTATION COMMITTEE APPOINTMENT REPORT

USE OF THIS FORM: This form is completed upon formation of the Ph.D. dissertation committee. <u>It must be accompanied by a short abstract of the proposed dissertation</u>. The committee must be formed within 12 months after passage of the qualifying examination. The policy for committee formation is described in the latest ECE *Handbook for Graduate Students.*

Ph.D. PROGRAM:_____

NAME OF DOCTORAL CANDIDATE:_____
                                                                LAST   FIRST

NJIT I.D. OR SOCIAL SECURITY #:_____

PRELIMINARY TITLE OF DISSERTATION:_____

_____

NAME, FACULTY RANK, DEPARTMENT/AFFILIATION OF DISSERTATION COMMITTEE CHAIR:

_____, _____, _____, _____
NAME   RANK   DEPARTMENT/AFFILIATION   SIGNATURE/DATE

NAME, FACULTY RANK, DEPARTMENT/AFFILIATION OF COMMITTEE MEMBERS:

NAME   RANK   DEPARTMENT/AFFILIATION   SIGNATURE/DATE

_____, _____, _____, _____

_____, _____, _____, _____

_____, _____, _____, _____

_____, _____, _____, _____

_____, _____, _____, _____

_____, _____, _____, _____

DOCTORAL PROGRAMS COORDINATOR APPROVAL SIGNATURE:_____ DATE:_____

DEPARTMENT CHAIR APPROVAL SIGNATURE:_____ DATE:_____

RECEIVED BY OFFICE OF GRADUATE STUDIES:_____ DATE:_____

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ECE Ph.D. DISSERTATION *PROPOSAL* DEFENSE REPORT

USE OF THIS FORM: This form must be completed by the Dissertation Advisor immediately after the proposal presentation, and it must be approved by the Doctoral Programs Coordinator before being submitted to the Office of Graduate Studies.

Ph.D. PROGRAM:_____

NAME OF DOCTORAL CANDIDATE:_____
                                                        LAST   FIRST

NJIT I.D. OR SOCIAL SECURITY #:_____

PROPOSED TITLE OF DISSERTATION:_____

_____

DATE OF PROPOSAL DEFENSE:_____

DISSERTATION ADVISOR(S):_____

_____

MEMBERS OF DISSERTATION COMMITTEE AT PROPOSAL DEFENSE:

_____

_____

_____

_____

_____

RESULTS OF DEFENSE: PASS _____   FAIL _____

CONDITIONS/COMMENTS:_____

DISSERTATION ADVISOR APPROVAL SIGNATURE:_____ DATE:_____

DOCTORAL PROGRAMS COORDINATOR APPROVAL SIGNATURE:_____DATE:_____

DEPARTMENT CHAIR APPROVAL SIGNATURE:_____ DATE:_____

RECEIVED BY OFFICE OF GRADUATE STUDIES:_____ DATE:_____

NJIT

New Jersey Institute of Technology

ECE Ph.D. DISSERTATION DEFENSE REPORT

USE OF THIS FORM: This form must be completed by either the Dissertation Committee Chair or the Doctoral Programs Coordinator immediately after the defense and submitted to the Office of Graduate Studies.

Ph.D. PROGRAM:_____

NAME OF DOCTORAL CANDIDATE:_____

                                    LAST   FIRST

NJIT I.D. OR SOCIAL SECURITY #:_____

FINAL TITLE OF DISSERTATION:_____

_____

DATE OF DEFENSE:_____

DISSERTATION ADVISOR(S):_____

                        _____

MEMBERS OF DISSERTATION COMMITTEE AT DEFENSE:

                        _____

                        _____

                        _____

                        _____

                        _____

RESULTS OF DEFENSE: PASS _____   FAIL _____

CONDITIONS/COMMENTS:_____

DISSERTATION ADVISOR APPROVAL SIGNATURE:_____ DATE:_____

DOCTORAL PROGRAMS COORDINATOR APPROVAL SIGNATURE:_____DATE:_____

DEPARTMENT CHAIR APPROVAL SIGNATURE:_____ DATE:_____

RECEIVED BY OFFICE OF GRADUATE STUDIES:_____ DATE:_____