Stony Brook University

Graduate Student Guide

Department of Electrical & Computer Engineering

Fall 2014

Note: All Electrical & Computer Engineering graduate students will be expected to read this guide before consulting academic advisors.

CONTENTS

INTRODUCTION

This *Guide* has been written to provide general information to graduate students in the Department of Electrical and Computer Engineering. It is intended to give some assistance and guidance to students regarding routine and other procedures involved in the pursuit of their program. This *Guide* is intended to be an informal one. It supplements, but does not replace, the official University *Graduate Bulletin* as a source of information.

The choice of a program to a large degree is the responsibility of the student. The members of the graduate committee are available for consultation on any point in this *Guide* that may be unclear to the student. Students may undertake an independent project under the direction of a faculty member, who often becomes the student's best source of advice on professional, academic, and financial support matters. Students should select their research advisor only after a careful canvass among the professors in their field of interests.

August 2014

GRADUATE PROGRAMS

M.S. AND PH.D. DEGREES

The Department offers graduate programs leading to the M.S. and Ph.D. Degrees in Electrical or Computer Engineering. Graduate Programs are tailored to the needs of each student so as to provide a strong analytical background helpful to the study of advanced engineering problems. Ample opportunities exist for students to initiate independent study and to become involved in active research programs, both experimental and theoretical.

CHANGE OF MAJOR POLICY

A change of major from Electrical Engineering to Computer Engineering or vice versa will only be permitted once in a student's graduate career, (provided the student meets degree requirements and retains department approval). Students cannot return to their original major once they have completed the change.

AREAS OF EMPHASIS

Areas of emphasis in current research and instruction are:

(1) Communications & Signal Processing
(2) Computer Engineering
(3) Semiconductor Devices and Quantum Electronics
(4) Circuits and VLSI

Specialties that fall under one or more of the above categories include: VLSI, Image Processing, Computer Vision, Integrated Circuit Fabrication, Novel Electronic Devices, Digital Communication, Biomedical Electronics, Computer-Aided Design, Computer Networks, Parallel Processing, Fault-Tolerant Computing, Microprocessors, Robotics, Network Theory, and Optical Signal Processing and Fiber Optic Sensors. Theoretical and experimental programs reflecting these areas are currently underway and students are encouraged to actively participate in these efforts. Outlined below is an overview of the Department's research areas.

COMMUNICATIONS AND SIGNAL PROCESSING

Subject areas of current interest include mobile, wireless and personal communications; high speed data and computer communication networks; communications traffic; data compression; coding and modulation techniques; inter-connection networks and high speed packet switching; digital communication; detection and estimation; statistical signal processing; spectrum estimation; image analysis and processing; computer vision.

COMPUTER ENGINEERING

The goal of computer engineering in the ECE department is to provide a balance view of hardware and software issues. The expertise in the program include parallel and/or high performance computer architecture, embedded microprocessor system design, fault tolerant computing, design communications and signal processing, parallel and distributed computing, computer networks, computer vision, artificial neural networks and software engineering.

SEMICONDUCTORS DEVICES, QUANTUM ELECTRONICS

The program of courses and of research pertinent to solid-state electronics, electromagnetics and optics ranges from a study of the fundamental electronic processes in solids and gases through a description of the mechanism which yield useful devices to a study of the design simulation, and fabrication of integrated circuits. The program's scientific interests center on physics, characterization and development of optoelectronic devices and systems. Over the past several years, major efforts were focused on the studies of physics of semiconductor lasers and detectors. Additionally, the department has a strong experimental effort on the development of coherent optical processors, fiber optic sensors and integrated fiber optics.

CIRCUITS AND VLSI

The program in the Circuits and VLSI area addresses problems associated to modeling, simulation, design and fabrication of analog, digital, and mixed-signal integrated circuits. Analog and mixed-mode integrated circuit (IC) devices have important applications in many fields including avionics, space technology, and medical technology. The department offers basic and advanced courses covering the following subjects: integrated circuit technology, device modeling, software tools for circuit design and simulation, analog circuit design, VLSI circuits, testing of analog and digital ICs, design automation for analog, digital and mixed-mode circuits, VLSI systems for communications and signal processing.

RELATIONS WITH INDUSTRY

The Department has joint efforts and close contact with many industrial firms. Areas include: VLSI, CAD, Controls, Digital Signal Processing, Telecommunications, Fiber Optic Sensors and Engineering Education.

ELECTRICAL ENGINEERING

ELECTRICAL ENGINEERING DEGREE REQUIREMENTS

I. M.S. in *Electrical Engineering* NON-THESIS OPTION

Please Note: Full-time M.S. students typically finish the Master's Degree in three (3) semesters.

Any Non-ESE course will need prior approval given by the Graduate Program Director before a student can register. **(approval form found on ECE website)**

(1) At least 30 graduate credits with a cumulative and departmental grade point average of 3.0 or better. Among these 30 credits, up to six credits may be ESE 597, ESE 599, or ESE 698 **PLEASE NOTE: Only 3 credits of ESE 698 may be used in above.**

(2) A minimum of eight (8) regular courses. Of these eight, at least seven (7) regular courses must be taken in the department (see above note about Non-ESE courses). Three of the seven regular courses must be selected from the following **CORE Courses**: ESE 502, ESE 503, ESE 511, ESE 520, **ESE 528 OR ESE 532**, ESE 545, ESE 554 and ESE 555.

(3) ESE 597, ESE 599, ESE 697, ESE 698 and ESE 699 are **not** counted as regular courses in (2). Also our Topics course, ESE 670, can be counted only once as a regular course credit toward the M.S. degree. Credits for ESE 597 can only be applied toward the electrical engineering degree if the following requirements are satisfied:

Prior approval from the Graduate Program Director based on the student submitting a proposal and securing an advisor in the ECE department as well as a contact person at the company involved. Approval will only be granted if it can be demonstrated that the faculty advisor will be kept in close touch with work on the project. To this end, practicum not in the local geographic area will be discouraged.

To obtain satisfactory credit the faculty advisor must verify that a substantial engineering project was undertaken and completed. This will be based on his close contact during the entire period of the project with the student and the contact person and upon reviewing a mandatory written report submitted by the student at the project's completion. The faculty advisor will determine the final grade for the course.

One credit of ESE 597 is required to fulfill the master's degree requirements. A maximum of three credits in ESE 597 may be applied towards the master's degree in electrical or computer engineering. CPT will be approved one time and can be taken during the summer or the academic year. Extensions of CPT will not be granted. ESE 599, ESE 699 and ESE 698 can be used to replace ESE 597 with the approval of the Graduate Program Director.

A candidate for the master's degree may petition to transfer a maximum of 12 graduate credits from another institution towards the master's degree requirements. Students transferring from non-matriculated status are also limited to a maximum of 12 credits for the master's degree.

II. M.S. in *Electrical Engineering* <u>THESIS</u> OPTION – Students must inform the department if they will do a master's thesis by the end of their FIRST semester.

Please Note: Full-time M.S. students typically finish the Master's Degree in <u>three</u> (3) semesters.

Any Non-ESE course will need prior approval given by the Graduate Program Director <u>before</u> a student can register. (approval form found on ECE website)

(1) At least 30 graduate credits with a cumulative and departmental grade point average of 3.0 or better. Among these 30 credits, <u>at least six credits</u> of ESE 599, with a maximum of 12 credits total being taken from ESE 599, ESE 597 or ESE 698.
<u>PLEASE NOTE:</u> Only 3 credits of ESE 698 may be used in above.

(2) Minimum of six (6) regular courses. Of these six, at least five (5) regular courses must be taken in the department (see above note about Non-ESE courses). <u>Three</u> of the five regular courses must be selected from the following **CORE Courses**: ESE 502, ESE 503, ESE 511, ESE 520, **ESE 528 OR ESE 532**, ESE 545, ESE 554 and ESE 555.

(3) ESE 597, ESE 599, ESE 697, ESE 698 and ESE 699 are **<u>not</u>** counted as regular courses in (2). Also our Topics course, ESE 670, can be counted only once as a regular course credit toward the M.S. degree. Credits for ESE 597 can only be applied toward the electrical engineering degree if the following requirements are satisfied:

Prior approval from the Graduate Program Director based on the student submitting a proposal and securing an advisor in the ECE department as well as a contact person at the company involved. Approval will only be granted if it can be demonstrated that the faculty advisor will be kept in close touch with work on the project. To this end, practicum not in the local geographic area will be discouraged.

To obtain satisfactory credit the faculty advisor must verify that a substantial engineering project was undertaken and completed. This will be based on his close contact during the entire period of the project with the student and the contact person and upon reviewing a mandatory written report submitted by the student at the project's completion. The faculty advisor will determine the final grade for the course.

<u>One credit of ESE 597 is required to fulfill the master's degree requirements.</u> A maximum of three credits in ESE 597 may be applied towards the master's degree in electrical or computer engineering. CPT will be approved one time and can be taken during the summer or the academic year. Extensions of CPT will not be granted. ESE 599, ESE 699 and ESE 698 can be used to replace ESE 597 with the approval of the Graduate Program Director.

In compliance with Graduate School guidelines, Master's Thesis students are expected to have **<u>two</u>** (2) readers from the department approve their thesis. Students will need to request the signature page from the Graduate Program Coordinator. **(Information and request form found on the ECE website)**

A candidate for the master's degree may petition to transfer a maximum of <u>12</u> graduate credits from another institution towards the master's degree requirements. Students transferring from non-matriculated status are also limited to a maximum of 12 credits for master's degrees.

III. Ph.D. DEGREE in *Electrical Engineering*

(1) Passing a **MAJOR** area (written) Qualifying Examination.

(2) Completion of three (3) courses in order to fulfill a **MINOR** area, these courses must be in a different area than the major.

(3) One year residency (two consecutive semesters of full time graduate study.)

(4) Six regular courses beyond the Master's degree **OR** fourteen regular courses above the Bachelor's degree PLUS **ESE 697 (3 credits) is required once G5 classification status is attained**. The choice of courses must have the prior approval of the designated faculty academic advisor. The courses ESE 597, ESE 599, ESE 697, ESE 698 and ESE 699 are NOT counted as regular courses. Courses presented under the title ESE 670 - Topics in Electrical Engineering, that have different subject matters, and are offered as formal lecture courses, are considered as regular courses but may not be counted more than once as a regular course for credit toward the Master's degree, and not more than twice, in total, for all graduate degrees awarded by the Department of Electrical & Computer Engineering.

(5) The student must satisfy the stipulations of a plan of study, which must be filed with the Graduate Program Committee within six months after the student passes the qualifying examination. The study plan, which will include the six regular courses, as required in item 4, will be developed under the aegis of the designated faculty advisor (who may or may not be the eventual thesis advisor). Modification of the study plan may be made by the preliminary examination committee and at any later time by the thesis advisor. An up-to-date plan must always be placed on file with the Graduate Program Committee each time a modification is made.

(6) Passing the Preliminary Examination not more than **3 years** after passing the Qualifying Examination. Both a thesis topic and the thesis background area are emphasized. All courses must be satisfactorily completed prior to taking the Preliminary Exam.

(7) Satisfactory completion of a dissertation (normally in four years after passing the Qualifying Examination).

POLICIES REGARDING THE QUALIFYING EXAMINATION: *Electrical Engineering Major*

There is a Major and Minor part to the Qualifying Examination. You must pass both parts for advancement to candidacy.

