ELECTRICAL ENGINEERING

GRADUATE STUDENT HANDBOOK

Master of Science
Doctor of Philosophy

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1. INTRODUCTION

This document serves as the primary source of information for the graduate programs in the Department of Electrical and Computer Engineering, as well as a manual on policies, procedures and guidelines for students and faculty involved in the program. It will be updated in a timely fashion to comply with regulation and requirement changes initiated either by the Graduate Curriculum Development (GCD) Committee in the Department of Electrical and Computer Engineering, the College of Engineering or the University. These changes will be initiated by the GCD committee and approved by the department's faculty. Guidelines and policies stipulated in this manual form the official basis for the program of study of each graduate student in the Department of Electrical and Computer Engineering. All graduate students must follow the requirements outlined in the University Graduate Catalog and this handbook.

2. GRADUATE CURRICULUM DEVELOPMENT COMMITTEE

The Graduate Curriculum Development Committee is primarily responsible for:

- Reviewing the graduate curriculum and recommending course additions, deletions, and changes.
- Reviewing and selecting graduate applicants for admission, assistantships or fellowships.
- Preparing graduate program brochures and other informational material.
- Recommending and approving graduate policies, procedures and guidelines.
- Staying abreast of graduate activities, needs, and potential opportunities for service on a broader basis in order to best serve the Department, College, University and the State of North Carolina.

3. STUDENT GRADUATE ADVISORY COMMITTEE

Each graduate student will form a committee whose role is to:

- Assist the student in defining his/her program of study;
- Advise the student on proper procedures;
- Monitor and guide the progress of the student towards timely completion of his/her program;
- Assess and certify the student's completion of his/her program.

The Committee Chair has overall responsibility for the thesis/project or dissertation research and serves as an advisor who should guide and administer the student's research accordingly.

4. GRADUATE PROGRAM GENERAL DESCRIPTION

The Master of Science in Electrical Engineering Program provides graduate level education for advanced professional practice or further graduate studies. This program is open to students with a bachelor's degree in a scientific discipline from an institution of recognized standing. The Doctoral Program is the terminal degree within the Department of Electrical and Computer Engineering at North Carolina A&T State University. The educational objectives of the graduate programs in Electrical Engineering are as follows:

1. To provide master and doctoral levels of study for students who have completed their bachelor's or master's degrees from North Carolina A&T State University, or an ABET accredited, equivalent university.

2. To provide local practicing electrical engineers from the Piedmont Triad with a part-time graduate program in electrical engineering.

3. To provide the region with a full-time graduate electrical engineering program.

4. To foster research in electrical engineering for the benefit of North Carolina A&T State University and its graduate students.

5. To enrich the undergraduate program as a result of student interaction with high quality engineering faculty who are concerned with graduate study and research.

6. To provide a graduate level electrical engineering resource to support electrical engineering activities in local and regional industry and in government.

7. To foster industrial development in the state and region.

The Graduate Program in the Department of Electrical and Computer Engineering offers the following degrees:

- Master of Science - Electrical Engineering
- Doctor of Philosophy - Electrical Engineering

The programs emphasize areas of specialization, which are the current strengths of the department. Thus, the department offers the following four areas of concentration for the graduate programs:

- Computer Engineering
- Communications and Signal Processing
- Electronic and Optical Materials and Devices
- Power Systems and Control

There are other academic programs at the university that are related to the graduate programs in the Department of Electrical and Computer Engineering. These programs are important because they include academic subject matter of potential interest to students as supporting courses and areas of minor concentration. Specific supporting master's degree programs include:

- Applied Mathematics, Physics, Chemistry
- Computer Science
- Industrial Engineering
- Mechanical Engineering
- Architectural Engineering
- General (interdisciplinary) Engineering
- Biology
- Environmental Engineering
- Bioinformatics
- Nano Science or Engineering

5. GRADUATE PROGRAM ADMISSION REQUIREMENTS

5.1. ADMISSION REQUIREMENTS FOR MASTERS DEGREE PROGRAM

A prospective student must first be admitted to the School of Graduate Studies. The applicant must have completed the required application forms and submitted two official copies of his or her undergraduate and/or graduate transcripts to the Graduate School. An official GRE score is required for all overseas students. Satisfying the requirements described does not guarantee admission. Students are admitted solely by the department in three categories:

5.1.1 Unconditional Admission

An applicant may be unconditionally admitted to the MSEE program if he/she possesses an undergraduate degree in Electrical Engineering from an ABET accredited institution with an overall GPA of 3.0 or better on a 4.0 scale. In addition, each applicant must have a 3.0 average in all of his or her engineering courses. International students are not given unconditional status unless they submit the GRE scores to the School of Graduate Studies.

5.1.2 Provisional Admission

Applicants may be granted provisional admission if they do not qualify for unconditional admission due to one or more of the following reasons:

a) Applicant has a non-Electrical Engineering baccalaureate engineering degree with a GPA of 3.0 or better, but he/she is deficient in required background courses.

b) Applicant who does not have a degree from an ABET accredited curriculum (e.g. international students) did not submit the GRE scores. A minimum GRE score of Verbal + Quantitative = 1100 for the test before August 2011 or 300 for the test after August 1, 2011 is required for the unconditional status.

c) Applicant has an overall GPA less than 3.0 in Electrical Engineering, but has a GPA over 2.8.

d) Electrical Engineering student has a GPA less than 2.8 with a minimum GRE Verbal + Quantitative scores of 1100 1100 for the test before August 2011 or 300 for the test after August 1, 2011.

A provisionally admitted student must achieve unconditional admission after completing all background courses and 9 graduate credit hours with an average of 3.0 or better. Upon the satisfaction of the above conditions, the student may request through the Graduate Coordinator for conversion to unconditional status by the School of Graduate Studies.

A Provisional student must not take more than 12 graduate credit hours in Electrical Engineering prior to receiving unconditional admission to the MSEE program. A student who fails to have his/her status upgraded risks not receiving graduate credit for completed graduate courses. It is the student's responsibility to request his/her status change from provisional status to unconditional status by the School of Graduate Studies through the Graduate Coordinator.

5.1.3 Post-Baccalaureate Studies (PBS)

This category applies to a student who does not possess a GPA of 3.0 or better from an accredited program, lacking a baccalaureate degree in engineering and requiring 9-15 hours of prerequisites in general engineering background.

Upon completion of the required background courses with a "B" average or better, the student may reapply to the graduate program. However, the PBS student must not take more than 12 graduate credit hours in Electrical Engineering prior to applying for admission to the MSEE program. No more than 12 graduate credit hours earned in PBS status can be counted in his/her MSEE program.

All graduate students admitted in the Department of Electrical and Computer Engineering must meet with the Graduate Coordinator to obtain information about the graduate programs. The Graduate Coordinator assists each student with registration and course selection until the student selects a permanent advisor by mutual agreement between the student and the faculty member. The student must select a permanent advisor no more than nine (9) credit hours into the program or by the end of the first semester.

5.2. ADMISSION REQUIREMENTS FOR DOCTORAL DEGREE PROGRAM

All applications for admission to the Ph.D. program are subject to review by the Graduate Curriculum Development (GCD) Committee in the Department. The GCD Committee's recommendation is not subject to further review. Satisfying the requirements described below does not guarantee admission. Denial of admission does not necessarily imply a negative evaluation of an applicant's qualification. Limited space, facilities, funding and mismatch in areas of interest may place limitations on the number of students who may be admitted.

5.2.1 Unconditional Admission

The minimum admission requirements for the Ph.D. program are as follows:

1. The student seeking a Doctor of Philosophy Degree in Electrical Engineering must possess a Master of Science Degree in Electrical Engineering, Computer Engineering, or a related discipline.
2. The applicant should have an overall graduate GPA of 3.0 or better on a 4.0 scale.
3. The applicant must submit his/her GRE scores to the School of Graduate Study. A minimum GRE score of Verbal + Quantitative = 1100 for the test before August 2011 or 300 for the test after August 1, 2011 is required for the unconditional status.
4. The application must include three letters of recommendations, one of which must come from an individual knowledgeable of the student's graduate performance and potential. The recommendations must be sent to the School of Graduate Studies in sealed envelopes.
5. An international student from a non-English speaking country must submit a TOEFL score.

5.2.2 Provisional Admission

An applicant may be granted provisional admission if they do not qualify for unconditional admission due to one or more of the following reasons:

a) Applicant does not have a 3.0 overall GPA in his/her master's degree. (Note: Applicant must have at least a 3.0 overall graduate GPA).
b) Applicant has a non-Electrical Engineering baccalaureate engineering degree with a GPA of 3.0 or better, but he/she is deficient in required background courses. (Note: Applicant must complete more than four (4) background courses).

Each applicant must submit his or her GRE scores to the Department of Electrical and Computer Engineering. A student in the provisional admission category must obtain 3.0 GPA after 12 credit hours earned in less than a year. The adjustment to unconditional status will occur after the change is requested through the Graduate Coordinator.

5.2.3 Direct-PhD Programs from B.S Degree

A highly qualified applicant with a bachelors (or equivalent) degree, without an M.S. degree, can apply for the Ph.D. Program. Such students generally shall have a bachelor's degree in electrical/computer engineering from an ABET accredited university, or from an acceptable institution of higher learning that is recognized by the department and the university.

a) Direct entry into the Ph.D. program shall be contingent upon an earned GPA of 3.5 or higher over the last 60 course credit hours of his/her undergraduate degree.
b) A minimum GRE score of Verbal + Quantitative = 1100 for the test before August 2011 or 300 for the test after August 1, 2011 is required for the direct-PhD application.
c) The applicant is advised to establish a relationship with at least one faculty member of the department who agrees to be the student's dissertation advisor.
d) The decision to recommend direct entry into the direct-PhD program shall be made by the Graduate Coordinator with recommendation by two faculty members in the Department of Electrical and Computer Engineering.
e) A prior research experience is required during his/her undergraduate program.