The Major (written) Area will be prepared by faculty in that area and will be designed to test a student's overall knowledge (from undergraduate and first year graduate courses). It will be a closed book exam, 3 hours in length and will be given each April.

Topic areas projected for the QE Exam are:

1. Communications and Signal Processing
2. Semiconductor Devices and Quantum Electronics
3. Circuits and VLSI

a) Students must pass one major written exam within two consecutive tries. The two consecutive tries need not be in the same area.

b) A 3.0 GPA is required to register for the exam. If a student whose GPA is less than 3.0 requests to take the exam, a written petition must be given to the Graduate Committee at the beginning of the semester that the qualifying exams are given. Approval will only be given in exceptional situations.

c) A student without electrical or computer engineering background may petition the graduate committee in writing to take a non-traditional major written exam in a novel subject of interest to electrical and computer engineering. Petitions must include a letter of support from their intended Ph.D. advisor.

The Minor Area adds an extra degree of breadth to the student's Ph.D. education, and makes possible interdisciplinary research. The minor nominally consists of receiving a B or better average in three or more electrical and computer engineering courses. Under extraordinary circumstances, faculty may suggest possible constellations of courses. Courses taken for the minor area must be from a different area than the major. **A student can satisfy the minor requirement by taking and passing a second major written exam.**

Please Note:
The Ph.D. Qualifying Exam syllabi are made to serve as an aid to students who plan to take the Ph.D. Qualifying Exam. The individual lists are not meant to be exhaustive. The students are expected to have a basic understanding of the fundamentals.

ADVANCEMENT TO CANDIDACY
Electrical Engineering Major

Students may Advance to Candidacy before completing the Preliminary Examination.

Departmental policy requires that all G3 classified doctoral students Advance to Candidacy within **2.5 years** from his/her academic start at Stony Brook University. All G4 classified doctoral students are required to Advance to Candidacy within **1.5 years** from his/her academic start.

ALL required course work must be satisfactorily completed <u>prior</u> to Advancing to Candidacy. Course work includes:

- Passing a **MAJOR** area (written) Qualifying Examination.
- Completion of three (3) courses in order to fulfill a **MINOR** area, these courses must be in a <u>different</u> area than the major.
- One year residency (two consecutive semesters of full time graduate study).
- Six **<u>regular</u>** courses beyond the Master's degree **OR** fourteen **<u>regular</u>** courses above the Bachelor's degree. The courses ESE 597, ESE 599, ESE 697, ESE 698 and ESE 699 are NOT counted as regular courses.
- A grade point average of at least 3.0

The student and his/her research advisor will decide when the student is ready to Advance to Candidacy. The Graduate Program Director must approve the request before final approval is decided by the Graduate School.

The student must submit the Request for Advancement to Candidacy to the department at least **<u>ONE</u>** full week <u>prior</u> to the start of the semester. If a request is received after the deadline, advancement to candidacy (G5 status) will NOT take effect until the NEXT semester or term. **(Request form available on ECE website)**

G5 is the final stage of Ph.D. students. To ensure timely completion and high quality of dissertation, in general, Ph.D. students should not change their dissertation advisors at G5 status. However, if for some special reason, a G5 student has to change his/her advisor, it is **<u>required that the student spends at least two more years on the new research for the dissertation with the new advisor.</u>** Shorter completion time is allowed if the old advisor and the new advisor of the student have reached a written agreement. The formal switching of advisors and the agreement between the old and new advisors (if any) <u>must be documented at the time of switching</u> by the Graduate Coordinator to be effective.
This policy is in effect in order to ensure the high quality of our Ph.D. program, and the above rule will be enforced when the Department submits the defense form to the Graduate School.

PRELIMINARY EXAMINATION

Electrical Engineering Major

This is an oral examination. Usually, a student prepares a short written research proposal and gives a 30-minute presentation. After that the floor is open for questioning.

I. Departmental policy requires that all doctoral students take the Preliminary Oral Examination **within 3 years** of passing the Qualifying Examination. ALL required courses (including three minor courses) must also be satisfactorily completed.

II. The student and his/her research advisor will together propose an examination committee and a date and time for the examination. They must obtain prior agreement to serve from each proposed member. The Graduate Program Director must approve the committee and then recommend to the Dean of the Graduate School that said committee be appointed.

III. The examining Preliminary Committee shall consist of at least four members, including the student's research advisor. If the advisor is from outside of the ECE department, a co-advisor from the department must be chosen. Of the four, at least two must be full-time faculty members from the ECE Department and at least one must be from outside the department or university. If member is from outside of the university, the student must provide a curriculum vitae.

IV. The student must submit the proposed committee to the department at least **THREE** full weeks prior to the proposed examination date.

V. At least **five** full days prior to the examination date, the student must deliver to each committee member a readable copy of the following:

1. Formal research proposal – proposal shall include a brief abstract (not to exceed 200 words), a table of contents, and within a standard format of Introduction, Discussion, etc., an outline of the related state-of-the-art, the specific research goals, methods to be followed, preliminary results (if any), prospects for success, alternatives if success is in doubt, etc. Except where results already obtained are sufficient to justify a near-final draft of one or more papers to be submitted or of whole chapters in the final thesis, the formal proposal should be at least 50 pages.

2. A brief Vita to include name, education, date of admission to ECE graduate program, date passed Qualifying Exam, area working on. Part-time students and any students who have interrupted their graduate studies to seek full-time employment must include their record of employment throughout the period. Any awards, significant publications, or other professional recognition should also be included.

Students must pass the Preliminary Exam at least ONE year prior to their Defense.

DISSERTATION DEFENSE

Electrical Engineering Major

This is an oral examination. An examination committee will consist of at least four members; three members must be Electrical & Computer Engineering faculty, and at least one member must be from outside the department. The student must submit to the committee members a copy of his/her dissertation with sufficient time before the actual defense, to permit careful reading. The defense consists typically of a 45-minute presentation followed by questions.

Note: At least FIVE weeks prior to the Defense date, the student must electronically submit committee member names, title of defense, date, time and place of defense, along with an Abstract (350 words or less) to the department.

Important: A student must be Advanced to Candidacy and pass the Preliminary Exam at least ONE year prior to the Defense.

COMPUTER ENGINEERING

COMPUTER ENGINEERING DEGREE REQUIREMENTS

Admission to the M.S. program in Computer Engineering requires the student to have completed a Bachelor degree in Computer Engineering or Computer Science. Students with a Bachelor degree in Electrical Engineering could also be admitted if they have taken or will take the following courses or their equivalent:

- ESE 345: Computer Architecture
- ESE 380: Embedded Microprocessor Systems Design I
- ESE 333: Real-Time Operating Systems

I. M.S. in *Computer Engineering* NON-THESIS OPTION

Please Note: Full-time M.S. students typically finish the Master's Degree in three (3) semesters.

Any Non-ESE course (not stated in the C.E. guidelines) will need prior approval given by the Graduate Program Director before a student can register. (approval form found on ECE website)

The M.S. degree requires at least 30 graduate credits with a cumulative and departmental grade point average of 3.0 or better.

The courses listed below can only be used once to satisfy the degree requirements:

1. **Computer Hardware: One** course from the following; ESE/CSE 536 (*Switching and Routing in Parallel and Distributed Systems*), ESE 545 (*Computer Architecture*), ESE 565 (*Parallel Processing Architectures*), ESE 566 (*Hardware-Software Co-Design of Embedded Systems*), ESE 580 (*Microprocessor-Based Systems I*), ESE 581 (*Microprocessor-Based Systems II*)

2. At least **three** (3) Computer Engineering courses with at least **one** course from **each** of the following three sub-areas:

   a. **Networking:** ESE 505 (*Wireless Network*), ESE 506 (*Wireless Networking and Mobile Computing*), ESE 546 (*Computer Communication Networks*), ESE 548 (*Local & Wide Area Networks*), ESE 550 (*Network Management and Planning*)

   b. **CAD and VLSI:** ESE 530 (*Computer Aided Design*), ESE 549 (*Advanced VLSI System Testing*), ESE 555 (*Advanced VLSI Circuit Design*), ESE 556 (*VLSI Physical and Logic Design Automation*), ESE 575 (*Advanced VLSI Signal Processing Architecture*)

   c. **Theory:** ESE 554 (*Computational Models for Computer Engineers*), CSE548/AMS542 (*Analysis of Algorithms*)

3. At least **one** Software course: ESE 568 (*Computer and Robot Vision*), ESE 588 (*Pattern Recognition*), CSE 504 (*Compiler Design*), CSE 506 (*Operating Systems*), CSE 526 (*Principles of Programming Languages*), CSE 533 (*Network Programming*), CSE 548/AMS542 (*Analysis of Algorithms*).

4. At least **<u>three</u>** additional regular courses (lecture based courses) offered by the ECE department.

5. Up to six credits may be from ESE 597, ESE 599, or ESE 698 (**Only 3 credits of ESE 698 may be used)**

ESE 597, ESE 599, ESE 697, ESE 698 and ESE 699 are **<u>not</u>** counted as regular courses. Also our Topics course, ESE 670, can be counted only once as a regular course credit toward the M.S. degree. Credits for ESE 597 can only be applied toward the Computer Engineering degree if the following requirements are satisfied:

Prior approval from the Graduate Program Director based on the student submitting a proposal and securing an advisor in the ECE department as well as a contact person at the company involved. Approval will only be granted if it can be demonstrated that the faculty advisor will be kept in close touch with work on the project. To this end, practicum not in the local geographic area will be discouraged.

To obtain satisfactory credit the faculty advisor must verify that a substantial engineering project was undertaken and completed. This will be based on his close contact during the entire period of the project with the student and the contact person and upon reviewing a mandatory written report submitted by the student at the project's completion. The faculty advisor will determine the final grade for the course.

<u>One credit of ESE 597 is required to fulfill the master's degree requirements.</u> A maximum of three credits in ESE 597 may be applied towards the master's degree in electrical or computer engineering. CPT will be approved one time and can be taken during the summer or the academic year. Extensions of CPT will not be granted. ESE 599, ESE 699 and ESE 698 can be used to replace ESE 597 with the approval of the Graduate Program Director.

A candidate for the master's degree may petition to transfer a maximum of <u>12</u> graduate credits from another institution towards the master's degree requirements. Students transferring from non-matriculated status are also limited to a maximum of 12 credits for the master's degree.

II. M.S. in *Computer Engineering* <u>THESIS</u> OPTION – Students must inform the department if they will do a master's thesis by the end of their FIRST semester.

Please Note: Full-time M.S. students typically finish the Master's Degree in <u>three</u> (3) semesters.

Any Non-ESE course (not stated in the C.E. guidelines) will need prior approval given by the Graduate Program Director <u>before</u> a student can register. (approval form found on ECE website)

The M.S. degree with thesis option requires at least 30 graduate credits with a cumulative and departmental grade point average of 3.0 or better. Among these 30 credits, **<u>at least six credits</u>** of ESE 599, with a maximum of 12 credits total being taken from ESE 597, ESE 599, or ESE 698.
<u>PLEASE NOTE:</u> Only 3 credits of ESE 698 may be used in above.

<u>The courses listed below can only be used once to satisfy the degree requirements:</u>

1. **Computer Hardware: <u>One</u>** course from the following; ESE/CSE 536 (*Switching and Routing in Parallel and Distributed Systems*), ESE 545 (*Computer Architecture*), ESE 565 (*Parallel Processing Architectures*), ESE 566 (*Hardware-Software Co-Design of Embedded Systems*), ESE 580 (*Microprocessor-Based Systems I*), ESE 581 (*Microprocessor-Based Systems II*)

2. At least **<u>three</u>** (3) Computer Engineering courses with at least **<u>one</u>** course from **<u>each</u>** of the following three sub-areas:

   a. **Networking:** ESE 505 (*Wireless Network*), ESE 506 (*Wireless Networking and Mobile Computing*), ESE 546 (*Computer Communication Networks*), ESE 548 (*Local & Wide Area Networks*), ESE 550 (*Network Management and Planning*)

   b. **CAD and VLSI:** ESE 530 (*Computer Aided Design*), ESE 549 (*Advanced VLSI System Testing*), ESE 555 (*Advanced VLSI Circuit Design*), ESE 556 (*VLSI Physical and Logic Design Automation*), ESE 575 (*Advanced VLSI Signal Processing Architecture*)

   c. **Theory:** ESE 554 (*Computational Models for Computer Engineers*), CSE 548/AMS542 (*Analysis of Algorithms*)

3. At least **<u>one</u>** Software course: ESE 568 (*Computer and Robot Vision*), ESE 588 (*Pattern Recognition*), CSE 504 (*Compiler Design*), CSE 506 (*Operating Systems*), CSE 526 (*Principles of Programming Languages*), CSE 533 (*Network Programming*), CSE 548/AMS542 (*Analysis of Algorithms*)

4. At least **<u>one</u>** additional regular course (lecture based course) offered by the ECE department.

   ESE 597, ESE 599, ESE 697, ESE 698 and ESE 699 are **<u>not</u>** counted as regular courses.
   Also our Topics course, ESE 670, can be counted only once as a regular course credit toward

the M.S. degree. Credits for ESE 597 can only be applied toward the Computer Engineering degree if the following requirements are satisfied:

Prior approval from the Graduate Program Director based on the student submitting a proposal and securing an advisor in the ECE department as well as a contact person at the company involved. Approval will only be granted if it can be demonstrated that the faculty advisor will be kept in close touch with work on the project. To this end, practicum not in the local geographic area will be discouraged.

To obtain satisfactory credit the faculty advisor must verify that a substantial engineering project was undertaken and completed. This will be based on his close contact during the entire period of the project with the student and the contact person and upon reviewing a mandatory written report submitted by the student at the project's completion. The faculty advisor will determine the final grade for the course.

<u>One credit of ESE 597 is required to fulfill the master's degree requirements.</u> A maximum of three credits in ESE 597 may be applied towards the master's degree in electrical or computer engineering. CPT will be approved one time and can be taken during the summer or the academic year. Extensions of CPT will not be granted. ESE 599, ESE 699 and ESE 698 can be used to replace ESE 597 with the approval of the Graduate Program Director.

In compliance with Graduate School guidelines, Master's Thesis students are expected to have <u>**two**</u> (2) readers from the department approve their thesis. Students will need to request the signature page from the Graduate Program Coordinator. **(Information and request form found on the ECE website)**

A candidate for the master's degree may petition to transfer a maximum of <u>12</u> graduate credits from another institution towards the master's degree requirements. Students transferring from non matriculated status are also limited to a maximum of 12 credits for master's degrees.

III. Ph.D. DEGREE in *Computer Engineering*

(1) Passing a **MAJOR** area (written) Qualifying Examination in Computer Engineering, Communications & Signal Processing, or Circuits and VLSI.

(2) Completion of three (3) courses in order to fulfill a **MINOR** area, these courses must be in a <u>different</u> area than the major.

(3) One year residency (two consecutive semesters of full time graduate study.)

(4) Six regular courses beyond the Master's degree **OR** fourteen regular courses above the Bachelor's degree <u>PLUS</u> **ESE 697 (3 credits) is required once G5 classification status is attained**. The choice of courses must have the prior approval of the designated faculty academic advisor. The courses ESE 597, ESE 599, ESE 697, ESE 698 and ESE 699 are NOT counted as regular courses. Courses presented under the title ESE 670 - Topics in Electrical Engineering & Computer Engineering, that have different subject matters, and are offered as formal lecture courses, are considered as regular courses but may not be counted more than once as a regular course for credit toward the Master's degree, and not more than twice, in total, for all graduate degrees awarded by the Department of Electrical & Computer Engineering

(5) The student must satisfy the stipulations of a plan of study, which must be filed with the Graduate Program Committee within six months after the student passes the qualifying examination. The study plan, which will include the six regular courses, as required in item 4, will be developed under the aegis of the designated faculty advisor (who may or may not be the eventual thesis advisor). Modification of the study plan may be made by the preliminary examination committee and at any later time by the thesis advisor. An up-to-date plan must always be placed on file with the Graduate Program Committee each time a modification is made.

(6) Passing the Preliminary Examination not more than **<u>3 years</u>** after passing the Qualifying Examination. Both a thesis topic and the thesis background area are emphasized. The thesis topic must be approved by the preliminary exam committee as appropriate for computer engineering. All courses must be satisfactorily completed prior to taking the Preliminary Exam.

(7) Satisfactory completion of a dissertation (normally in four years after passing the Qualifying Examination).

POLICIES REGARDING THE QUALIFYING EXAMINATION:

Computer Engineering Major

There is a Major and Minor part to the Qualifying Examination. You must pass both parts for advancement to candidacy.

The Major (written) Area will be prepared by faculty in the computer engineering area and will be designed to test a student's overall knowledge (from undergraduate and first year graduate courses). It will be a closed book exam, 3 hours in length and will be given each April.

Topic areas projected for the QE Exam are:

1. Communications and Signal Processing
2. Computer Engineering
3. Circuits and VLSI

a) Students must pass one major written exam within two consecutive tries. The two consecutive tries need not be in the same area.

b) A 3.0 GPA is required to register for the exam. If a student whose GPA is less than 3.0 requests to take the exam, a written petition must be given to the Graduate Committee at the beginning of the semester that the qualifying exams are given. Approval will only be given in exceptional situations.

c) A student without electrical or computer engineering background may petition the graduate committee in writing to take a non-traditional major written exam in a novel subject of interest to electrical and computer engineering. Petitions must include a letter of support from their intended Ph.D. advisor.

The Minor Area adds an extra degree of breadth to the student's Ph.D. education, and makes possible interdisciplinary research. The minor nominally consists of receiving a B or better average in three or more electrical and computer engineering courses. Faculty will suggest possible constellations of courses. Courses taken for the minor area must be from a different area than the major. **A student can satisfy the minor requirement by taking and passing a second major written exam.**

Please Note:

The Ph.D. Qualifying Exam syllabi are made to serve as an aid to students who plan to take the Ph.D. Qualifying Exam. The individual lists are not meant to be exhaustive. The students are expected to have a basic understanding of the fundamentals.

ADVANCEMENT TO CANDIDACY
Computer Engineering Major

Students may Advance to Candidacy before completing the Preliminary Examination.

Departmental policy requires that all G3 classified doctoral students Advance to Candidacy within **2.5 years** from his/her academic start at Stony Brook University. All G4 classified doctoral students are required to Advance to Candidacy within **1.5 years** from his/her academic start.

ALL required course work must be satisfactorily completed <u>prior</u> to Advancing to Candidacy. Course work includes:

- Passing a **MAJOR** area (written) Qualifying Examination in Computer Engineering, Communications & Signal Processing, or Circuits and VLSI.

- Completion of three (3) courses in order to fulfill a **MINOR** area, these courses must be in a <u>different</u> area than the major.

- One year residency (two consecutive semesters of full time graduate study).

- Six **<u>regular</u>** courses beyond the Master's degree **OR** fourteen **<u>regular</u>** courses above the Bachelor's degree. The courses ESE 597, ESE 599, ESE 697, ESE 698 and ESE 699 are NOT counted as regular courses.

- A grade point average of at least 3.0

The student and his/her research advisor will decide when the student is ready to Advance to Candidacy. The Graduate Program Director must approve the request before final approval is decided by the Graduate School.

The student must submit the Request for Advancement to Candidacy to the department at least **<u>ONE</u>** full week <u>prior</u> to the start of the semester. If a request is received after the deadline, advancement to candidacy (G5 status) will NOT take effect until the NEXT semester or term. **(Request form available on ECE website)**

G5 is the final stage of Ph.D. students. To ensure timely completion and high quality of dissertation, in general, Ph.D. students should not change their dissertation advisors at G5 status. However, if for some special reason, a G5 student has to change his/her advisor, it is **<u>required that the student spends at least two more years on the new research for the dissertation with the new advisor.</u>** Shorter completion time is allowed if the old advisor and the new advisor of the student have reached a written agreement. The formal switching of advisors and the agreement between the old and new advisors (if any) <u>must be documented at the time of switching</u> by the Graduate Coordinator to be effective.
This policy is in effect in order to ensure the high quality of our Ph.D. program, and the above rule will be enforced when the Department submits the defense form to the Graduate School.

PRELIMINARY EXAMINATION

Computer Engineering Major

This is an oral examination. Usually, a student prepares a short written research proposal and gives a 30-minute presentation. After that the floor is open for questioning.

I. Departmental policy requires that all doctoral students take the Preliminary Oral Examination **within 3 years** of passing the Qualifying Examination. ALL required courses (including three minor courses) must also be satisfactorily completed.

II. The student and his/her research advisor will together propose an examination committee, and a date and time for the examination. They must obtain prior agreement to serve from each proposed member. The Graduate Program Director must approve the committee and then recommend to the Dean of the Graduate School that said committee be appointed.

III. The examining Preliminary Committee shall consist of at least four members, including the student's research advisor. If the advisor is from outside of the ECE department, a co-advisor from the department must be chosen. Of the four, at least two must be full-time faculty members from the ECE Department and at least one must be from outside the department or university. If member is from outside of the university, the student must provide a curriculum vitae.

IV. The student must submit the proposed committee to the department at least **THREE** full weeks prior to the proposed examination date.

V. At least **five** full days prior to the examination date, the student must deliver to each committee member a readable copy of the following:

1. Formal research proposal – proposal shall include a brief abstract (not to exceed 200 words), a table of contents, and within a standard format of Introduction, Discussion, etc., an outline of the related state-of-the-art, the specific research goals, methods to be followed, preliminary results (if any), prospects for success, alternatives if success is in doubt, etc. Except where results already obtained are sufficient to justify a near-final draft of one or more papers to be submitted or of whole chapters in the final thesis, the formal proposal should be at least 50 pages.

2. A brief Vita to include name, education, date of admission to ECE graduate program, date passed Qualifying Exam, area working on. Part-time students and any students who have interrupted their graduate studies to seek full-time employment must include their record of employment throughout the period. Any awards, significant publications, or other professional recognition should also be included.

Students must pass the Preliminary Exam at least ONE year prior to their Defense.

DISSERTATION DEFENSE

Computer Engineering Major

This is an oral examination. An examination committee will consist of at least four members; three members must be Electrical & Computer Engineering faculty, and at least one member must be from outside the department. The student must submit to the committee members a copy of his/her dissertation with sufficient time before the actual defense, to permit careful reading. The defense consists typically of a 45-minute presentation followed by questions.

Note: At least FIVE weeks prior to the Defense date, the student must electronically submit committee member names, title of defense, date, time and place of defense, along with an Abstract (350 words or less) to the department.

Important: A student must be Advanced to Candidacy and pass the Preliminary Exam at least ONE year prior to the Defense.