Every graduate student admitted in the Department of Electrical and Computer Engineering meet with the Graduate Coordinator to obtain information about graduate programs. The Graduate Coordinator provides assistance with registration and course selection until the student selects a permanent advisor by mutual agreement between the student and the faculty member. The student must select his/her permanent advisor by the completion of nine (9) credit hours or by the end of the first semester.

6. MASTER DEGREE PROGRAM REQUIREMENTS

6.1. PROGRAM OPTIONS AND CREDIT HOUR REQUIREMENTS

The Master of Science in Electrical Engineering program consists of three options: (a) Thesis Option (b) Project Option and (c) Course Only Option. All options require total 30 credit hours including ECEN Core Courses, ECEN Elective, Technical Elective, and thesis or project as follows:

Category	Course	Credit Hours Required for Each Option		
		Thesis	Project	Course Only
ECEN Core	*	9	9	9
ECEN Elective	ECEN600-800	9	9	9
Technical Elective	Adviser's Approval	6	9	12
Program Option	ECEN797 (Thesis) ECEN796 (Project)	6	3	
Exit Exam for Course Only				0
Total Credit Hours Required		30	30	30

* ECEN Core: Student must choose one of the core concentration areas:
- Computer Engineering (CpE): ECEN621 / ECEN623 / ECEN647
- Communications and Signal Processing (C&S): ECEN649 / ECEN650 /ECEN656
- Materials and Devices (M&D): ECEN625 / ECEN629 / ECEN702
- Controls and Power (C&P): ECEN668 / ECEN678 / ECEN870

❖ The Course Only Option includes and exit exam for capstone experience.

❖ At least 60% of the 30 credits (18) must be at the 600 or 700 level.

All students must take the three core courses (9 credit hours) in his/her declared core concentration area based on the student adviser's area, and three ECEN elective courses (9 credit hours). In addition, as the technical elective, two courses (6 credit hours), three courses (9 credit hours) and four courses (12 credit hours) for Thesis, Project and Course Only option, are required, respectively.

Therefore, the Thesis Option requires a minimum of 24 hours of coursework and six credit hours of master's thesis ELEN797 (Master's thesis). The Project Option requires a minimum of 27 hours of coursework and three hours of ELEN796 (Master's project). The Course Only Option requires 30 hours of coursework. However, at least 18 credit hours (60% of the 30 credits) must be taken among the 600 and 700 levels. The course only option requires an exit examination for the program completion and graduation.

6.2. SELECTION OF ADVISOR

At the beginning of the first semester, the student meets with the Graduate Coordinator to obtain information about the Graduate Program. The Graduate Coordinator assists the student with registration and course selection until the student selects a permanent advisor by mutual consent. The student must select his/her permanent advisor by the completion of nine (9) credit hours or by the end of the first semester.

6.3. THE PLAN OF GRADUATE STUDY FOR THE MASTER DEGREE PROGRAM

By the completion of nine (9) credit hours or by the end of the first semester, the student and his/her advisor must establish a Plan of Graduate Study for the student's chosen master's program and submit the original document including signatures of all members of the Advisory Committee to the Graduate Coordinator. Copies of the Plan of Graduate Study must be submitted to the School of Graduate Studies and all committee members. Also, a copy of the Plan of Graduate Study must be filed in the department. The Plan of Graduate Study must show the committee chairperson, other committee members, and a chronological list of courses approved by the student's advisor. A committee member's signature on the Plan of Graduate Study denotes his/her approval of the plan for the student's Master's program. After approval by the Graduate Coordinator, the Plan of Graduate Study becomes the student's official guideline for the completion of his/her Master's degree program.

6.4. CHANGE OF ADVISOR AND STUDY PLAN

A student may change his/her advisor at any time through mutual consent. When a student changes his/her advisor, the student must submit a revised Plan of Graduate Study including signatures of the new advisor and all committee members, along with the consent of the previous advisor. After the submission of the initial Plan of Graduate Study, a student must resubmit a revised Plan of Graduate Study to the Graduate Coordinator indicating that the plan has been "REVISED" and including the signatures of his/her advisor and all committee members.

6.5. THE ADVISORY COMMITTEE

The advisor and the student form the Advisory Committee for the student's thesis/project by the completion of nine (9) credit hours or by the end of the first semester. The advisory committee will have a minimum of three members for the thesis option and two members for the project option including the student's advisor. The advisor serves as the chairperson of the advisory committee. For the course only option, only the student's advisor guides and advises the student's graduate program. The advisor must be a faculty member in the Department of Electrical and Computer Engineering. Only one member of the committee may be selected from outside of the department. A co-advisor may be selected from outside of the department for the student Advisory Committee. This co-advisor is responsible for the student's research work and financial support in the spirit of cooperation with the main advisor in the department. A co-advisor from outside the department must apply in writing and be approved by the Graduate Curriculum Development (GCD) Committee in the department. The main advisor is responsible for advising the student.

6.6. TIMING FOR TRANSFERRING TO DIRECT-PhD PROGRAM WITHOUT A MS DEGREE

A MS student with a GPA 3.8 or better after 18 graded course credit hours taken may request to change his/her graduate program from MS to Direct-PhD on recommendation of two faculty members in the department. Such a student who enters the Ph.D. program must take the Qualifying Examination in one and a half year after entering the Ph.D. program. A prior research experience is required in the research area the student intends to pursue.

6.7. RESEARCH TITLE AND SCOPE APPROVAL FOR THESIS/PROJECT

A student's research title and scope must be approved by the student's advisory committee for the MS thesis and project options. The thesis/project proposal and its approval must be completed at least one semester before the date of the oral defense examination. Therefore, the student's advisor must call a proposal meeting where the student presents his/her research proposal with the title and scope.

6.8. THESIS/PROJECT ORAL EXAMINATION

The student must present his/her thesis/project work to their Advisory Committee for the thesis or project Oral Examination. In order to schedule the thesis/project Oral Examination, the student must submit an Application for Oral Examination including signatures of all members of the Advisory Committee to the Graduate Coordinator at least two weeks prior to the date of the Oral Examination. This notification must include the date, time and place of the Oral Examination. The student requesting his/her Oral Examination must distribute a copy of the thesis/project to all members of his/her committee two weeks prior to the date of the Oral Examination. The copy of the application form for the Oral Examination, as approved by the Graduate Coordinator, must be sent to the members of the committee to confirm the approval, date and place. If any committee member cannot participate in the scheduled Oral Examination, it must be rescheduled. The location of a thesis/project Oral Examination must be on-campus so that the presentation is accessible to faculty, staff and students.

6.9. SUBMISSION OF THESIS/PROJECT

Upon passing the thesis/project Oral Examination, the student must have their thesis approved by the advisor and the Chairperson of Electrical and Computer Engineering Department. The thesis must be submitted to the School of Graduate Studies by the deadline given in the academic calendar, and must conform to the Guide for Preparation of a Thesis. A copy of this document may be obtained from the School of Graduate Studies. The student's project report for the project option must be submitted to the departmental office.

6.10. SUMMARY OF PROCEDURES FOR THE MASTERS DEGREE PROGRAM

1. Apply for admission to the School of Graduate Studies.
   (a) The application and all supporting documentation are sent to the School of Graduate Studies.
   (b) The application material includes the following items:
      - The signed application form, application processing fee, letters of recommendation, N.C. residency form (if applicable), acknowledgement card, letter of intent, official transcripts, and other supporting documents
2. Student receives admission decision from the School of Graduate Studies.
3. Student submits the enrollment intention card to the School of Graduate Studies.
4. Student meets with the Graduate Coordinator to obtain information about graduate programs.
5. Student prepares course schedule and registers for classes under the supervision of the Graduate Coordinator.
6. Graduate Coordinator may assign a temporary advisor until a permanent advisor is found.
7. Student selects a permanent advisor by the completion of nine (9) credit hours or by the end of the first semester.
8. Student completes the Plan of Study for the Master's program in consultation with his/her advisor by the completion of nine (9) credit hours or by the end of the first semester including the following:
   - Selection of the Program Option (Thesis, Project, and Course Only)
   - Selection of the advisory committee members according to the program option
   - Course list according to the coursework requirement
   - Signatures of all members of the advisory committee
9. Student must submit the original Plan of Study to the Graduate Coordinator with all signatures of the committee members and the Plan of Study will be submitted to the School of Graduate Studies and all committee members. Also, the copy of the Plan of Study must be file in the department.
10. This Plan of Study becomes the student's official guideline for the student's master's degree program.
11. If a student decides to change his/her Plan of Study, the student must restart from Step 7 above.
    - The revised Plan of Study must include the word "REVISED".
12. Student completes all the coursework.
13. For the Thesis/Project options, the student must present the research scope to the committee members in the proposal meeting which is called by the student's advisor. The committee members must approve these items at least one semester before the Final Oral Examination. The Thesis/Project Title and Research Scope Approval must be submitted to the Graduate Coordinator with all signatures by the committee members.
14. For the Thesis/Project options, the student schedules the Thesis/Project presentation and defense in consultation with his/her advisor, and submits the Application for Oral Examination to the Graduate Coordinator and the School of Graduate Studies with all signatures from the advisory committee. Upon approval of the request, the student submits the written report for the Project Option or the draft of the thesis for the Thesis Option to all committee members for review at least two weeks prior to the suggested date. The student completes the Thesis/Project presentation and defense.
15. The examination result must be sent to the Graduate Coordinator with signatures of all committee members, and it will be submitted to the School of Graduate Studies within 48 hours.
16. Student submits Application for Graduation to the Graduate Coordinator, and then the Graduate Coordinator submits Final Graduate Clearance Checklist to the School of Graduate Studies.
17. All of the required documentation is submitted to the School of Graduate Studies and the Department Office.
18. The student graduates.
19. See the university web site for dates and deadlines.

7. DOCTORAL DEGREE PROGRAM REQUIREMENTS

7.1. CREDIT-HOUR REQUIREMENTS AFTER MS DEGREE

The Ph.D. program in Electrical Engineering is based on the Dissertation Option. This program requires total 36 credit hours after Master degree and 60 for Direct-PhD (after BS degree) including ECEN Core Courses (only for Direct-PhD), ECEN Elective, Technical Elective, and Dissertation credit hours as follows:

Category	Course	Credit Hours Required	
		Post-MS	Direct-PhD (After BS)
ECEN Core (Direct-PhD)	*		9
ECEN Elective	ECEN600-800	15	30
Technical Elective	Adviser's Approval	9	9
Qualifying Exam		0	0
Preliminary Exam		0	0
Dissertation	ECEN997	12	12
Doctoral Seminar			
Total Credit Hours Required		36	60

* ECEN Core: Student must choose one of the core concentration areas:
- Computer Engineering (CpE): ECEN621 / ECEN623 / ECEN647
- Communications and Signal Processing (C&S): ECEN649 / ECEN650 /ECEN656
- Materials and Devices (M&D): ECEN625 / ECEN629 / ECEN702
- Controls and Power (C&P): ECEN668 / ECEN678 / ECEN870

❖ At least 12 credit hours of the coursework must be at 800 level for Post-MS.
❖ At least 24 credit hours of the coursework must be at 800 level for Direct-PhD (after BS).

A Direct-PhD student must take three core courses (9 credit hours) in his/her declared core concentration area based on the student adviser's area. Five ECEN elective courses (15 credit hours) are required for Post-MS and ten courses (30 credit hours) for Direct-PhD, respectably. In addition, as the technical elective, three courses (9 credit hours) are required for all students.

At least 12 credit hours and 24 credit hours must be completed at 800 level for Post-MS and Direct-PhD, respectably. All students must complete a minimum of 12 credit hours of doctoral dissertation ECEN997, and all students must pass the Qualifying Examination and Preliminary Examination before the final Dissertation Oral Defense.

7.2. DISSERTATION RESEARCH

There is no limit to the maximum number of dissertation credits for Ph.D. students. However, no more than 12 dissertation credits are counted toward the credit hours requirement described above. Student can not register the dissertation credits before passing Qualifying Examination. The dissertation research must be continued in the declared major area.

7.3. SELECTION OF ADVISOR

At the beginning of the first semester, each student meets with the Graduate Coordinator to obtain information about the Graduate Program. The Graduate Coordinator assists the student with registration and course selection until the student selects a permanent advisor by mutual consent. The student must select his/her permanent advisor by the completion of nine (9) credit hours or by the end of the first semester.

7.4. DOCTORAL ADVISORY COMMITTEE

The advisor and the student must form the Advisory Committee for the student's dissertation by the completion of nine (9) credit hours or by the end of the first semester. The Advisory Committee for the Ph.D. program consists of an advisor in the student's major subject and four other members. The adviser serves as a chairperson of the Advisory Committee. The chair must be selected from the Department of Electrical and Computer Engineering based on the area of emphasis chosen by the student. More than half of the members must be selected from the Department of Electrical and Computer Engineering. The Advisory Committee may consist of co-advisor. A co-advisor from outside of the department must apply in writing and be approved by the Graduate Curriculum Development (GCD) Committee in the department. At least a co-adviser must be selected among the faculty members in the major area in the department if the main adviser is outside from the student's major area.

7.5. THE PLAN OF GRADUATE STUDY FOR DOCTORAL PROGRAM

By the completion of nine (9) credit hours or by the end of the first semester, the student and his/her advisor establish the Plan of Graduate Study for the student's doctoral program and submit the original document with signatures of all members of the Advisory Committee to the Graduate Coordinator. Copies of the Plan of Graduate Study must be submitted to the School of Graduate Studies and all committee members. Also, a copy of the Plan of Graduate Study must be filed in the department. The Plan of Graduate Study shows the committee chairperson, other committee members, and a chronological list of courses approved by the student's advisor. A committee member's signature on the Plan of Graduate Study denotes their approval of the plan for the student's doctoral program. After approval by the Graduate Coordinator in the department, the Plan of Graduate Study becomes the student's official guideline for the completion of his/her Ph.D. degree program.

7.6. RESIDENCE REQUIREMENTS

Each Ph.D. student must secure at least two residence credits through registration in continuous semesters at North Carolina A&T State University. Residence credit is determined from the number of semester hours completed during a regular semester according to the following table. Summer registration is not required. However, residence credit for a six-week summer session equals one-half that of a regular semester. For example, completing a three-credit course during a six-week summer session will earn 1/6 of a regular semester residence credit.

Semester Credit Hours	Residence Credits
9 or more	1
6 - 8	2/3
less than 6	1/3
(including registration for "Dissertation"	

7.7. CHANGE OF COMMITTEE MEMBERS AND STUDY PLAN

A student may change his/her advisor at any time through a mutual consent. When a student changes his/her advisor, the student must submit a revised Plan of Graduate Study including signatures by the new advisor and all committee members and the consent of the previous advisor. After the submission of a Plan of Graduate Study, a student must resubmit a revised Plan of Graduate Study to the Graduate Coordinator indicating that the plan has been "REVISED" and including the signatures of his/her advisor and all committee members.

7.8. Ph.D. QUALIFYING EXAMINATION

The purpose of the Qualifying Examination is to identify students who are qualified to work toward the Ph.D. degree in Electrical Engineering by requiring these students to demonstrate basic competence in a broad range of relevant subjects. Students are not expected to engage in research until they have passed their Qualifying Examination.

The full-time and part-time students with an MS degree must take this examination within two and four years of the admission to the Ph.D. program respectively. The Direct-PhD student must take the examination within the first

five academic semesters of the admission to Ph.D. program. A Direct-PhD student who enters the Direct-PhD program from MS program without an MS degree must take the Qualifying Examination in one and a half year after entering Ph.D. program.

Only the student with unconditional status can apply for the Qualifying Examination. Any student in provisional status can not sit for the Qualifying Examination. A student must be enrolled with a 3.0 GPA or better at the time of the examination. A student must also have an approved Plan of Graduate Study for his/her doctoral program submitted to the School of Graduate Studies prior to scheduling the exam. The Qualifying Examination is given each regular (Fall and Spring) semester on two successive days during the week before the final exam period. A registration notice will be posted outside the Department Office in the middle of each academic semester. The student must apply for the Qualifying Examination by the posted deadline.

The examination consists of a three-hour written examination for each subject and covers two subjects per day in two consecutive days. At the time of registration, the student declares the track in which he or she will be taking the examination. Each student must select only two subjects in his/her concentration area and two subjects from other areas from the subject list announced by the department.

Questions on the Qualifying Examination are developed based on the contents of the courses in the subject list. Therefore, each student is encouraged to take the courses related to the subjects selected.

Students must obtain an overall score of at least 80% to pass the examination. The final pass/fail shall be decided by the Graduate Curriculum Development Committee (GCDC). A student who has failed the Qualifying Examination one time is given a second chance to retake the Qualifying Examination within a year. A student whose overall score is below 80% must retake the examination. The student who needs to retake the examination can not change any subjects selected in the first attempt. The Graduate Coordinator will notify each examinee of his or her results by letter within three weeks from the date of examination.

A student who wants to retake the Qualifying Examination must apply to retake the Qualifying Examination by the posted deadline. No student is permitted to take the Qualifying Examination more than twice. A student not recommended for re-examination, or who fails the exam on a second attempt is afforded the opportunity to withdraw from the university. A student who chooses not to withdraw will have his or her graduate program terminated upon completing the semester in which the denial or second failure occurs. Additionally, a student who fails to take the examination or re-examination at the prescribed time is considered failing the examination or re-examination.

7.9. FAILURE IN QUALIFYING EXAMINATION FOR DIRECT-PhD

A student who failed the qualifying exams twice is required to withdraw from the graduate program upon completing the semester. Also, a student who fails to take the examination or re-examination at the prescribed time is considered failing the examination or re-examination. However, a Direct-PhD student who failed the examination in good standing may elect to be approved to transfer to the M.S. program for a terminal M.S. degree if they have completed less than six semesters at North Carolina A&T State University.

7.10. Ph.D. PRELIMINARY ORAL EXAMINATION

After passing the Qualifying Examination, each Ph.D. student must complete a preliminary oral examination conducted by the student's Advisory. This is an Oral Examination and defense of the student’s dissertation proposal. Passing this exam allows the School of Graduate Studies to enter the student into "*Ph.D. Candidacy*".

Unanimous approval by the Advisory Committee is required to pass the examination. Approval may be conditioned on satisfactory completion of additional work. In this situation, a student passes the examination when these conditions are met. A student is admitted to candidacy for the Ph.D. degree only upon passing the preliminary examination. Failure of the examination terminates the student's graduate study unless the student's Advisory Committee unanimously recommends re-examination. Only one re-examination is permitted and at least one full semester must elapse before the re-examination.

The examination may be held no earlier than the end (final exam week) of the second year of graduate study and no later than one semester (or four months) prior to the Ph.D. final oral examination. The Preliminary Oral Examination is scheduled at the request of the student and only upon the approval of the student’s Advisory Committee. A student cannot submit a request to schedule an oral examination unless the student's Plan of Graduate Study has been approved by the Graduate Coordinator. The student must be in good academic standing when the request is submitted and when the examination is held.

The student must submit the Application for Oral Examination with the signatures of all members of the Advisory Committee to the Graduate Coordinator at least two weeks prior to the date of the Preliminary Examination. The application form must include the date, time and place of the preliminary examination. The student requesting his/her oral examination must distribute a copy of the written report to all members of his/her committee two weeks prior to the date of the Preliminary Oral Examination. The copy of the application form for the preliminary examination (approved by the Graduate Coordinator) is sent to the student and the members of the committee to confirm the approval, date and place of the examination. If any committee member can not attend a scheduled preliminary examination, it must be rescheduled.

7.11. PUBLICATION REQUIREMENT

Each Ph.D. student must publish at least one conference paper and submit one journal paper prior to his/her Ph.D. Final Oral Examination. Therefore, when submitting the application of the oral examination, the copy of the first page of each conference paper and an evidence of submission of the journal paper must be attached to the application form for the PhD Final Oral Defense.