Ph.D. Qualifying Exam Syllabus

Please Note: The following syllabi are made to serve as an aid to students who plan to take the Ph.D. Qualifying Exam. The individual lists are not meant to be exhaustive. The students are expected to have a basic understanding of the fundamentals

Communications and Signal Processing

Major Area Topics:

Signal and Systems
Signals, spectra, time and bandwidth properties. Shannon sampling theorem. Fourier series, transforms, and applications to signal and system analysis.

Probability and Stochastic Processes
Probability concepts, random variables, vectors, and processes. Statistical description of random processes, autocorrelation and cross-correlation function. Basic probability models in communications and signal processing.

Basic Communications Concepts
Basic analog and digital communication schemes. Noise in communication systems. PCM, baseband transmission schemes. Basics of information theory. Uncertainty, information, and entropy. Channel capacity. Relationship between signaling speed, bandwidth, power, and reliability. Continuous- and discrete-time queueing systems.

Digital Signal Processing
Sampling and reconstruction of signals. DTFT and Z-transforms. FIR and IIR filter design. Signal flow graphs and filter structures. DFT and FFT. Interpolation, decimation, and oversampling.

Image Processing
Mathematical preliminaries. Multidimensional transforms for images spatial frequency content of images via multi-dimensional FFT's. Sampling and quantization. Image enhancement and color. Image Compression. Standard operations of image enhancement: **(**a**)** convolutional smoothing and sharpening, and similar operations in Fourier domain and **(**b**)** median window filter. Image restoration: inverse filtering, Weiner filtering. Least squares restoration in discrete domain. Reconstruction from Projections - especially Filtered Backprojection Method.

Reference Books:

- G. R. Grimmet and D. R. Stirzaker, *Probability and Random Processes*, Oxford Science Publication, 1998.
- R. C. Gonzalez and R. E. Woods, *Digital Image Processing*, Adison-Wesley, 1992.
- S Haykin, *Communication Systems*, John Wiley and Sons, Inc., 2001.

- C.T. Chen, *Digital Signal Processing*, Oxford Univ. Press, 2001 .
- C.T. Chen, *Systems and Signal Analysis*, Oxford Univ. Press, 1994.
- Papoulis, Probability, *Random Variables, and Stochastic Processes*, McGraw Hill, 1991.
- J. G. Proakis and M. Salehi, *Communication System Engineering*, Pentice-Hall, 2002.
- T. Robertazzi, *Computer Networks and Systems: Queueing Theory and Performance Evaluations*, 2nd ed., Springer-Verlag, 2000.
- Rosenfeld and A. C. Kak, *Digital Picture Processing*, Vol. 1, Academic Press, 1982

Minor Area Courses for Communications & Signal Processing:

ESE 532 Theory of Digital Communications <u>OR</u> ESE 528 Communications Systems
ESE 547 Digital Signal Processing
ESE 558 Digital Image Processing I

Computer Engineering

Major Area Topics:

Discrete Mathematics

Permutations and Combinations; Relations and Functions; Graphs and Trees; Boolean algebra; Algebraic Structures.

Digital Systems

Digital concepts and number systems; Boolean switching algebra; Principles of combinational logic; Analysis and design of combinational logic; flip-flops, simple counters and registers; introduction to sequential circuits; sequential circuit design; asynchronous sequential circuits.

Computer Architecture

Computer Abstractions and Technology; The role of Performance; Instructions: Language of the machine; Arithmetic for Computers; the Processor:Datapath and Control; Enhancing performance with Pipelining; Large and Fast: Exploiting Memory Hierarchy; Interfacing Processors and Peripherals.

Software

Programming Principles; Arrays and Stacks; Queues; Recursion; Lists; Searching; Sorting; Hashing; Binary Trees; Trees; Graphs.

Reference Books:

- C.L. Liu, “Elements of Discrete Mathematics”, McGraw-Hill Book Company, 1985.
- John Yarbrough, "Digital Logic - Applications and Design", PWS Publishing Company, 1997.
- M. Morris Mano, "Logic and Computer Design Fundamentals", Prentice Hall, 2001.
- D.A. Patterson and J. L. Hennessy, “Computer Organization and Design”, Morgan Kaufmann Publishers, Inc, 1998.
- Robert L. Kruse, Alexander Ryba, “Datastructures and Program Design in C++”, Prentice-Hall, 1999. ISBN 0-13-768995-0
- Robertazzi, Computer Networks & Systems: Queueing Theory & Performance Evaluations, 2nd edition, Springer-Verlag, 2000

Minor Area Courses for Computer Engineering:

Choose <u>three</u> from the following six choices:

ESE 501 System Specification and Modeling
ESE 506 Wireless Network
ESE 536 Switching and Routing in Parallel and Distributed Systems
ESE 545 Computer Architecture
ESE 546 Analysis & Synthesis of Computer Comm. Networks <u>OR</u> ESE 548 Local & Wide Area Networks
ESE 554 Computational Models for Computer Engineers

Semiconductor Devices and Quantum Electronics

Major Area Topics:

Energy bands in semiconductors
- a) Energy dependence on wave vector
- b) Effective masses of electrons and holes

Mechanisms of conductivity in semiconductors
- a) Doping in semiconductors
- b) Carrier statistics in semiconductors
- c) Scattering mechanisms

Carrier drift and diffusion
Recombination-generation phenomena in semiconductors
Photoconductivity and luminescence phenomena
Semiconductor quantum wells
Energy spectra of carriers in quantum wells
Semiconductor heterostructures
p-n junction and operating principles of semiconductor diodes
Operating principles of bipolar transistors. Device band diagram
Operating principles of FET
Design and operating principles of MOSFET
p-n junction as light detectors
- a) Solar Cells
- b) Photodiodes

Light emitting diodes: band diagram and operating principles
Semiconductor lasers: band diagram and operating principles

Reference Books:

- Robert Pierret, "*Semiconductor Device Fundamentals*" Addison-Wesley, 1996
- Michael Shur, *"Introduction to Electronic Devices"* John Wiley&Sons, 1995
- Govind P. Agrawal, Niloy K. Dutta, *"Semiconductor Lasers"*, Van Nostrand Reinhold, New York, 1993

Minor Area Courses for Semiconductor Devices & Quantum Electronics:

Choose <u>three</u> from the following five courses:

ESE 511 Solid State Electronics
ESE 512 Bipolar Junction & Heterojunction Elec. Dev.
ESE 514 MOS Transistor Modeling
ESE 515 Quantum Electronics I
ESE 519 Semiconductor Lasers and Photodectors

Circuits and VLSI

Major Area Topics:

The following are the topics for the Circuits and VLSI section of the PhD qualifying exam.

Modeling and operation of bipolar junction transistors and MOS field effect transistors

Static and dynamic MOS gates

Design of sequential logic circuits

Layout of integrated circuits

Interconnects and parasitics

Timing issues in digital circuits

Basic building blocks in analog integrated circuits (single-transistor stages, differential amplifiers, current mirrors, output stages).

Op-amp structures and applications of op-amps

Frequency response of analog circuits

Feedback, stability, compensation

Reference Books:

- A.S. Sedra and K.C. Smith, *Microelectronic Circuits*, Oxford University Press, 1998.
- P.R. Gray, P.J. Hurst, S.H. Lewis, and R.G. Meyer, *Analysis and Design of Analog Integrated Circuits*, 4th Edition, John Wiley, 2000.
- Jan M. Rabaey, *Digital Integrated Circuits: A Design Perspective*, Prentice-Hall, 1996.
- N. Weste and K. Eshraghian, *Principles of CMOS VLSI Design: A Systems Perspective*, 2nd Edition, Addison-Wesley, 1993.

Minor Area Courses for Circuits & VLSI:

Choose three from the following four courses:

ESE 501 System Specification and Modeling
ESE 516 Integrated Electronic Devices and Circuits – Part I
ESE 555 VLSI Circuit Design
ESE 556 VLSI Physical and Logic Level Design Automation

POLICIES REGARDING RA/TA/GA SUPPORT AND TUITION SCHORLARSHIP/TEACHING ASSISTANT DUTIES AND EVALUATION

1. Full-time graduate students are eligible for research assistant (RA) positions. Individual faculty should be contacted on the availability of RA positions.

2. State lines - Teaching Assistantships (TA) and Graduate Assistantships (GA) - are used by the Department to help fulfill its undergraduate academic mission and at the same time to support graduate students, who are making satisfactory progress towards a Ph.D. degree.

3. Tuition scholarship may be awarded to an RA/TA/GA if the department budget permits. Preference will be given to Ph.D. students. If a student does not pass the Preliminary Oral Examination within 3 years of passing the Qualifying Exam, the student may not receive the tuition scholarship.

   Note: **In order to receive a Graduate School Tuition Scholarship as a G5 student, the student must have been fully supported as a TA/GA/RA with a department tuition scholarship for the academic year prior to advancing to candidacy. Otherwise the student will be liable for his/her own tuition costs.**

4. Because of the limited TA positions, the awarding of a TA will be according to the following guidelines:

State (TA) support is limited to four years, which includes periods when a student is only partially supported during MS or Ph.D.

Except for new incoming supported students, state support will generally be limited to 1/2 TA, with the priority given to eligible students awarded at least 1/2 RA by their faculty advisor.

To be eligible for second-year support, the student must have passed the Major Area of the Qualifying Examination and must have a GPA of at least 3.0. The student must also have a research advisor in the Electrical & Computer Engineering Department. To be eligible in subsequent years, the student must be making satisfactory progress in taking the courses for the Minor Area. Additionally, the student must have a grade of ‘S’ on all previous research courses and assistantship assignments.

The remaining TA lines will be allocated on a competitive basis, based on the academic merit of the candidate. The guiding principle for the Committee will be the need to ensure continuity and completion of a successful Ph.D. project, as well as to help the new faculty to establish their research program.

5. Academic dishonesty or failure to meet assigned TA or GA responsibilities may result in loss of any support from the program.

Each semester, all Teaching Assistants must be on campus and in contact with the faculty member of the course to which he/she has been assigned by the FIRST day of classes. If a TA does not meet this requirement, they will be subject to having their stipend and tuition scholarship rescinded.

TEACHING ASSISTANT DUTIES AND EVALUATION

All TAs are expected to behave professionally and take their teaching responsibilities seriously.

All TAs must be on campus and in contact with the faculty member of their TA Assignment by the first day of classes or they are subject to having their stipend and tuition scholarship rescinded.

- A full-time TA is expected to work up to 20 hours a week. However, it is understood that this load is not distributed evenly during the semester. In the first few weeks, the load is usually much less than 20 hours. The load tends to increase towards the semesters end.
- If it becomes apparent that the average load constantly exceeds 20 hours per week, the student should discuss the problem with the supervisor.
- A TA must be familiar with the concepts and course material. TAs must prepare designated material and understand and assist with the everyday operation of the course. TAs are required to attend the lectures, unless excused by their supervisor.
- A TA must understand and follow course standards set by the supervisor.
- A TA must be reliable. Perfect attendance is expected in classes, assigned recitation, laboratory and help sessions, office hours, TA meetings, and proctoring. If a TA can't meet a responsibility, they must inform their supervisor and where appropriate, must find a substitute acceptable to their supervisor.
- A TA must be prepared for all recitations, labs, meetings, etc.
- A TA must treat all students with courtesy regardless of gender, race, ethnic background, etc.
- A TA must not initiate or maintain inappropriate relationships with students. These include romantic, sexual, or financial. The University prohibits such abuses of power.
- A TA must have proficiency in English sufficient for communication with students.
- A TA must grade consistently and fairly, according to the course standards determined by the course instructor.
- At the end of each semester, a TA must assist the supervisor as long as necessary to help the supervisor with grading exams, labs, and other assignments.
- A TA must complete grading and other assigned duties promptly based upon the standards and guidelines set by their supervisor.
- A TA must take the designated graduate teaching assistant training classes.