7.12. Ph.D. FINAL ORAL EXAMINATION

Each Ph.D. student must pass a Final Oral Examination conducted by the student's Advisory. This examination is the final dissertation defense presentation that is scheduled after a dissertation is completed. It consists of the defense of the methodology used and the conclusions reached in the research in the dissertation. Unanimous approval by the Advisory Committee is required for passing the oral examination. Such approval may be conditioned on satisfactory completion of additional work. Failure of the examination terminates the student's graduate study unless the student's Advisory Committee unanimously recommends re-examination. Only one re-examination is permitted.

The examination may be held no earlier than one semester (or four months) after admission to candidacy. The examination must be held on or before the deadline for final oral examinations (see the academic calendar in the Graduate Catalog) if the degree is to be awarded at the end of that semester. Otherwise, the degree is awarded at the end of the following semester. The examination is scheduled only upon the request of the student and the approval of his or her Advisory Committee. The student must submit the Application for Oral Examination with the signatures of all members of the Advisory Committee to the Graduate Coordinator at least two weeks prior to the date of the Final Oral Examination. The application form must include the date, time and place of the Final Oral Examination. The dissertation must be completed and copies of it must be distributed to all members of his/her Advisory Committee two weeks prior to the date of the Final Oral Examination. The copy of the application form for the Final Oral Examination (approved by the Graduate Coordinator) is sent to the student and the members of the committee to confirm the approval, date and place of the defense. If any committee member can not attend a scheduled Final Oral Examination, it must be rescheduled.

7.13. SUBMISSION OF DISSERTATION

Upon passing the Ph.D. Final Oral Examination, each Ph.D. student must have the dissertation approved by each member of the student's Advisory Committee. The dissertation must be submitted to the School of Graduate Studies by the deadline given in the academic calendar, and must conform to the Guide for Preparation of Thesis and Dissertations.

7.14. SUMMARY OF PROCEDURES FOR THE DOCTORAL PROGRAM

1. Apply for admission to the School of Graduate Studies
   a) The application and all supporting documentation are sent to School of Graduate Studies.
   b) The application material includes the following:
      - The signed application form, application processing fee, letters of recommendation, N.C. residency form (if applicable), acknowledgement card, letter of intent, official transcripts, and other supporting documents
2. Student receives admission decision from the School of Graduate Studies.
3. Student reports his or her enrollment intentions to the School of Graduate Studies.
4. Student meets with the Graduate Coordinator to obtain information about graduate programs.
5. Student prepares the course schedule and registers for first semester classes under the supervision of the Graduate Coordinator.

6. Graduate Coordinator may be a temporary advisor until a permanent advisor is found.
7. Student selects a permanent advisor by the completion of nine (9) credit hours or by the end of the first semester.
8. Student completes the Plan of Graduate Study for the doctoral program in consultation with his/her advisor during the second semester and includes the following activities in this process:
    - Selection of the advisory committee members. The advisory committee consists of a chairperson in the student's major subject, and four other members.
    - Selection of course list according to coursework requirements. The coursework may include courses in preparation for the Qualifying Examination.
    - Obtaining signatures of all members of the advisory committee
9. Student submits the original Plan of Graduate Study to the Graduate Coordinator. Copies will be sent to the School of Graduate Studies and all committee members by the completion of nine (9) credit hours or by the end of the first semester.
10. This Plan of Graduate Study becomes the student's official guideline for the student's Ph.D. degree program.
11. If a student decides to change his/her Plan of Graduate Study, the student must restart from Step 7 above.
12. The revised Plan of Study must include the word "REVISED".
13. Student takes Qualifying Examination within two years plus one semester of student's admission to the Ph.D. program.
14. Whenever the direction of the student's dissertation topic has been determined in consultation with his/her advisor, the student submits the dissertation title and the outline of the proposed research to the student's Advisory Committee.
15. Student completes all coursework.
16. After passing the Qualifying Examination, and when the proposed research is in a mature stage and is likely to succeed in experimentation, the student schedules the Preliminary Oral Exam in consultation with his/her advisor and forwards the exam schedule to the Graduate Coordinator and the School of Graduate Studies. After their approval, the student and his/her advisor post the time and place of the examination and submit a written report to all committee members for their review at least two weeks prior to the examination date.
17. The examination result is sent to the Graduate Coordinator, and then it will be submitted to the School of Graduate Studies in 48 hours. If the examination has been passed without conditions, the student is admitted as a "*Ph.D. Candidate*".
18. At least one semester (or four months) into the "*Ph.D. Candidacy*", the student schedules the Final Oral Examination in consultation with his/her advisor. The student must submit the Application for Oral Examination with the signatures of all members of the Advisory Committee to the Graduate Coordinator at least two weeks prior to the date of the Final Oral Examination. Upon approval of this request, the student and his/her advisor must post the time and place of the exam and submit a copy of the draft of his/her dissertation to all committee members for their review by two weeks prior to the suggested date.
19. The examination result is sent to the Graduate Coordinator with signatures of all advisory committee members, and then it will be submitted to the School of Graduate Studies in 48 hours.
20. Student submits Application for Graduation to the Graduate Coordinator, and then the Graduate Coordinator submits Final Graduate Clearance Checklist to the School of Graduate Studies.
21. Student submits all required documentation to the School of Graduate Studies and the Department Office.
22. The student graduates.
23. See the university web site for dates and deadlines.

8. SPECIALIZATION OPTION

The field of electrical engineering has grown in breadth as well as in depth; consequently, it is possible to achieve levels of specialization in several area options. Thus, the department specializes in the following four areas for the master's and doctoral programs:

- Communications and Signal Processing
- Computer Engineering
- Electronic and Optical Materials and Devices
- Power Systems and Control

A student may select any area as a major in this department and concentration courses in related areas with the guidance of his/her advisor. The following pages present the list of courses for each area.

Communication and Signal Processing Course List

600 LEVEL COURSES:

Courses	Titles	Hours	Semester
ECEN-647	Introduction to Telecommunication Networks	3	Spring
ECEN-649	Digital Communications	3	Fall
ECEN-650	Digital Signal Processing	3	Fall
ECEN-651	Digital Signal Processing Laboratory	2	Fall
ECEN-652	Wireless Information Networks	3	Spring
ECEN-656	Probability and Random Processes	3	Fall
ECEN-657	Digital Image Processing	3	Spring
ECEN-658	Digital Image Processing Laboratory	2	Spring

800 LEVEL COURSES:

Courses	Titles	Hours	Semester
ECEN-847	Telecommunication Networks	3	Fall
ECEN-848	Information Theory	3	Spring
ECEN-849	Data Communications	3	Spring
ECEN-850	Multi-Dimensional Signal Processing	3	Spring
ECEN-852	Advanced Topics in Wireless Communications	3	Fall/Spring
ECEN-857	Pattern Recognition	3	Fall

UNDERGRADUATE BACKGROUND:

Courses	Titles	Hours	Semester
ECEN-400	Linear Systems and Signals	3	Fall/Spring
ECEN-449	Introduction to Communication Systems	3	Spring
ECEN-452	Wireless Communication Systems	3	Fall
ECEN-459	Digital and Data Communications	3	Fall

Computer Engineering Course List

LOWER 600 LEVEL COURSES:

Courses	Titles	Hours	Semester
ECEN-621	Embedded Computing System Design	3	Fall
ECEN-622	Embedded Systems Design Laboratory	2	Fall
ECEN-623	Advanced Digital Systems	3	Fall
ECEN-624	Computer Organization and Architecture Design	3	Spring

700 LEVEL COURSES:

Courses	Titles	Hours	Semester
ECEN-720	Theoretical Issues in Computer Engineering	3	Spring
ECEN-721	Fault-Tolerant Digital System Design	3	Spring
ECEN-723	System Design Using Programmable Logic Devices	3	Spring
ECEN-725	Pervasive Computing System Design	3	Spring
ECEN-727	Switching and Finite Automata Theory	3	Fall

800 LEVEL COURSES:

Courses	Titles	Hours	Semester
ECEN-821	Advanced Computer Organization and Architecture	3	Fall
ECEN-822	Error-Correcting Codes	3	Spring

UNDERGRADUATE BACKGROUND:

Courses	Titles	Hours	Semester
ECEN-327	Digital Logic	3	Fall/Spring
ECEN-427	Introduction to Microprocessors	3	Fall/Spring
ECEN-433	Digital Systems Laboratory	3	Fall/Spring

Electronic and Optical Materials and Devices Course List

600 LEVEL COURSES:

Courses	Titles	Hours	Semester
ECEN-606	Digital Electronics	3	Fall/Spring
ECEN-608	Analog Electronics	3	Fall/Spring
ECEN-610	Power Electronics	3	Fall/Spring
ECEN-614	Integrated Circuit Fabrication Methods	3	Spring
ECEN-615	Silicon Device Fabrication Laboratory	2	Spring
ECEN-625	Microwave Circuits	3	Fall/Spring
ECEN-626	Electronic Design Automation	3	Fall/Spring
ECEN-629	VLSI Circuit Design	3	Spring
ECEN-630	VLSI Design Laboratory	2	Spring

700 LEVEL COURSES:

Courses	Titles	Hours	Semester
ECEN-701	Electronic Ceramics	3	Spring
ECEN-702	Semiconductor Theory and Devices	3	Fall
ECEN-710	Radio Frequency (RF) Waves, Fields and Antennas	3	Fall
ECEN-724	Mixed-Signal VLSI Design	3	Spring

800 LEVEL COURSES:

Courses	Titles	Hours	Semester
ECEN-801	Solid State Devices	3	Spring
ECEN-802	Advanced Solid State Theory	3	Fall
ECEN-803	Compound Semiconductors and Nanostructured Devices	3	Spring
ECEN-804	Semiconductor Material and Device Characterization	3	Fall
ECEN-805	Thin Film Technology for Device Fabrication	3	Spring
ECEN-810	Theory and Techniques in Photonics	3	Spring
ECEN-812	RF CMOS Integrated Circuits	3	Fall
ECEN-823	Advanced VLSI Design	3	Fall

UNDERGRADUATE BACKGROUND:

Courses	Titles	Hours	Semester
ECEN-450	Electromagnetic Radiation and Microwave Theory	3	Fall
ECEN-460	Electronics II	3	Fall/Spring
ECEN-470	Properties of Materials for Electrical Engineering	3	Spring

Power Systems and Control Course List

600 LEVEL COURSES:

Courses	Titles	Hours	Semester
ECEN-661	Power Systems Analysis	3	Fall
ECEN-662	Advanced Power Systems Laboratory	2	Fall
ECEN-668	Theory of Linear Control Systems	3	Fall
ECEN-669	Control Laboratory	2	Fall
ECEN-674	Genetic Algorithms	3	Spring
ECEN-678	Introduction to Artificial Neural Networks	3	Fall
ECEN-679	Machine Intelligence Laboratory	2	Fall

700 LEVEL COURSES:

Courses	Titles	Hours	Semester
ECEN-762	Network Matrices and Graphs	3	Fall
ECEN-764	Power System Planning	3	Fall

800 LEVEL COURSES:

Courses	Titles	Hours	Semester
ECEN-861	Power Systems Control and Protection	3	Fall
ECEN-862	Computer Methods in Power Systems	3	Fall
ECEN-865	Optimal Control Systems	3	Spring
ECEN-866	Discrete Time Systems	3	Fall
ECEN-867	Neural Networks Design	3	Spring
ECEN-868	Intelligent Methods for Control Systems	3	Fall
ECEN-870	Fuzzy Logic with Applications	3	Fall
ECEN-871	Nonlinear Control Systems	3	Fall
ECEN-872	Decision Making and Supervisory Control of Discrete Event Systems	3	Fall/Spring
ECEN-869	Machine Vision for Intelligent- Robotics	3	Fall
ECEN-880	Parallel Simulated Neural Networks	3	Fall

UNDERGRADUATE BACKGROUND:

Courses	Titles	Hours	Semester
ECEN-410	Linear Systems and Control	3	Spring
ECEN-420	Power Electronics	3	Fall/Spring
ECEN-430	Power Systems, Energy Conversion and Electric Machinery	3	Fall/Spring
ECEN-436	Power Systems, Energy Conversion and Electric Machinery Laboratory	3	Fall/Spring

General Course List for 600, 700, 800 and 900 Levels

600 LEVEL COURSES:

Courses	Titles	Hours	Grade
ECEN-685	Selected Topics in Engineering	3	Graded
ECEN-686	Special Projects	1-3	Graded

700 LEVEL COURSES:

Courses	Titles	Hours	Grade
ECEN-792	Masters Seminar	1	Pass / Fail
ECEN-793	Masters Supervised Teaching	3	Pass / Fail
ECEN-794	Masters Supervised Research	3	Pass / Fail
ECEN-796	Masters Project	3	Pass / Fail
ECEN-797	Masters Thesis	3 -6	Pass / Fail
ECEN-799	Masters Thesis Continuation	1	Pass / Fail

800 & 900 LEVELS COURSES:

Courses	Titles	Hours	Grade
ECEN-885	Doctoral Special Topics	3	Graded
ECEN-991	Doctoral Qualifying Examination	1	Pass / Fail
ECEN-992	Doctoral Seminar	1	Pass / Fail
ECEN-993	Doctoral Supervised Teaching	3	Pass / Fail
ECEN-994	Doctoral Supervised Research	3	Pass / Fail
ECEN-995	Doctoral Preliminary Examination	3	Pass / Fail
ECEN-997	Doctoral Dissertation	3 - 12	Pass / Fail
ECEN-999	Doctoral Dissertation Continuation	1	Pass / Fail

* ECEN-685 and 885 are experimental courses that are being used to create new courses.
* ECEN-x93, x94 and x99 are graded by Pass/Fail, and not counted as course credit requirements.

SUMMARY OF COURSE OFFERINGS

The 600 level courses numbered 600-699 are open to qualified seniors and graduate students for the master's program. Courses numbered 700 and above are only open to graduate students.

COURSE #	DESCRIPTION	CREDIT HOURS
ECEN 606	Digital Electronics	3 (3-0)
ECEN 608	Analog Electronics	3 (3-0)
ECEN 610	Power Electronics	3 (3-0)
ECEN 614	Integrated Circuit Fabrication Methods	3 (3-0)
ECEN 615	Silicon Device Fabrication Laboratory	2 (1-3)
ECEN 621	Embedded Computing System Design	3 (3-0)
ECEN 622	Embedded Systems Design Laboratory	2 (1-3)
ECEN 623	Advanced Digital Systems	3 (3-0)
ECEN 624	Computer Organization and Architecture Design	3 (3-0)
ECEN 625	Microwave Circuits	3 (3-0)
ECEN 626	Electronic Design Automation	3 (3-0)
ECEN 629	Very Large Scale Integrated (VLSI) Circuit Design	3 (3-0)
ECEN 630	VLSI Design Laboratory	2 (1-3)
ECEN 647	Introduction to Telecommunication Networks	3 (3-0)
ECEN 649	Digital Communications	3 (3-0)
ECEN 650	Digital Signal Processing	3 (3-0)
ECEN 651	Digital Signal Processing Laboratory	2 (1-3)
ECEN 652	Wireless Information Networks	3 (3-0)
ECEN 656	Probability and Random Processes	3 (3-0)
ECEN 657	Digital Image Processing	3 (3-0)
ECEN 658	Digital Image Processing Laboratory	2 (1-3)
ECEN 661	Power Systems Analysis	3 (3-0)
ECEN 662	Advanced Power Systems Laboratory	2 (1-3)
ECEN 668	Theory of Linear Control Systems	3 (3-0)
ECEN 669	Control Laboratory	2 (1-3)
ECEN 674	Genetic Algorithms	3 (3-0)
ECEN 678	Introduction to Artificial Neural Networks	3 (3-0)
ECEN 679	Machine Intelligence Laboratory	2 (1-3)
ECEN 685	Selected Topics in Engineering	3 (3-0)
ECEN 686	Special Projects	Var. 1-3
ECEN 701	Electronic Ceramics	3 (3-0)
ECEN 702	Semiconductor Theory and Devices	3 (3-0)
ECEN 710	Radio Frequency (RF) Waves, Fields and Antennas	3 (3-0)
ECEN 720	Theoretical Issue in Computer Engineering	3 (3-0)
ECEN 721	Fault-Tolerant Digital System Design	3 (3-0)
ECEN 723	System Design Using Programmable Logic Devices	3 (3-0)
ECEN 724	Mixed-Signal VLSI Design	3 (3-0)
ECEN 725	Pervasive Computing System Design	3 (3-0)
ECEN 727	Switching and Finite Automata Theory	3 (3-0)

ECEN 762	Network Matrices and Graphs	3 (3-0)
ECEN 764	Power System Planning	3 (3-0)
ECEN 792	Masters Seminar	1 (1-0)
ECEN 793	Masters Supervised Teaching	3 (0-3)
ECEN 794	Masters Supervised Research	3 (0-3)
ECEN 796	Masters Project	3 (3-0)
ECEN 797	Master's Thesis	Var. (3-6)
ECEN 799	Master's Thesis Continuation	1 (0-1)
ECEN 801	Solid State Devices	3 (3-0)
ECEN 802	Advanced Solid State Theory	3 (3-0)
ECEN 803	Compound Semiconductors and Nanostructured Devices	3 (3-0)
ECEN 804	Semiconductor Material and Device Characterization	3 (3-3)
ECEN 805	Thin Film Technology for Device Fabrication	3 (3-0)
ECEN 810	Theory and Techniques in Photonics	3 (3-0)
ECEN 812	RF CMOS Integrated Circuits	3 (2-3)
ECEN 821	Advanced Computer Organization and Architecture	3 (3-0)
ECEN 822	Error-Correcting Codes	3 (3-0)
ECEN 823	Advanced VLSI Design	3 (3-0)
ECEN 847	Telecommunication Networks	3 (3-0)
ECEN 848	Information Theory	3 (3-0)
ECEN 849	Data Communications	3 (3-0)
ECEN 850	Multi-Dimensional Signal Processing	3 (3-0)
ECEN 852	Advanced Topics in Wireless Communications	3 (3-0)
ECEN 857	Pattern Recognition	3 (3-0)
ECEN 861	Power System Control and Protection	3 (3-0)
ECEN 862	Computer Methods in Power Systems	3 (3-0)
ECEN 865	Optimal Control Systems	3 (3-0)
ECEN 866	Discrete Time Systems	3 (3-0)
ECEN 867	Neural Networks Design	3 (3-0)
ECEN 868	Intelligent Methods for Control Systems	3 (3-0)
ECEN 869	Machine Vision for Intelligent-Robotics	3 (3-0)
ECEN 870	Fuzzy Logic with Applications	3 (3-0)
ECEN 871	Nonlinear Control Systems	3 (3-0)
ECEN 872	Decision Making and Supervisory Control of Discrete Event Systems	3 (3-0)
ECEN 880	Parallel Simulated Neural Networks	3 (3-0)
ECEN 885	Doctoral Special Topics	3 (3-0)
ECEN 991	Doctoral Qualifying Examination	1 (0-1)
ECEN 992	Doctoral Seminar	1 (0-1)
ECEN 993	Doctoral Supervised Teaching	3 (0-3)
ECEN 994	Doctoral Supervised Research	3 (0-3)
ECEN 995	Doctoral Preliminary Examination	3 (0-3)
ECEN 997	Doctoral Dissertation	Var. (3-12)
ECEN 999	Doctoral Dissertation Continuation	1 (0-1)

9. DESCRIPTION OF GRADUATE COURSES

In the Master's and Doctoral Degree Programs in Electrical and Computer Engineering,

ECEN-606 Digital Electronics **Credit 3(3-0)**

This course covers analysis, design and applications of digital integrated circuits. These circuits may include resistor-transistor logic (RTL), diode transistor logic (DTL), transistor-transistor (TTL), emitter-coupled logic (ECL), metal-oxide-semiconductor (MOS) gates and n-channel MOS (NMOS) logic, complementary MOS (CMOS) logic, Bipolar CMOS (BiCMOS) structures, memory circuits, and interfacing circuits. Prerequisite: ECEN-460 or consent of instructor.

ECEN-608 Analog Electronics **Credit 3(3-0)**

This course covers the analysis, design and application of analog integrated circuits. These circuits may include operational amplifiers, voltage comparators, voltage regulators, Integrated Circuit (IC) power amplifiers, Digital to Analog (D/A) and Analog to Digital (A/D) converters, voltage-controlled oscillators, phase-locked loops, other special-function integrated circuits. Prerequisite: ECEN-460 or consent of instructor.

ECEN-610 Power Electronics **Credit 3(3-0)**

This course is an introduction to principles and methods of power electronics. Subjects covered are semiconductor devices and their complementary components and systems, different static switching converters like AC to DC AC to AC, DC to DC and DC to AC converters and their applications. Pre-requisite: ECEN-320 or consent of instructor.

ECEN-614 Integrated Circuit Fabrication Methods **Credit 3(3-0)**

This course presents the various processes utilized in the fabrication of semiconductor integrated circuits. Oxidation, diffusion, ion implantation, metalization, and epitaxial processes will be discussed. Limits on device design and performance will be considered. Prerequisite: ECEN-470 or consent of instructor.

ECEN-615 Silicon Device Fabrication Laboratory **Credit 2(1-3)**

Laboratory experiments in the fabrication of silicon p-n junction diodes, MOS capacitors and MOS field effect transistors will be performed. Oxidation, diffusion, photolithography, and metalization techniques will be presented. Co-requisite: ECEN-614.

ECEN-621 Embedded Computing System Design **Credit 3(3-0)**

This course is a study of Embedded Computing System (a.k.a Embedded System) Design, which is the design of microprocessor-based, application-specific systems. A popular contemporary high-level language is used for the majority of the software development, with some use of assembly language as well. An integrated development environment (IDE) popular in industry, along with a compatible hardware evaluation board, are utilized for practical experience. The core of the course material is organized using a data access hierarchy perspective. Other embedded computing topics covered include hardware/software co-design and debugging, real-time systems, digital/analog interfacing, low power modes, and firmware. Prerequisite: none

ECEN-622 Embedded Systems Design Laboratory **Credit 2(1-3)**

This laboratory course is an introduction to developing processor-based embedded systems. The development tools include a C++ cross compiler, an Electronically Programmable Read Only Memory (EPROM), and an Application Specific Integrated Circuit (ASIC) programmer. A student project is part of the laboratory requirements. Co-requisite: ECEN-621.

ECEN-623 Advanced Digital Systems **Credit 3(3-0)**

Digital system top-down design and analysis will be presented. Topics include timing, power and performance issues in digital circuits, Very High Speed Integrated Circuit Hardware Description Language (VHDL)-based system analysis and synthesis, hardware-software co-design, data-flow models, and digital system primitives. This course includes experience with Field Programmable Gate Array (FPGA)-based project implementations. Prerequisites: none

ECEN-624 Computer Organization and Architecture Design **Credit 3(3-0)**

This course covers the design of modern uniprocessors and their memory, and Input/Output (I/O) subsystems. Performance, microarchitecture, and design philosophies used to realize pipeline, superscalar, Reduced Instruction Set Computer (RISC) and Complete Instruction Set Computer (CISC) processors will be studied. Prerequisites:

ECEN-427 or consent of instructor.

ECEN-625 Microwave Circuits Credit 3(3-0)

This course will cover RF and microwave circuits appropriate for wireless communications and radar sensing. It emphasizes the theoretical and practical aspects of microstrip design of highly integrated systems. Matrix analysis and computer-aided design techniques are introduced and used for the analysis and design of circuits. Impedance transformer, power combiner, couplers, mixers, and calibrated measurements techniques are also covered. Prerequisites: none

ECEN-626 Electronic Design Automation Credit 3(3-0)

This class introduces Electronic Design Automation (EDA) and explores performance-driven approaches to the following concepts: technology mapping, circuit partitioning, chip floor-planning, cell placement, and wire routing. Also discussed are applications of a number of important optimization techniques, such as network flow, Steiner tree, scheduling, simulated annealing, and linear programming. Prerequisites: none

ECEN-629 Very Large Scale Integrated (VLSI) Circuit Design Credit 3(3-0)

This course introduces CMOS technology and devices for design and implementation of digital integrated circuits. Propagation delay and power dissipation of static and dynamic combinational and sequential logic circuits are studied. Method of Logical Effort is introduced for predicting path delays. Layout design rules and verification tools are introduced. Design examples include Arithmetic Units and Memory and Array Structures. Prerequisite: none

ECEN-630 VLSI Design Laboratory Credit 2(1-3)

This is an introduction of Computer Aided Design (CAD) tools for integrated circuit design and verification. These CAD tools include; geometric pattern generators, design rule checkers, circuit simulators, and Programmable Logic Array (PLA) generators. A student design project is part of the laboratory requirements. Co-requisite: ECEN-629.

ECEN-647 Introduction to Telecommunication Networks Credit 3(3-0)

This course introduces telecommunication networks utilization and design. Emphasis is on using and designing voice, video and image digital networks. Prerequisite: ECEN-400 or consent of instructor.

ECEN-649 Digital Communications Credit 3(3-0)

The fundamental theory and applications of the digital communications are introduced. Topics in digital communications include sampling, quantizing, coding, detection, modulation / demodulation, signal-to-noise ratio, and error probability. Prerequisites: none

ECEN-650 Digital Signal Processing Credit 3(3-0)

This course introduces a fundamental theory and applications for digital signal processing including topics such as digital signals and systems, digital filtering, spectral analysis, and Discrete Fourier transform (DFT). Prerequisites: none

ECEN-651 Digital Signal Processing Laboratory Credit 2(1-3)

Experiments and student projects will be performed which are related to the practical applications of digital signal processing techniques to data acquisition, digital filtering, control, spectral analysis, and communications. Co-requisite: ECEN-650.

ECEN-652 Wireless Information Networks Credit 3(3-0)

The fundamental theory and applications of wireless mobile communication systems are covered for voice, data, and multimedia. Topics in wireless networks include characterization of radio propagation, source and channel coding, theory and analysis of wireless data networks, and wireless Local Area Networks (LANs). Prerequisites: none

ECEN-656 Probability and Random Processes Credit 3(3-0)

This course covers sample space and events, conditional probabilities, independent events, Bayes formula, discrete random variables, expectation of random variables, joint distribution, conditional expectation, Markov chains, stationary processes, ergodicity, correlation and power spectrum of stationary processes, and Gaussian processes. Prerequisite: ECEN-400 or consent of instructor.

ECEN-657 Digital Image Processing Credit 3(3-0)

This course deals with concepts and techniques for digital image analysis and processing. Topics include image representation, image enhancement, edge extraction, image segmentation, geometric structure, feature extraction, knowledge representation, and image understanding. Prerequisite: ECEN-400 or consent of instructor.

ECEN-658 Digital Image Processing Laboratory **Credit 2(1-3)**
This laboratory course will demonstrate many important and practical applications of digital image processing techniques. The experiments include image enhancement, feature extraction, Hough transform, and various transforms in spatial and frequency domains, image understanding and quantization.
Co-requisite: ECEN- 657.

ECEN-661 Power Systems Analysis **Credit 3(3-0)**
The course studies power system representation, transmission lines, symmetrical and asymmetrical faults, electric power flow, power systems control and stability. Prerequisite: ECEN-430 or consent of instructor.

ECEN-662 Advanced Power Systems Laboratory **Credit 2(1-3)**
In this laboratory course, basic concepts, transmission lines, power flows, faults, and transient and steady-state stability will be investigated. Prerequisite: ECEN-436 or consent of instructor. Co-requisite: ECEN-661.

ECEN-668 Theory of Linear Control Systems **Credit 3(3-0)**
The aim of a control system is to influence the system's behavior to achieve a desired performance. Many control systems can be described by a linear model for which there are well developed analysis and synthesis tools. The focus of this course will be on linear time invariant lumped systems which are described either by state space equations or rational transfer functions. Different analysis and design techniques will be discussed. Prerequisite: none

ECEN-669 Control Laboratory **Credit 2(1-3)**
This laboratory course demonstrates methods of system identification and control. Verifications of control system designs in both the time domain and frequency domain will be studied. Co-requisite: ECEN-661.

ECEN-674 Genetic Algorithms **Credit 3(3-0)**
This course covers the theory and application of genetic algorithms. Genetic algorithms combine a Darwinian survival-of-the-fittest with a randomized, yet structured, information exchange to form an improved search mechanism with surprising robustness. Engineering applications of genetic algorithms for design and control will be presented. Prerequisite: ECEN-410 or consent of instructor.

ECEN-678 Introduction to Artificial Neural Networks **Credit 3(3-0)**
This course introduces neural network design and development. Emphasis is on designing and implementing information processing systems that autonomously develop operational capabilities in adaptive response to an information environment. Prerequisite: ECEN-400 or consent of instructor.

ECEN-679 Machine Intelligence Laboratory **Credit 2(1-3)**
This laboratory will explore the design and development of intelligent, autonomous, physical agents. An emphasis will be placed upon machine intelligence experiments with visual sensors, tactile sensors, robotic manipulators and autonomous inexpensive mobile robots. Prerequisite: ECEN-433 or consent of instructor. Co-requisite: ECEN-678.

ECEN-685 Selected Topics in Engineering **Credit 3(3-0)**
This lecture course is used to introduce engineering topics of current interest to students and faculty. The subject matter will be identified before the beginning of the course. Prerequisite: consent of instructor.

ECEN-686 Special Projects **Credit Var (1-3)**
This is an investigation of an engineering topic which is arranged between a student and a faculty advisor. Project topics may be analytical and/or experimental and should encourage independent study. Prerequisite: consent of instructor.

ECEN-701 Electronic Ceramics **Credit 3(3-0)**
This course introduces the properties of ceramic materials in electronic applications. The effects of processing parameters on the ultimate device characteristics will be investigated. Prerequisite: ECEN-602 or consent of instructor.