If a TA fails to satisfy any of the above responsibilities, their supervisor will meet with them to rectify any problems. If problems persist, the TA must meet with the Director of Graduate Studies and further actions may be taken.

TA Evaluation: TA’s will be evaluated each semester by the supervisor as follows:

- Excellent, well-above expectations
- Very good
- Good, meets expectations
- Below expectations
- Unsatisfactory, well-below expectations

Teaching Assistants who perform below expectations may see their support terminated in the following semester.

CURRICULAR PRACTICAL TRAINING

CPT must be in the student's major area of study and MUST count towards completion of the degree requirements. The master's degree requires 30 credits. Students must plan their CPT credits along with their other course credits accordingly.

Master's students are required to take ONE credit of CPT to fulfill the master's degree requirements. CPT can be taken only ONE time. Students can take CPT during the academic year OR the summer. In exceptional circumstances, the Graduate Program Director can approve a replacement for this requirement by substituting one credit of ESE 599, ESE 699 or ESE 698.

ESE Department Requirements for CPT Approval

- **Students should consult with an International Student Adviser to confirm that they are eligible for CPT. If eligible, please submit the following to the Graduate Program Coordinator at least two weeks prior to the start of the internship:**

  - **CPT Application instructions and application are located on the Visa & Immigration Services website. (AccessVIS)**
  - **Letter of Offer from the internship supervisor to the department, which states the start & end dates of the internship, hours per week, and specific CPT job duties. This letter must be on original company letterhead.**
  - **E-Mail the Graduate Program Coordinator, stating how the CPT is integral to your program of study.**

Registration Requirement

Students must register for ESE 597 (variable credit). ESE 597 is a non-regular course. Register under your advisor's section number. If you do not have an advisor, you should register under the section number of the Graduate Program Director.

Requirements Upon Completion of CPT

The internship supervisor must inform the student's advisor or Graduate Program Director via e-mail that the student has satisfactorily fulfilled the CPT requirements.

Student must submit a CPT report (1-2 pages) to their advisor or the Graduate Program Director PRIOR to the beginning of the next semester. A grade of "S" or "U" will then be

assigned.

FACILITIES

The department operates laboratories for both teaching and research:

The Advanced IC Design & Simulation Laboratory contains equipment and computing facilities for the design, simulation, and characterization of analog, digital and mixed-signal integrated circuits. The lab is equipped with several SUN workstations and PCs, and assorted electronic measurement equipment.

The Communications, Signal Processing, Speech, and Vision (CSPV) Laboratory has several SUN workstations and desktop computers with specialized software for research in telecommunications networks and signal processing. The computers are networked to departmental computing facilities allowing access to shared campus resources and the Internet.

The Computer-Aided Design Laboratory provides a network of 386 based workstations. Advanced computer-aided design software for analog and digital systems design is available on these workstations.

The Computer Vision Laboratory has state-of-the-art equipment for experimental research in three-dimensional machine vision. The facilities include desktop computers, imaging hardware, and printers.

The Digital Signal Processing Research Laboratory is involved in digital signal processing architectures and hardware and software research. The laboratory is presently active in the development of algorithms to be implemented on a variety of signal processing chips.

The Fluorescence Detection Lab is involved in the design, development, implementation and testing of various DNA sequencing instruments. Research areas include laser induced fluorescence detection, single photon counting techniques, fast data acquisition and transfer, design and development of analog and digital integrated circuits, signal processing, capillary electrophoresis phenomena and DNA sequencing.

The Graduate Computing Laboratory has 12 Windows 2000 Professional based Windows PC's, equipped with Microsoft Office XP, Microsoft Visual Studio, X-Windows for Unix connectivity, Adobe Acrobat reader, Ghost script and Ghost view. There is an HP LaserJet 5Si/MX printer. The lab is also equipped with 8 Sun Blade 100 machines. These machines run Sun Solaris 8 operating systems and are connected to the departmental Unix servers. Industry standard packages such as Cadence tools, Synopsys, Hspice and Matlab are available from the application servers.

The High Performance Computing and Networking Research Laboratory is equipped to conduct research in the broad area of networking and parallel/distributed computing with emphasis on wireless/mobile networks, cloud computing, data center networks, optical networks, high-speed networks, interconnection networks and multicast communication. The laboratory has 1 Dell PowerEdge 1800 computing server, 8 Dell OptiPlex GX620 MT workstations, 2 Sun Ultra 60

Workstations with dual processors, and 4 Sun Ultra 10 Workstations.

The Medical Image Processing Laboratory, located in the medical school, is involved in research in image reconstruction methods and image analysis with applications to medical imaging. It is equipped with a SUN SPARC l0, SPARC 2, HP730 workstations and a full complement of peripherals.

The Optical Signal Processing and Fiber Optic Sensors Laboratory is equipped to perform research in the broad area of optoelectronics. Some of the current research projects include development of fiber optic systems for real time process control in adverse environments, integrated fiber optics, fiber optic sensors and coherent optical processing.

The Parallel and Neural Processing Laboratory conducts research in various parallel and neural network applications. Current research projects include Natural Adaptive Critic control, pattern recognitions and Bayesian Neural Networks. It is equipped with Pentium PCs and Synapse3 parallel neural network processing boards.

The Petaflops Design Laboratory is a research facility equipped with two SUN workstations, several PC's with Linex, and a 16-process Beowulf-type cluster. All computes are connected by Fast 100 Mb/sec Ethernet LAN.

The Semiconductor Optoelectronics Laboratory – possesses the infrastructure for wafer processing, testing and sophisticated characterization of optoelectronics devices. Processing facilities are based on a "Class 100" clean room with Darl Suss aligner, Temescal metal film deposition system and other equipment required for modern semiconductor wafer processing. Wafer testing can be performed by low and high temperature probe-stations. Characterization of devices after processing includes electrical, optical and spectral measurements. Electrical and optical measurements can be carried out within a wide frequency range from CW to 22GHz. Semiconductor laser near and far field emission patterns can be studied in a wide spectral range from visible to mid-infrared. Spectral analysis of radiation is performed with high resolution and sensitivity using grating and two Fourier transform spectrometers in combination with state-of-the-art detector systems. Time resolved luminescence experiments are available with ns resolution. The laboratory is equipped with 150fs Nd-glass mode locked laser for optical pumping as well as other pump sources including a high energy Q-switched Nd solid-state laser. New experimental methods of studying semiconductor laser parameters, developed in the Laboratory, include direct heterobarrier leakage current measurements as well as gain, loss and alpha-factor measurements in broad area and single mode lasers.

FACULTY

Faculty with research interest in computer engineering are underlined.

Belenky, Gregory, Distinguished Professor
Optoelectronic devices and systems. semiconductor devices, physics and technology.

Bugallo, Monica, Associate Professor
Statistical signal processing and its applications to multi-user communications, smart antenna systems, target tracking and vehicle positioning and navigation.

Dhadwal, Harbans, Associate Professor
Fiber optic sensors; optical signal processing; photon correlation spectroscopy; inverse problems.

Djuric, Petar, Professor
Signal analysis, modeling and processing; Monte Carlo methods; wireless communications and sensor networks.

Doboli, Alex, Professor
VLSI CAD with emphasis on hardware/software co-design, mixed-signal synthesis.

Donetski, Dmitri, Associate Professor
Design and technology of optoelectronic devices and systems including photovoltaic and photo-conductive detectors, diode lasers and diode laser arrays.

Dorojevets, Mikhail, Associate Professor
Parallel computer architecture; high-performance systems design.

Eisaman, Matthew, Assistant Professor
Photovoltaic devices, especially light trapping, nanostructures for improved solar cell efficiency, and spatial variations at the nanoscale.

Gindi, Gene, Associate Professor
Medical image processing and analysis with an emphasis on statistical methods.

Gorfinkel, Vera, Associate Professor
Semiconductor devices, including microwave and optoelectronics.

Hong, Sangjin, Professor
Low-power VLSI design of multimedia wireless communications and digital signal processing systems, including SOC design methodology and optimization.

Kamoua, Ridha, Associate Professor, Undergraduate Program Director
Solid-state devices & circuits; microwave devices and integrated circuits.

Lin, Shan, Assistant Professor
Cyber physical systems, networked information systems, wireless networks, sensing & control systems.

Luryi, Serge, Distinguished Professor, Chairperson
High speed solid-state electronic and photonic devices, physics and technology.

Milder, Peter, Assistant Professor
Digital hardware design, generation, and optimization focusing on signal processing, computer vision, and related domains; design for FPGA.

Murray, John, Associate Professor
Signal processing systems' theory.

Parekh, Jayant P., Professor
Microwave acoustics; microwave magnetics; microwave electronics; microcomputer applications.

Robertazzi, Thomas G., Professor
Computer networking, parallel processing, grid computing, scheduling, performance evaluation and E-commerce technology.

Salman, Emre, Assistant Professor
Nanoscale integrated circuit design, emerging technologies for future electronic systems, highly heterogeneous integrated systems, digital and mixed-signal circuits.

Shamash, Yacov, Dean CEAS
Control systems, robotics.

Short, Kenneth L., Professor
Digital system design; embedded microprocessor systems; instrumentation.

Shterengas, Leon, Associate Professor
High power and high speed light emitters, carrier dynamics in nanostructures, molecular beam epitaxy of semiconductor nanostructures.

Stanacevic, Milutin M., Associate Professor
Analog and mixed-signal VLSI circuits and systems, autonomous adaptive microsystems, real-time source localization and separation, micropower implantable biomedical instrumentation and telemetry.

Subbarao, Murali,, Professor
Computer vision; image processing.

Tang, K. Wendy, Associate Professor
Parallel and distributed processing; massively parallel systems; computer architecture, neural networks.

Wang, Xin, Associate Professor
Mobile and ubiquitous computing, wireless networking and systems.

Westerfeld, David, Assistant Professor
Design and characterization of high-performance mid-infrared semiconductor light sources (LEDs and lasers).

Yang, Yuanyuan, Professor, Graduate Program Director
Wireless and mobile networks, cloud computing, data center networks, optical networks, high speed networks, interconnection networks, multicast communication and parallel and distributed computing and systems.

Ye, Fan, Assistant Professor
Mobile computing/sensing systems and applications, indoor localization and floor plan reconstruction, Internet- of-Things and sensor networks.

Zhao, Yue, Assistant Professor
Smart energy systems, renewable energy integration, electricity market, infrastructure security, sensing and signal processing, optimization theory, information theory, communication networks.

COURSE LISTING

ESE 501 System Specification and Modeling

A comprehensive introduction to the field of System-on-Chip design. Introduces basic concepts of digital system modeling and simulation methodologies. Various types of hardware description language (HDL) will be studied, including Verilog, VHDL and System C. Topics include top-down and bottom-up design methodology, specification language syntax and semantics, RTL, behavioral and system-level modeling, and IP core development. Included are three projects on hardware modeling and simulation. Fall, 3 credits, grading ABCF.

ESE 502 Linear Systems- CORE COURSE

Development of transfer matrices and state-space equations from the concepts of linearity, time-invariance, causlity and lumpedness. Op-amp circuit implementations. Solutions and equivalent state equations. companion and modal forms. Stability and Lyapunov equations. controllability, observability, and their applications in minimal realization, state feedback and state estimators. Coprime fraction of transfer functions and their designs in pole-placement and model matching. Both the continuous-time and discrete-time systems will be studied. Fall, 3 credits, grading ABCF.

ESE 503 Stochastic Systems – CORE COURSE

Basic probability concepts and application. Probabilistic bounds, characteristic functions and multivariate distributions. Central limit theorem, normal random variables. Stochastic processes in communications, control and other signal processing systems. Stationarity, ergodicity, correlation functions, spectral densities and transmission properties. Optimum linear filtering, estimation and prediction. Fall, 3 credits, grading ABCF.

ESE 504 Performance Evaluation of Communication and Computer Systems

Advanced queuing models and algorithms for communication and computer systems. Mean value analysis and convolution algorithm. Transient analysis and M/G/1 queue. Models for traffic characterization in broadband integrated networks. Buffer sizing calculations. Bursty and self-similar traffic. Prerequisite: ESE 503 or permission of instructor. Spring, 3 credits, grading ABCF.

ESE 505 Wireless Communications

This course covers first year graduate level material in the area of wireless communications: wireless channels, overview of digital communications and signal processing for wireless communications, voice and data applications, design basics for wireless modems, analysis of system issues like resource management and handoff, cellular and wireless LAN systems. Fall and Spring, 3 credits, grading ABCF.

ESE 506 Wireless Network

This course will examine the area of wireless and mobile computing, looking at the unique network protocol challenges and opportunities presented by wireless communications and host or router mobility. The course will give a brief overview of fundamental concepts in mobile wireless systems and mobile computing, it will then cover system and standards issues including second generation circuit switches and third generation packet switched networks, wireless LANs, mobile IP, ad-hoc networks, sensor networks, as well as issues associated with small handheld portable devices and new applications that can exploit mobility and location information. This is followed by several topical studies around recent research publications in mobile computing and wireless networking field. This course will make the system architecture and applications accessible to the electrical engineer. Prerequisite: ESE 505 and ESE 546 or ESE 548 or permission of instructor. Fall, 3 credits, grading ABCF.

ESE 507 Advanced Digital System Design & Generation

This course focuses on languages, tools, and abstractions for design and implementation of digital systems. Course material is divided roughly into three categories: Limitations and constraints on modern digital systems; Hardware design abstractions, languages, and tools (including the SystemVerilog hardware description language); and new architectures and paradigms for digital design. Coursework will be primarily project and assignment based; there will also be reading and discussion of published papers in these areas. Students should have experience with hardware description languages (VHDL, Verilog, or SystemVerilog,) and software (C, C++ or Java). Fall, 3 credits, grading ABCF.

ESE 508 Analytical Foundations of Systems Theory

An exposition of the basic analytical tools for graduate study in systems, circuits, control, and signal processing. Sets and mappings, finite- dimensional linear spaces, metric spaces, Banach spaces, Hilbert spaces. The theory will be developed and exemplified in the context of systems applications such as nonlinear circuits, infinite networks, feedback control, signal restoration via projections, and optimal signal modeling. Spring, 3 credits, grading ABCF.

ESE 510 Electronic Circuits – This course is only for students in the Optoelectromechanical Systems Eng. program and cannot be used to fulfill any ESE degree requirement.

This is a course in the design and analysis of analog circuits, both discrete and integrated. The first part of the course presents basic topics related to circuit analysis: laws, theorems, circuit elements, and transforms. Fundamental semiconductor devices are introduced next. A number of aspects of circuit design beginning with basic device operation through the design of large analog functional blocks including amplifiers, oscillators, and filters are discussed. Fall, 3 credits, grading ABCF.

ESE 511 Solid-State Electronics – CORE COURSE

A study of the electron and hole processes in solids leading to the analysis and design of solid-state electronic devices. Solutions to the Schrodinger representation of quantum effects, perturbation techniques. Simple band structure, effective mass theorem. Derivation and application of the Boltzman transport theory. Electrical and thermal conductivities of metals and of semiconductors, Hall effect, thermal effects, and their application to electronic devices. Properties of semiconductors and the theories underlying the characteristics of semiconductor devices. Fall, 3 credits, grading ABCF.

ESE 512 Bipolar Junction and Heterojunction Electronic Devices

A study of fundamental properties of homojunction and heterojunction semiconductor devices. Derivation of the characteristic equations for p-n junction diodes, for the bipolar junction transistor (BJT) and for the heterojunction bipolar transistor (HBT); the device parameters for low- and high-frequency operation, the effects on the device characteristics of fabrication methods and of structural arrangements. The development of the large-signal and small-signal equivalent circuits for the p-n diode and the BJT and HBT devices, with emphasis on models used in prevalent computer-aided analysis routines (e.g., SPICE). Considerations for the devices in integrated-circuit applications. Spring, 3 credits, grading ABCF.

ESE 514 MOS Transistor Modeling

An overview of the metal-oxide semiconductor (MOS) transistor and its models for circuit analysis. The course is modular in structure. In a common first part, CMOS fabrication, device structure and operation are introduced. Starting from basic concepts of electrostatics, MOS field-effect transistor operation is presented in an intuitive fashion, and no advanced background in solid-state theory is required. Analytical models of increasing complexity and their SPICE implementations are discussed. The second part of the course allows students to focus on their field of preference: Device physics; Digital circuits; Analog circuits. The course includes a project in one of these subtopics. Fall, 3 credits, grading ABCF.

ESE 515 Quantum Electronics I

Physics of microwave and optical lasers. Topics include introduction to laser concepts; quantum theory; classical radiation theory; resonance phenomena in two-level systems: Block equations - Kramers Kronig relation, density matrix; rate equation and amplification; CO_2 lasers; discharge lasers; semiconductor lasers. Fall, 3 credits, grading ABCF.

ESE 516, 517 Integrated Electronic Devices and Circuits I and II

Theory and applications: elements of semiconductor electronics, methods of fabrication, bipolar junction transistors, FET, MOS transistors, diodes, capacitors and resistors. Design techniques for linear digital integrated electronic components and circuits. Discussion of computer-aided design. MSI and LSI. Fall, Spring, 3 credits each semester, grading ABCF.

ESE 518 Advanced Design of Low-Noise and Low-Power Analog Circuits

Design of advanced low-noise and low-power analog and mixed-signal integrated circuits for radiation sensors. Students will learn state-of-the-art circuit techniques for low-noise and low-power amplification and processing of signals from sensors. Examples of circuits are low-noise amplifiers, filters, peak detectors and discriminators. Applications range from medical, to security, safety, industrial measurements and physics research. As a course project, students will develop part of a front-end circuit from transistor level to physical layout using industry-standard CAD tools, and will participate in the experimental characterization of those or similar circuits. At the end of the course the student will own a solid background and the basic instruments to design low-noise and low-power amplifiers and processing circuits. Fall, 3 Credits, grading ABCF.

ESE 519 Semiconductor Lasers and Photodectors

The course provides an introduction to performance, testing and fabrication techniques for semiconductor lasers and photodetectors. The topics include fundamentals of laser and detector operation, devices band diagram, device characteristics, and testing techniques for analog and digital edge emitting and surface emitting lasers, avalanche and PIN photodetectors. Special attention is given to the design and working characteristics of transmitters and pumping lasers for telecommunication networks. Prerequisite: BS in Physical sciences or Electrical or Computer Engineering. Fall, 3 credits, grading ABCF

ESE 520 Applied Electromagnetics – CORE COURSE

Wave phenomena and their importance in electromagnetic engineering. Harmonic waves. Phase and group velocities. Dispersive and nondispersive propagation. Transmission lines. Maxwell Equations. Uniform plane waves. Poynting theorems, waveguides, resonators. Scattering matrix theory. Introduction to antenna theory. Electrostatics and magnetostatics as special cases of Maxwell equations. Prerequisite: Bachelor’s degree in Physical Sciences. Spring, 3 credits, grading ABCF.

ESE 521 Applied Optics
This course teaches students the fundamental techniques necessary for analyzing and designing optical systems. Topics include matrix methods for ray optics, fundamentals of wave optics, beam optics, Fourier optics and electromagnetic optics. The latter part of the course will deal with optical activity in anisotropic media and include polarization and crystal optics, electro-optics and acousto-optics. Fall, 3 credits, grading ABCF.

ESE 522 Fiber Optic Systems
This course covers the essential components of a modern optical fiber communication system. Following a brief review of optical sources and characterization of optical fiber waveguides the remainder of the course examines the design of digital fiber optic links, single wavelength fiber-optic networks and wavelength division multiplexing. Fall, 3 credits, grading ABCF.

ESE 524 Microwave Acoustics
Continuum acoustic field equations. Wave equation, boundary conditions and Poynting vector. Waves in isotropic elastic media: Plane-wave modes, reflection and refraction phenomena, bulk-acoustic-wave (BAW) waveguides, surface acoustic waves (SAW's). Plane and guided waves in piezoelectric media. BAW transduction and applications: delay-line and resonator structures, the Mason equivalent circuit, monolithic crystal filters, IM CON dispersive delay lines, acoustic microscopes, SAW transduction and applications: the interdigital transducer, band-pass filters, dispersive filters, convolvers, tapped delay lines, resonators. Prerequisite: ESE 319. Fall, 3 credits, grading ABCF.

ESE 525 Modern Sensors
Sensors are devices that convert physical values into electrical signals. This course will provide practical information on diversified subjects related to the operation principles, design and use of various sensors. Established and novel sensor technologies as well as problems of interfacing various sensors with electronics are discussed. Objectives of the course are; Operation principles of sensors. Practical implementation of the sensors for scientific, industrial and consumer application. Useful and noise signals generated by sensors. Design of the sensor system. Spring, 3 credits, grading ABCF.

ESE 526 Silicon Technology for VLSI
This course introduces the basic technologies employed to fabricate advanced integrated circuits. These include epitaxy, diffusion, oxidation, chemical vapor deposition, ion implantation lithography and etching. The significance of the variation of these steps is discussed with respect to its effect on device performance. The electrical and the geometric design rules are examined together with the integration of these fabrication techniques to reveal the relationship between circuit design and the fabrication process. Fall, 3 credits, grading ABCF.

ESE 527 Circuit Theory and Applications
Foundations of design procedures for electric circuits. Fundamental concepts, graph theory, network equations, network functions, state equations, network synthesis, scattering parameters, nonlinear circuits. Fall, 3 credits, grading ABCF.

ESE 528 Communication Systems – CORE COURSE

This course provides a general overview of communication theory and addresses fundamental concepts in this field. After a review of signals and systems representations, various continuous and digital modulation schemes are analyzed. Spread spectrum systems and their application to multiuser communications are also addressed. Advanced communication systems are described and general concepts of wide and local area networks are introduced. Fall, 3 credits, grading ABCF.

ESE 529 Electrical Network Theory
Linear and nonlinear electrical networks; graph theory; determination of operating points; transient estimation; interconnection networks; numerical methods; parameter extraction; infinite and transfinite networks; discrete potential theory; random walks on networks. Spring, 3 credits, grading ABCF.

ESE 530 Computer-Aided Design
The course presents techniques for analyzing linear and nonlinear dynamic electronic circuits using the computer. Some of the topics covered include network graph theory, generalized tableau and hybrid analysis, companion modeling, Newton's method in n-dimensions, numerical integration, sensitivity analysis, and optimization. Prerequisite: B.S. in electrical engineering. Spring, 3 credits, grading ABCF.