ECEN-702 Semiconductor Theory and Devices **Credit 3(3-0)**
This course is a study of the phenomena of solid-state conduction and devices using band models, excess carriers in semiconductors, p-n junctions, and devices. Prerequisites: none

ECEN-710 Radio Frequency (RF) Waves, Fields and Antennas **Credit 3(3-0)**
This course emphasizes principles, phenomena and methods relevant to Radio Frequency and antenna technology. The topics will include basic electromagnetic propagation in free space and material media, guided electromagnetic waves, and theory of transmitting and receiving antennas. Related topics include radomes, antenna materials, lens

antennas, computer modeling of antennas, and antenna measurement techniques. Prerequisite: none

ECEN-720 Theoretical Issues in Computer Engineering Credit 3(3-0)
This course is designed to introduce the theoretical aspects of computer engineering. It includes selected topics in the set theory, elements of algebra such as semigroups, monoids, groups, rings, and fields, quotient groups and homomorphism theorems. It also includes finite state machines, the Myhill-Nerode theory, pseudo / random generators, linear feedback registers, introduction to error correcting codes and Turing Machines. Various applications will be demonstrated and implemented. Prerequisite: none

ECEN-721 Fault-Tolerant Digital System Design Credit 3(3-0)
This course covers reliability, test generation, self-checking techniques, principles and applications of fault-tolerant design techniques. The course features in-depth analysis of sample hardware systems. The course also discusses built-in self-test. Prerequisite: ECEN-623 or consent of instructor.

ECEN-723 System Design Using Programmable Logic Devices Credit 3(3-0)
This course will cover advanced system design using modern programmable logic devices. Hardware/software co-design techniques will be discussed. Includes comparisons of commercially available Programmable Logic Devices and consider their applications in both combinational and sequential logic system design. Students will also be familiarized with hardware description language such as VHDL and shown how design ideas can be efficiently translated into programmable hardware implementations. Prerequisite: ECEN-623 or consent of instructor.

ECEN-724 Mixed-Signal VLSI Design Credit 3(3-0)
This course will introduce CMOS circuit techniques for low-power, low-voltage mixed-signal integrated circuits. Continuous-time signal processing, sampled-data analog filters, delta-sigma data converters, and mixed analog-digital layout techniques will be introduced. Prerequisite: none

ECEN-725 Pervasive Computing System Design Credit 3(3-0)
This course is a study of Pervasive Computing (a.k.a. Ubiquitous Computing) System Design, which is the seamless integration of computing and communication technology into human-centered environments. A popular object-oriented internet programming language, its corresponding integrated development environment (IDE), and contemporary smart devices are used for prototyping most of the example systems. The core of the course material is organized using a contextual data access hierarchy perspective. Other pervasive computing topics covered included wearable computing, smart devices, intelligent environments, and the Internet of Things. Prerequisite: ECEN-621 or consent of instructor.

ECEN-727 Switching and Finite Automata Theory Credit 3(3-0)
This course provides an in-depth discussion of the abstract mathematical modeling of combinational and sequential switching networks. Finite automata theory and fault tolerant concepts with applications to both combinational networks and finite state machines will be presented. Prerequisite: none

ECEN-762 Network Matrices and Graphs Credit 3(3-0)
Use of vector space techniques in the description, analysis and realization of networks modeled as matrices and graphs. The course investigates vector space concepts in the modeling and study of networks. Prerequisite: none

ECEN-764 Power System Planning Credit 3(3-0)
This course presents an overview of the issues and methods relevant to power systems planning. The course reviews the basics of financial analysis, regression analysis, forecasting, and reliability. Special topics relevant to power systems, such as deregulation, peak-load forecasts, load management and representation. Prerequisite: none

ECEN-792 Master Seminar Credit 1(1-0)
Discussions and reports of subjects in electrical engineering and allied fields will be presented. Prerequisite: Master level standing.

ECEN-793 Master Supervised Teaching Credit 3(0-3)
Students will gain teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment. Prerequisite: Master level standing.

ECEN-794 Master Supervised Research Credit 3(0-3)
This course is supervised research under the mentorship of a faculty member. It is not intended to serve as the project or thesis topic of the master's student. Prerequisite: Master level standing.

ECEN-796 Master Project **Credit 3(3-0)**

The student will conduct advanced research of interest to the student and the instructor. A written proposal, which outlines the nature of the project, must be submitted for approval. This course is only available to project option students. Prerequisite: Masters standing and Consent of advisor.

ECEN-797 Master Thesis **Credit Var. (3-6)**

Master of Science thesis research will be conducted under the supervision of the thesis committee chairperson leading to the completion of the Masters thesis. This course is only available to thesis option students. Prerequisite: Master standing and Consent of advisor.

ECEN-799 Master Thesis Continuation **Credit 1 (0-1)**

The course is for Master's students who have completed all required course works and all Master Project or Thesis credits. This optional course assists the student in maintaining full-time enrollment following completion of the Masters Project, ECEN796 or Master's Thesis, ECEN797. The course may be taken to allow time for the student to complete the final project or thesis write-up and to prepare for the masters project or thesis defense. Prerequisite: Completion of all required course works and master project or thesis credits for Master standing students and Consent of advisor.

ECEN-801 Solid State Devices **Credit 3(3-0)**

This course deals with p-n junction and Schottky barrier diodes, bipolar junction and field effect transistors, heterostructure devices (e.g., heterojunction bipolar transistors and solar cells), and device modeling and simulation. Prerequisite: ECEN-602 or consent of instructor.

ECEN-802 Advanced Solid State Theory **Credit 3(3-0)**

This course presents the physical properties of solids, including crystal lattice structure, atomic bonding, the band theory of electronic conduction, carrier mobility, and scattering mechanisms. Prerequisite: ECEN-602 or consent of instructor.

ECEN-803 Compound Semiconductors and Nanostructured Devices **Credit 3(3-0)**

Physics of compound semiconductors, application of Schrodinger equation to nanoscale structures, heteroepitaxy, layered and self-assembled nanostructures, materials and device options for advanced optoelectronic devices at the nanoscale will be covered. Prerequisite: none

ECEN-804 Semiconductor Material and Device Characterization **Credit 3(3-0)**

This course covers electrical, optical, and physical/chemical characterization of semiconductor materials and devices. Laboratory demonstrations will be presented on selected characterization techniques. Prerequisite: ECEN-602 or consent of instructor.

ECEN-805 Thin Film Technology for Device Fabrication **Credit 3(3-0)**

The course will provide the principles and practices of different film deposition techniques, high vacuum technology, nucleation and growth of thin films as well as epitaxial growth of films. Prerequisite: none

ECEN-810 Theory and Techniques in Photonics **Credit 3(3-0)**

This course will concentrate on photonic materials such as semiconductors and oxide materials for opto-electronic integrated optic and nonlinear optic guided wave devices such as lasers, modulators and fibers. The course will also cover photonic systems for computing, communications, sensing, and data acquisition, processing and storage. Prerequisites: ECEN-450 or ECEN-470 and ECEN-602.

ECEN-812 RF CMOS Integrated Circuits **Credit 3(2-3)**

This course covers the design of RF CMOS integrated circuits. Passive and active RF components and their modeling using modern CAD tools, high-frequency circuit design techniques, noise analysis and RF circuits such as low-noise amplifiers (LNA), mixers, voltage-controlled oscillators (VCO), power amplifiers, and wireless transceiver architectures will be presented. Prerequisite: none

ECEN-821 Advanced Computer Organization and Architecture **Credit 3(3-0)**

This course introduces the design and performance issues of array processors and multiprocessors. Very Long Instruction Word (VLIW), data-flow machines, array processors, interconnection networks, and memory structures will be discussed. Prerequisite: ECEN-624 or consent of instructor.

ECEN-822 Error-Correcting Codes **Credit 3(3-0)**

In this course, the basic principles of coding, such as error control schemes, coding in communication systems, and

block coding, are studied. Linear block codes, polynomial algebra and cyclic codes, block codes based on finite field arithmetic, convolution codes, coding for bursty channels, coding for bandwidth limited channels, codes for computer memories and error detection and correction methods will be discussed. Prerequisite: ECEN-624.

ECEN-823 Advanced VLSI Design Credit 3(3-0)

This course introduces the design of very high performance digital circuits, interconnect modeling, and packaging. Timing issues in digital circuits, designing memory and array structures, reliability and yield predictions, design synthesis, and validation and testing of VLSI circuits will be discussed. Prerequisite: ECEN-629 or consent of instructor.

ECEN-847 Telecommunication Networks Credit 3(3-0)

The course familiarizes the student with the concepts of the International Standards Organization Open Systems Interconnection (ISO OSI) standards for the seven layer network model. This course introduces techniques for the analysis and optimization of computer networks, and illustrates some of the technical issues of current networks. Prerequisites: ECEN-647.

ECEN-848 Information Theory Credit 3(3-0)

This course covers topics in classical information theory such as entropy, source coding, channel coding, and rate distortion theory. Several related topics are discusses, including entropy for Markov sources and entropy for the extension of sources. Prerequisite: ECEN-749.

ECEN-849 Data Communications Credit 3(3-0)

This course is an extended study of digital communications. Various topics in the upper level of digital communications, such as channel coding, synchronization, multiplexing, multiple access, and frequency spreading are discussed. Prerequisite: ECEN-749 or consent of instructor.

ECEN-850 Multi-Dimensional Signal Processing Credit 3(3-0)

This course deals with multi-dimensional signal processing including digital video processing. The topics include video perception and representation, video modeling and processing, 2-D and 3-D motion estimation for video coding. Prerequisite: ECEN-650 or consent of instructor.

ECEN-852 Advanced Topics in Wireless Communications Credit 3(3-0)

Wireless communication networks are growing very fast to obtain the ultimate goal of ubiquitous access to information, anywhere, anyplace, and anytime and it is almost impossible to imagine the world around us without communication systems due to their ever growing roles in our lives. There are still various challenges to be addressed in these networks in order to provide high transmission rate, reliability and high quality of service for the ever growing number of users. This course will focus on popular and emerging wireless networks and the most recent advanced technologies in wireless systems, including cellular networks, ad hoc networks, wireless sensor networks, personal communications systems, cognitive radio networks, and satellite networks. The efficient techniques to improve the performance of wireless communication networks including multiple access techniques, MIMO systems, cooperative communications and spectrum management will be also discussed in this course. Prerequisite: ECEN-652 or consent of instructor.