ESE 531 Detection & Estimation Theory
Hypothesis testing and parameter estimation. Series representation of random processes. Detection and estimation of known signals in white and non-white Gaussian noise. Detection of signals with unknown parameters. Prerequisite: ESE 503 or permission of instructor. Spring, 3 credits, grading ABCF.

ESE 532 Theory of Digital Communication - CORE COURSE
Optimum receivers, efficient signaling, comparison classes of signal schemes. Channel capacity theorem, bounds on optimum system performance, encoding for error reduction, and the fading channel. Source coding and some coding algorithms. Prerequisite: ESE 503 or permission of instructor. Fall, 3 credits, grading ABCF.

ESE 535 Information Theory and Reliable Communications
Measures of information: entropy, relative entropy and mutual information. The asymptotic equipartition property. Lossless source coding: Kraft inequality and the source coding theorem. Introduction to error correcting codes. Continuous and waveform channels. Rate-distortion theory. Prerequisite: ESE 503 or equivalent or permission of instructor. Fall, 3 credits, grading ABCF.

ESE 536/*CSE 626* Switching and Routing in Parallel and Distributed Systems (cross listed)
This course covers various switching and routing issues in parallel and distributed systems.
Topics include message switching techniques, design of interconnection networks, permutation, multicast and all-to-all routing in various networks, non-blocking and re-arrangeable capability analysis and performance modeling. Prerequisites: ESE 503 and 545 or CSE 502 and 547, or permission of the instructor. Fall, 3 credits, grading ABCF.

ESE 540 Reliability Theory
Theory of reliability engineering. Mathematical and statistical means of evaluating the reliability of

systems of components. Analytical models for systems analysis, lifetime distributions, repairable systems, warranties, preventive maintenance and inspection. Software reliability and fault tolerant computer systems. Prerequisite: ESE 503 or permission of instructor. Fall, 3 credits, grading ABCF.

ESE 541 Digital System Design - This course is only for students in the Optoelectromechanical Systems Eng. program and cannot be used to fulfill any ESE degree requirement.

This course provides an introduction to digital and computer systems. The course follows a top-down approach to presenting design of computer systems, from the architectural-level to the gate-level. VHDL language is used to illustrate the discussed issues. Topics include design hierarchy and top-down design, introduction to hardware description languages, computer-aided design and digital synthesis, basic building blocks like adders, comparators, multipliers, latches, flip-flops, registers etc., static and dynamic random access memory, data and control buses, fundamental techniques for combinational circuit analysis and design, sequential circuit design procedures, and programmable logic devices. Testing of digital designs is addressed throughout the course. A mini project will complement the course. Spring, 3 credits, grading ABCF.

ESE 542/*MEC 525* Product Design Concept Development and Optimization (cross listed)
This course will concentrate on the design concept development of the product development cycle, from the creative phase of solution development to preliminary concept evaluation and selection. The course will then cover methods for mathematical modeling, computer simulation and optimization. The concept development component of the course will also cover intellectual property and patent issues. The course will not concentrate on the development of any particular class of products, but the focus will be mainly on mechanical and electromechanical devices and systems. As part of the course, each participant will select an appropriate project to practice the application of the material covered in the course and prepare a final report. Prerequisite: Undergraduate electrical or mechanical engineering and/or science training. Fall, 3 credits, grading ABCF.

ESE 544 Network Security Engineering
An introduction to computer network and telecommunication network security engineering. Special emphasis on building security into hardware working with software. Topics include encryption, public key cryptography, authentication, intrusion detection, digital rights management, firewalls, trusted computing, encrypted computing, intruders and virus. Some projects. Prerequisite or co-requisite: ESE 546 OR ESE 548 Fall, alternate years, grading ABCF

ESE 545 Computer Architecture – CORE COURSE
The course covers uniprocessor and pipelined vector processors. Topics include: hierarchical organization of a computer system; processor design; control design; memory organization and virtual memory; I/O systems; balancing subsystem bandwidths; RISC processors; principles of designing pipelined processors; vector processing on pipelines; examples of pipelined processors. The course involves a system design project using VHDL. Prerequisite: ESE 218 or equivalent. Spring, 4 credits, grading ABCF.

ESE 546 Networking Algorithms and Analysis
An introduction to algorithms and analysis for computer and telecommunication networks. Continuous time and discete time single queue analysis. Algorithms for public key cryptography, routing, protocol verification, multiple access, error, codes, data compression, search. Prerequisite: ESE 503 or permission of instructor. Fall, 3 credits, grading ABCF.

ESE 547 Digital Signal Processing

A basic graduate course in Digital Signal Processing. Sampling and reconstruction of Signals. Review of Z-Transform theory. Signal flow-graphs. Design of FUR and IIR filters. Discrete and fast Fourier transforms. Introduction to adaptive signal processing. Implementation considerations. Prerequisites: Senior level course in signals and systems. Fall, 3 credits, grading ABCF.

ESE 548 Local & Wide Area Networking

Extended coverage of specific network protocols. Protocols covered include IEEE 802 Local area network protocols, Asynchronous Transfer Mode (ATM), Synchronous Optical Network (SONET), metropolitan area network protocols, backbone packet switching protocols and transport control protocol/Internet protocol (TCP/IP), network security, web server design and grid computing. Prerequisite: ESE 546 or permission of instructor. As needed in industry. 3 credits, grading ABCF.

ESE 549 Advanced VLSI System Testing

This course is designed to acquaint students with fault diagnosis of logic circuits. Both combinatorial and sequential circuits are considered. Concepts of faults and fault models are presented. Emphasis is given to test generation, test selection, fault detection, fault location, fault location within a module and fault correction. Spring, 3 credits, grading ABCF.

ESE 550 Network Management and Planning

This course provides an introduction to telecommunications and computer network management and planning. Network management is concerned with the operation of networks while network planning is concerned with the proper evolution of network installations over time. Network management topics include meeting service requirements, management operations, management interoperability and specific architectures such as Telecommunications Management Network (TMS), and Simple Network Management Protocol (SNMP). Network planning topics include planning problem modeling, topological planning design, heuristic and formal solution techniques. Fall, 3 credits, grading ABCF.

ESE 551 Switching Theory and Sequential Machines

Survey of classical analysis and synthesis of combination and sequential switching circuits, followed by related topics of current interest such as error diagnosis and fail soft circuits, use of large-scale integration, logic arrays, automated local design. Prerequisite: ESE 218 or equivalent. Fall, 3 credits, grading ABCF.

ESE 552 Interconnection Networks

Formation and analysis of interconnect processing elements in parallel computing organization. Topics include: SIMD/MIMD computers, multiprocessors, multicomputers, density, symmetry, representations, and routing algorithms. Topologies being discussed include: Benes, Omega, Banyan, mesh, hypercube, cube-connected cycles, generalized chordal rings, chordal rings, DeBruijn, Moebius graphs, Cayley graphs and Borel Cayley graphs. Prerequisite: ESE 545 or equivalent. Fall, 3 credits, grading ABCF.

ESE 553 A/D and D/A Integrated Data Converters

This is an advanced course on analog integrated circuit design aspects for data converters. Topics include: continuous and discrete-time signals and systems; sampling theorem; ideal A/D and D/A converters; specifications and testing of data converters; basic building blocks in data converters: current sources and mirrors, differential gain stages, voltage references, S/H circuits, comparators:

Nyquist D/A and A/D converters: principles of data conversion and circuit design techniques; over sampling data converters: low-pass and band-pass delta-sigma modulators, decimation and interpolation for delta-sigma data converters. The attending students must be acquainted with principles of transistor operation, function of simple analysis. Familiarity with SPICE is required. Fall, 3 credits, grading ABCF.

ESE 554 Computational Models for Computer Engineers – CORE COURSE

This course covers mathematical techniques and models used in the solution of computer engineering problems. The course heavily emphasizes computer engineering application. Topics covered include set theory, relations, functions, graph theory and graph algorithms, computational complexity, ordering relations, lattices, Boolean algebras, combinations and algebraic structures. Fall, 3 credits, grading ABCF.

ESE 555 Advanced VLSI Circuit Design – CORE COURSE

Techniques of VLSI circuit design in the MOS technology are presented. Topics include MOS transistor theory, CMOS processing technology, MOS digital circuit analysis and design and various CMOS circuit design techniques. Digital systems are designed and simulated throughout the course using an assortment of VLSI design tools. Prerequisite: BS in Electrical Engineering or Computer Science. Spring, 3 credits, grading ABCF.

ESE 556 VLSI Physical and Logic Design Automation

Upon completion of this course, the students will be able to develop state-of-the-art CAD tools and algorithms for VLSI logic and physical design. Tools will address design tasks such as floor planning, module placement and signal routing. Also, automated optimization of combinational and sequential circuits will be contemplated. Prerequisite: BS in Computer Engineering/Science or Electrical Engineering. Spring, 3 credits, grading ABCF.

ESE 557 Digital Signal Processing II: Advanced Topics

A number of different topics in digital signal processing will be covered, depending on class and current research interest. Areas to be covered will include the following: parametric signal modeling, spectral estimation, multirate processing, advanced FFT and convolution algorithms, adaptive signal processing, multidimensional signal processing for inverse problems. Students will be expected to read and present current research literature. Prerequisite: ESE 547 or permission of instructor. Spring, 3 credits, grading ABCF.

ESE 558 Digital Image Processing I

Covers digital image fundamentals, mathematical preliminaries of two-dimensional systems, image transforms, human perception, color basics, sampling and quantization, compression techniques, image enhancement, image restoration, image reconstruction from projections, and binary image processing. Prerequisite: BS in engineering or physical or mathematical sciences. Spring. 3 credits, grading ABCF.

ESE 559 Digital Image Processing II

The course material will proceed directly from DIP-I starting with image reconstruction from projections. After the basic projection theorems are developed, computerized axial tomography techniques will be examined in detail including forward and inverse random transformations, convolution, back projection and Fourier reconstruction: nuclear magnetic resonance imaging and positron emission tomography will be similarly covered. Surer resolution concepts will be developed and applied to a variety of remote sensing applications as well as digital image coding for efficient transmission of digital TV imagery. Prerequisite: ESE 558. Spring, 3 credits, grading ABCF.

ESE 560 Optical Information Processing

The course is designed to give the student a firm background of the fundamentals of optical information processing techniques. It is assumed that the student is familiar with complex algebra and is conversant with the principles of linear system theory and Fourier transformation. The body of the course is concerned with the scalar treatment of diffraction and its application to the study of optical imaging techniques and coherent and incoherent optical processors. Prerequisite: Bachelor's degree in Physical Sciences. Spring, 3 credits, grading ABCF.

ESE 563 Fundamentals of Robotics I

This course covers: homogenous transformations of coordinates; kinematic and dynamic equations of robots with their associated solutions; control and programming of robots. Prerequisite: Permission of instructor. Fall, 3 credits, grading ABCF.

ESE 565 Parallel Processing Architectures

The course provides a comprehensive introduction to parallel processing. Topics include; types of parallelism, classification of parallel computers; functional organizations, interconnection networks, memory organizations, control methods, parallel programming, parallel algorithms, performance enhancement techniques and design examples for SIMD array processors, loosely coupled multiprocessors, tightly coupled multiprocessors will be discussed; a brief overview of dataflow and reduction machines will also be given. Prerequisite: ESE 545 or equivalent. Spring, 3 credits, grading ABCF.

ESE 566 Hardware-Software Co-Design of Embedded Systems

This course will present state-of-the-art concepts and techniques for design of embedded systems consisting of hardware and software components. Discussed topics include system specification, architectures for embedded systems performance modeling and evaluation, system synthesis, and validation. The course is complemented by three mini-projects focused on designing and implementing various co-design methods. Prerequisite: ESE 545, ESE 554 and ESE 333.
Fall, 3 credits, grading ABCF.

ESE 568 Computer and Robot Vision

Principles and applications of computer and robot vision are covered. Primary emphasis is on techniques and algorithms for three-dimensional machine vision. The topics include image sensing of three- dimensional scenes, a review of two-dimensional techniques, image segmentation, stereo vision, optical flow, time-varying image analysis, shape-from-shading, texture, depth-from- defocus matching, object recognition, shape representation, interpretation of line drawings, and representation and analysis of 3D range data. The course includes programming projects on industrial applications of robot vision.

Prerequisite: BS in Engineering or Physical or Mathematical Sciences. Fall, 3 credits, grading ABCF.

ESE 570 Bioelectronics

Origin of bioelectric events; ion transport in cells, membrane potentials; neural action potentials and muscular activity, cortical and cardiac potentials. Detection and measurement of bioelectric signals; impedance measurements used to detect endocrine activity, perspiration and blood flow; impedance cardiography, vector cardiography; characteristics of transducers and tissue interface; special requirements for the amplification of transducer signals. Fall, 3 credits, grading ABCF.

ESE 571 – Introduction to Auto ID Technologies

Introductory course is first in a series of Auto ID systems, technologies and applications. The course covers theory and applications of important data-capture technologies, namely, barcodes, biometrics and RFID. Topics to be covered include: architecture of data-capture/Auto ID systems, barcodes: overview of 1-D and 2-D barcodes and other LOS technologies; biometrics: fingerprints, iris-scan, voice recognition and smart cards; radio frequency identification (RFID): fundamentals, near-field vs. far-field, UHF read range estimation, reader sensitivity limits, tag singulation and multiple access protocols, standards, privacy and security issues in RFID, real time location systems (RTLS), and wireless sensor networks.

ESE 575 Advanced VLSI Signal Processing Architecture

This course is concerned with advanced aspects of VLSI architecture in digital signal processing and wireless communications. The first phase of the course covers the derivation of both data transformation and control sequencing from a behavioral description of an algorithm. The next phase reviews the general purpose and dedicated processor for signal processing algorithms. This course focuses on low-complexity high-performance algorithm development and evaluation, system architecture modeling, power-performance tradeoff analysis. The emphasis is on the development of application-specific VLSI architectures for current and future generation of wireless digital communication systems. An experimental/research project is required. Prerequisite: ESE 355 or equivalent. ESE 305 or ESE 337 or equivalent. ESE 306 or ESE 340 or equivalent. ESE 380 or equivalent. Spring, 3 credits, grading ABCF.

ESE 580, 581 Microprocessor-Based Systems, Engineering I and II

This course is a study of methodologies and techniques for the engineering design of microprocessor-based systems. Emphasis is placed on the design of reliable industrial quality systems. Diagnostic features are included in these designs. Steps in the design cycle are considered. Specifically, requirement definitions, systematic design implementation, testing, debugging, documentation and maintenance are covered. Laboratory demonstrations of design techniques are included in this course. The students also obtain laboratory experience in the use of microprocessors, the development of systems, circuit emulation and the use of signature and logic analyzers. Fall, Spring, 4 credits, each semester, grading ABCF.

ESE 585 Nanoscale Integrated Circuit Design

This course describes high performance and low power integrated circuit (IC) design issues for advanced nanoscale technologies. After a brief review of VLSI design methodologies and current IC trends, fundamental challenges related to the conventional CMOS technologies are described. The shift from logic-centric to interconnect-centric design is emphasized. Primary aspects of an interconnect-centric design flow are described in four phases: (1) general characteristics of on-chip interconnects, (2) on-chip interconnects for data signals, (3) on-chip power generation and distribution, and (4) on-chip clock generation and distribution. Existing design challenges faced by IC industry are investigated for each phase. Tradeoffs among various design criteria such as speed-power-noise-area are highlighted. In the last phase of the courses, several post-CMOS devices, emerging circuit styles, and architectures are briefly discussed. At the end of the course, the students will have a thorough understanding of the primary circuit and physical level design challenges with application to industrial IC design. Prerequisite: ESE 555 or ESE 330 and ESE 355. Spring, 3 credits, grading ABCF.

ESE 588 Pattern Recognition

Basic concepts of pattern recognition techniques are introduced, including statistical pattern recognition, syntactic pattern recognition and graph matching. Topics on Bayes decision theory, parametric and nonparametric techniques, clustering techniques, formal languages, parsing algorithms and graph matching algorithms are covered. Prerequisite: Stochastic Processes and Data Structures. Spring, 3 credits, grading ABCF.

ESE 591 Industrial Project in OEMS Engineering

Students must carry out a detailed design of an industrial project in Optoelectromechanical Systems engineering. A comprehensive technical report of the project and an oral presentation are required. Fall, 3 credits, grading ABCF.

ESE 597 Practicum in Engineering (Internship) *Non-Regular Course*

This course is for part-time and full-time students who will be on Curricular Practical Training (CPT). CPT is defined as training that is an integral part of an established curriculum. Participation is in private corporations, public agencies or non-profit institutions. Students will be required to have a faculty coordinator as well as a contact in the outside organization, to participate with them in regular consultations on their project and to submit a final report to both. Registration must have the prior approval of the Graduate Program Director. This course can only be taken once by master‘s students and the credits must count towards the degree completion. Summer only, variable credit (1-3). Grading, S/U.

ESE 599 Research (for students in the Master's program) *Non-Regular Course*

Fall and Spring, variable and repetitive credit, Grading S,U.

ESE 610 Seminar in Solid-State Electronics

Current research in solid-state devices and circuits and computer-aided network design. Fall and Spring, 3 credits, grading.

ESE 670 Topics in Electrical Sciences

Varying topics selected from current research topics. This course is designed to give the necessary flexibility to students and faculty to introduce new material into the curriculum before it has attracted sufficient interest to be made part of the regular course material. Topics include: a) Biomedical Engineering; b) Circuit Theory; c) Controls; d) Electronics Circuits; e) Digital Systems and Electronics; f) Switching Theory and Sequential Machines; g) Digital Signal Processing; h) Digital communications; i) Computer Architecture; j) Networks; k) Systems Theory; l) Solid State Electronics; m) Integrated Electronics; n) Quantum Electronics and Lasers; o) Communication Theory; p) Wave Propagation; q) Integrated Optics; r) Optical Communications and Information Processing; s) Instrumentation; t) VLSI Computer Design and Processing. Fall and Spring, variable and repetitive credit.

ESE 691 Seminar in Electrical Engineering

This course is designed to expose students to the broadest possible range of the current activities in electrical engineering. Speakers from both on and off campus discuss topics of current interest in electrical engineering. Fall and Spring, 1 credit, repetitive, grading S,U

ESE 697 Ph.D. Practicum in Teaching – * 3 credits required for Ph.D. degree - *Non-Regular Course*

This course provides hands-on experience in classroom teaching. Other activities may include preparation and supervision of laboratory experiments, exams, homework assignments, and projects.
Final report that summarizes the activities and provides a description of the gained experience and a list of recommendations is required. 3 credits, grading ABCF.
*Prerequisite: G5 status and Permission of Graduate Program Director. Students must inform the department TWO weeks prior to the beginning of each semester, if they plan on taking ESE 697. The graduate program director will then assign you to a course.

ESE 698 Practicum in Teaching *Non-Regular Course*

This course enables graduate students to gain experience in teaching and interacting with students enrolled in an electrical and computer engineering courses. Students enrolled in ESE 698 are expected to perform various teaching duties required by the course instructor, such as attending lectures, providing office hours, holding review/recitation sessions, assisting in lab sections, grading, etc. Fall, Spring and Summer, variable and repetitive, grading ABCF.

ESE 699 Dissertation (Research on Campus) *Non-Regular Course*

Students should register for this if the major portion of their research will take place on Stony Brook University campus, Cold Spring Harbor or Brookhaven National Lab.
Fall and Spring, variable and repetitive credit, grading S,U.

ESE 700 Dissertation Research (Off Campus – Domestic) *Non-Regular Course*

Students should register for this when a major portion of their research will take place off-campus but in the United States and/or U.S. provinces (please note that Brookhaven National Labs and Cold Spring Harbor are considered on-campus). All international students who register for ESE 700 must enroll in one of the graduate student employee insurance plans and should be advised by an International Advisor. Fall and Spring, variable and repetitive credit, grading S,U.

ESE 701 Dissertation Research (Off Campus – INTERNATIONAL) *Non-Regular Course*

Students should register for this when a major portion of their research will take place outside of the

United States and/or U.S. provinces. In these cases, domestic students have the option of the health plan and may also enroll in MEDEX. Fall and Spring, variable and repetitive credit, grading S,U.

International students should note the following:

- International students who are in their home country are NOT covered by the mandatory health plan and must contact the Insurance Office for the insurance charge to be removed.

- International students who are not in their home country ARE charged for the mandatory health insurance. If they are to be covered by another insurance plan, they must file a waiver by the second week of classes. The charge will only be removed if the other plan is deemed comparable.
- All international students must receive clearance from an International Advisor.

ESE 800 Full-Time Summer Research
0 Credits, S/U grading

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OUTSIDE OF DEPARTMENT: COURSE LISTING

Please Note: The following are courses from outside of the ECE department that may be used by Computer Engineering majors (as stated by guidelines) toward achieving their degree.

CSE 504 Compiler Design
Advanced topics in compilation, including memory management, dataflow analysis, code optimization, just-in-time compilation, and selected topics from compilation of object-oriented and declarative languages. Prerequisite: CSE 304 and CSE 307. Spring, 3 credits.

CSE 506 Operating Systems
This course is an in-depth study of important concepts and techniques found in modern computer operating systems. An undergraduate course in operating systems is a prerequisite. The course focuses on in-depth study of such important issues as virtual memory, filesystems, networking, and multiprocessor support, with an eye to recent directions in these areas. Textbook readings are supplemented, where appropriate, by papers from the research literature. An important part of the course is the case study of an actual operating system. Students study the source code for this operating system, and do programming exercises and projects that involve modifying the operating system and measuring its performance. Prerequisite: CSE 306. Spring, 3 credits.

CSE 526 Principles of Programming Languages
Programming language concepts and design, with emphasis on abstraction mechanisms. Topics include: language paradigms (procedural, object-oriented, functional and logic), language concepts (values, bindings, types, modules), and foundations (lambda calculus, denotational semantics). Examples will be drawn from several representative languages, such as C, Java, Standard ML and Prolog. Prerequisite: CSE 307. Spring, 3 credits.

CSE 533 Network Programming

Socket and client-server programming, remote procedure calls, data compression standards and techniques, real-time protocols (e.g: audio chat, etc,) security and cryptography (specifically, application layer security issues (e.g., authentication), web-related programming (CGI, Java/Java Script, HTTP, etc.,) network management (SNMP-based management, dynamic/CORBA-based management). Prerequisite: CSE 306 and CSE 310. Fall and Spring, 3 credits.

CSE 548/AMS542 Analysis of Algorithms

Techniques for designing efficient algorithms, including choice of data structures, recursion, branch and bound, divide and conquer, and dynamic programming. Complexity analysis of searching, sorting, matrix multiplication, and graph algorithms. Standard NP-complete problems and polynomial transformation techniques. Prerequisite: CSE 373. Fall, 3 credits.