ECEN-857 Pattern Recognition Credit 3(3-0)

This course covers classical topics in statistical decision function, Bayesian learning, error probability estimation, cluster-seeking, and deterministic approach. Several related topics are discussed, including stochastic approximation, feature selection and ranking, syntactic and structural pattern recognition. Prerequisite: ECEN-657.

ECEN-861 Power System Control and Protection Credit 3(3-0)

This course deals with power and voltage control systems, and power systems protection by relays. Related topics are also covered. Prerequisite: ECEN-661 or ECEN-668.

ECEN-862 Computer Methods in Power Systems Credit 3(3-0)

This course deals with commercially available software for modeling and analysis of electric power systems. Prerequisites: ECEN-661 or equivalent.

ECEN-865 Optimal Control Systems Credit 3(3-0)

In many practical control problems it is required to find a control technique to optimally improve the dynamical system's performance while satisfying different physical constraints. The system performance can be quantified as a performance index or a cost function. Then, the problem will be reduced to find a control law to optimize a given cost functions. This course explores theory and application of optimal control for linear and nonlinear systems. The course uses optimal control theory and computational optimal control algorithms to improve the system's performance,

reduce the control energy, and stabilize the system. Prerequisites: ECEN-668 or consent of instructor.

ECEN-866 Discrete Time Systems **Credit 3(3-0)**

In this course, analyses and syntheses of discrete time systems are carried out using Z-transform and state variable representations. The controllability and observability, stability criteria, sampled spectral densities and correlation sequence, optimum filtering and control of random processes are discussed. Prerequisite: ECEN-668 or equivalent.

ECEN-867 Neural Networks Design **Credit 3(3-0)**

This course covers the design of neural network systems using CMAC (Cerebellum Model Articulation Controller), back propagation, and multifunction hybrid networks. Prerequisite: ECEN-678 or equivalent.

ECEN-868 Intelligent Methods for Control Systems **Credit 3(3-0)**

The course covers advanced control methods for dynamic systems. The focus will be on intelligent control algorithms, and adaptive and self-learning methods. Stability analysis and performance simulation will also be addressed. Prerequisite: ECEN-668 or consent of instructor.

ECEN-869 Machine Vision for Intelligent-Robotics **Credit 3(3-0)**

This course is a study of visual/non-visual sensor technologies for the intelligent control of a robot. The course will cover image understanding, non-contact sensor analysis, and data fusion for intelligent robotics system design. Prerequisite: ECEN-657.

ECEN-870 Fuzzy Logic with Applications **Credit 3(3-0)**

The course objective is to understand the basic theory and the foundations of fuzzy sets. Fuzzy logic is shown to contain evidence, possibility, and probability logic. This course emphasizes engineering applications in control, decisions-making, and pattern recognition. The hardware/software implementation of those applications is also demonstrated. Prerequisite: ECEN-668 or consent of instructor.

ECEN-871 Nonlinear Control Systems **Credit 3(3-0)**

This course explores the basic issues of nonlinear system analysis and control. The course will introduce the general characteristics of nonlinear behavior and some of the tools needed to analyze and understand them. It will also introduce basic concepts of stability theory, especially Lyaunov's. Some basic design techniques for the control of these systems, such as the sliding mode method and feedback linearization, will be introduced. Prerequisite: ECEN-668 or consent of instructor.

ECEN-872 Decision Making and Supervisory Control of Discrete Event Systems **Credit 3(3-0)**

Discrete Event Systems (DES) are time abstracted systems which can be described by sequences of events. Modelling, and control of discrete event systems can address a wide range of problems in different areas including computer systems, manufacturing systems, robotics, aerospace systems, process control, software engineering, communication networks, smart grids, and system biology. Decision making problems for tasking, resource allocation, etc. can be effectively addressed within the context of discrete event systems. This course therefore studies the modelling, decision making, and control of Discrete Event Systems, and their applications. Different techniques such as automata theory, language, and Petri Nets will be studied to model discrete event systems. Several techniques will be introduced for the design of supervisory control of discrete event systems. The applications of supervisory control of discrete event systems will be explored. Prerequisite: ECEN-668 or consent of instructor.

ECEN-880 Parallel Simulated Neural Networks **Credit 3(3-0)**

This is an advanced graduate-level course that focuses on leading system architecture, high-speed interconnects, and programming models that have been used for parallel and distributed simulations of artificial neural networks. Prerequisite: ECEN678 consent of instructor.

ECEN-885 Doctoral Special Topics **Credit 3(3-0)**

This lecture course is used to introduce engineering topics of current interest to doctoral students and faculty. The subject matter will be identified before the beginning of the course. Prerequisite: Doctoral student and consent of instructor.

ECEN-991 Doctoral Qualifying Examination **Credit 1(0-1)**

This course is for students who are preparing for and taking the written qualifying examination. Prerequisite: Doctoral student and consent of advisor.

ECEN-992 Doctoral Seminar **Credit 1(0-1)**

In this course, doctoral students attend colloquia or seminars. These consist of presentations by doctoral students on dissertation topics and works-in-progress and by guests on important classical, contemporary, or research problems in electrical engineering. Prerequisite: Doctoral level standing.

ECEN-993 Doctoral Supervised Teaching **Credit 3(0-3)**

Students will gain teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment. Prerequisite: Doctoral level standing.

ECEN-994 Doctoral Supervised Research **Credit 3(0-3)**

This is supervised research under the mentorship of a member of the graduate faculty. It is not intended to serve as the dissertation topic of the doctoral student. Prerequisite: Doctoral level standing and consent of instructor.

ECEN-995 Doctoral Preliminary Examination **Credit 3(0-3)**

This course is for students who are preparing for and taking the written and/oral preliminary examination. Prerequisite: Doctoral student and consent of advisor.

ECEN-997 Doctoral Dissertation **Credit Var. (3-12)**

This supervised research serves as the dissertation of the doctoral student. Twelve credits of dissertation are required for graduation. Prerequisite: Doctoral student and consent of advisor.

ECEN-999 Doctoral Dissertation Continuation **Credit 1 (0-1)**

The course is for doctoral students who have completed all required course works and all dissertation credits. This optional course assists the student in maintaining full-time enrollment following completion of the Doctoral Dissertation, ECEN997. The course may be taken to allow time for the student to complete the dissertation write-up and to prepare for the dissertation defense. Prerequisite: Completion of all required course works and dissertation credits for Doctoral student and Consent of advisor.

10. SPECIAL CONSIDERATIONS

10.1. TRANSFER OF CREDIT

A maximum of six semester hours of graduate credit may be transferred from another graduate institution if they are not part of any prior undergraduate degree requirements. Transfer credit must be at the graduate level in the university where the work was completed. Credits to be transferred must be approved by the student's advisor according to their appropriate nature in the student's curriculum. Only the permanent advisor of the student may recommend a transfer of credit to the department chairman by submitting a letter indicating courses, credit hours and justification and the Plan of Graduate Study for the student's degree program. The chair of the Electrical and Computer Engineering Department may then send a form of "Request Transfer of Graduate Credit" to the School of Graduate Studies.

10.2. TIME LIMITATION

The student must complete his/her master program within six successive calendar years. The doctoral student has a maximum of six calendar years from admission to attain candidacy and ten calendar years to complete all requirements. A dissertation must be completed in no more than five years after entering into candidacy. Programs remaining incomplete after this time interval are subject to cancellation, revision, or special examination for out-dated work. When the program of study is interrupted because the student has been drafted into the armed services, the limit shall be extended for the length of time the student is on active duty, if the candidate resumes graduate work no later than one year following his/her release from military service.

10.3. GRADUATE STUDENTS' COURSE LOAD FOR REGISTERATION

Any student holding a Teaching Assistantship (TA) or Research Assistantship (RA) who receives tuition remission and medical insurance must register for full-time enrollment. It is usually at least nine credit hours each semester. However, to ensure that student can devote sufficient time to courses and other duties, the maximum number of credits per semester for the TA or RA are given in the table below:

Maximum Course Loads – TA/RA Assistantship(s)

ASSISTANT CLASSIFICATION	MAXIMUM LOAD (credit-hours/semester)
Full time assistant	15 with permission by adviser
Half time assistant	15

10.4. GRADUATE STUDENT FUNDING

Financial assistance provided to graduate students has as its objective fair compensation for work and/or a supporting level of subsistence while the student attends graduate school and diligently pursues his or her graduate program. In order to be fair to all students requesting assistance, the following policies and/or guidelines are in effect.

- To be considered for financial assistance, the graduate student must be enrolled in courses which are applicable to, and on the student's Plan of Graduate Study. In the event the Plan of Graduate Study has not been established, the courses must be approved by the student's advisor and Graduate Coordinator.
- A request for financial assistance must be on file at least 30 days prior to the time the assistance is requested. In the event of late filing, there is a strong possibility that funding will not be possible due to a limitation of funds.
- All funding decisions are normally made prior to the completion of registration and each student is notified of both consideration and final appointment.
- Funding becomes effective when it is established that the student is available, assigned to work, enrolled in the graduate program, and diligently pursuing graduate studies.
- Funding and work assignments follow the guidelines below:

If a student is assigned a work load less than	The student must enroll in	
	at least	no more than
20 hrs/wk	3 hrs	12 hrs
30 hrs/wk	3 hrs	9 hrs
40 hrs/wk	1 hr	6 hrs

These hours represent semester hours of study, which are either applicable to the Plan of Study or are approved by the student's advisor and the Graduate Coordinator.

- Funding provided by Fellowships, the School of Graduate Studies, College, and other sources not under the administration of the Department of Electrical and Computer Engineering is governed by the policies, procedures, and guidelines of the applicable funding source.