Graduate Student Handbook

Introduction

The Electrical and Computer Engineering department offers M.S. and Ph.D. degrees in both Electrical Engineering and Computer Engineering. The M.S. program includes an all-coursework option and a thesis option. In addition, there is also a Master of Engineering (MENGR) degree program in Electrical Engineering available to off-campus students who take courses through the University Telecampus Program. The MENGR is distinct in that applicants are not required to take the Graduate Record Examination (GRE) and are not required to satisfy a focus area requirement. In the MENGR program an Engineering Report is submitted in lieu of a conventional master's thesis. The engineering report is fundamentally the same as a thesis, but is required to conform to college formatting standards as opposed to university thesis standards. There is also a direct entry Ph.D. program for suitably qualified students having completed a baccalaureate degree.

This handbook is intended to familiarize graduate students with the operational aspects of the Department of Electrical and Computer Engineering at Clemson University. As such, it serves as an informational guide and a catalog of departmental procedures and requirements that may affect graduate students. The requirements specified herein are in addition to those described in the Graduate School Procedures and Regulations. The Clemson University policies for graduate students are specified in The Graduate School Announcements. It is very important that each student read all the information in this document website) pertaining to the program of study. Additional departmental requirements for the degree programs administered by this department are provided in this handbook.

All new students are required to attend orientations held by the Electrical and Computer Engineering Department and the Graduate School to become acquainted with the Department's instructional activities and research as well as with general regulations. Information from these orientations helps students to select specific research areas and allows them to choose their advisory committee members more responsibly. Dates and times of orientation meetings are announced each semester.
We hope this handbook is useful both to graduate students and faculty. Any inconsistencies or omissions should be brought to the attention of one of the graduate program coordinators.

Personnel

The following is a list of key people involved with the graduate program along with their responsibilities.

Student Services Program Coordinator for the Graduate Program

Ms. Lane Swanson (102A Riggs Hall, 656-5902) and Ms. Elizabeth Gibisch (102C

Riggs Hall, 656-3947) assists the Graduate Program Coordinator with all aspects of Graduate Program administration. In general, they are the first people to see with any questions regarding the graduate program. Among their duties, they are responsible for making changes to graduate student payroll. They also maintain all records for the Graduate Program and has copies of all forms associated with the program. They prepare Graduate School forms (GS-2, GS-5, GS-7) for students and distributes official notices of oral exams and thesis and dissertation presentations. They have copies of all documents associated with the Graduate Program.

Graduate Program Coordinator

Dr. Dan Noneaker is responsible for decisions concerning admissions. He makes recommendations to the Department Chair regarding teaching assistantship and fellowship offers and interacts with the Graduate School on many matters including student status, assistantships, and fellowships. He also coordinates graduate student recruitment activities and is in charge of making laboratory teaching assistant and grader assignments.

ECE Department Chair

Dr. Darren Dawson is the current Chair of the Department. He gives the final word on all matters involving resources available to graduate students and final approval on all assistantship and fellowship offers.

ECE Graduate Committee

The ECE Graduate Committee oversees academic policies of the graduate program. Petitions should be through the student's advisor to the Chair of this committee. The current Chair is Dr. Harlan Russell.

The following is a list of administration staff members and their association with the Graduate Program.

Ms. Janet Hendricks, Administrative Assistant to the Department Chair (105 Riggs Hall).

Ms. Elizabeth Gibisch, Information Resource Consultant (102C Riggs Hall). Coordinates computer center accounts. Has official copies of course syllabi. Has desk copies of texts and laboratory manuals for students teaching lectures and some labs.

Ms. Gale Black, Administrative Assistant (222 Riggs Hall). Initiates all purchases for the Department.

Ms. Wendy Howard, Accountant/Fiscal Analyst II for Electrical and Computer Engineering Undergraduate Program (221C Riggs Hall). Maintains accounting information for all ECE accounts.

Ms. Janet Bean, Student Services Program Coordinator for Electrical and Computer Engineering Undergraduate Program (102B Riggs Hall). Provides support for both electrical and computer engineering undergraduates as well as administrative support

for Riggs Hall faculty.

Ms. Lillian Burns, Administrative Assistant (305 EIB).

The following is a list of technical staff members and their association with the Graduate Program.

Mr. David Moline, Technical Support Manager (221-F Riggs Hall). In charge of graduate student office assignments and key distribution. Provides some lab support. Provides analysis of computer systems with responsibility for the design, programming, testing, debugging and implementation of systems; serves as an independent leader and user contact for design of special system projects; provides electronic servicing of computer boards and peripheral devices. Aids with design project for graduate students and undergraduate students.

Mr. John Hicks, Instrument Technician II (202A Riggs). Maintains analog and digital instrumentation in the ECE Department and assists the students in the use of equipment for lab experiments, research and projects. Also, responsible for activities of the electronic shop.

Relevant Phone Numbers

The following is a list of places and phone numbers relevant to the Graduate Program.

Campus Police (Below IPTAY Building)	656-2222
Computer Center (Basement of P&A Building)	656-3494
Graduate School Office (E-106 Martin Hall)	656-3195
Graduate Student Association Office	656-2697

Selecting an Advisor

Each graduate student is admitted into a selected focus area after review by faculty in that area based upon the student's expressed interest. Each student's initial advisor is the faculty chairperson of that focus area and should be consulted in selecting courses for the first semester of study. Thereafter each student may select a faculty member as the graduate program advisor. It is possible to change the area of focus, but it should be understand that acceptance criteria may vary from one focus to another and resource limitations may preclude a change. Each change is subject to review by faculty in the new focus area.

The selected advisor's research interests should closely relate to the focus area of study. See the published list of faculty and their research interests to assist in that selection. Your advisor should be your first contact for planning your study program and selecting courses. Your advisor and your Faculty Advisory Committee should be

determined by the end of your first semester of study. (Refer to M.S. committee details or Ph.D. committee details as appropriate.)

Current Chairpersons for the focus areas are as follows:

Communication Systems and Networks (EE or CpE)	D. L. Noneaker
Computer Systems Architecture (CpE)	R. J. Schalkoff
Digital Signal Processing(EE or CpE)	C. W. Baum
Intelligent Systems(EE or CpE)	I. D. Walker
Electronics (EE)	K. F. Poole
Applied Electromagnetics (EE)	A. Q. Martin
Power (EE)	A. A. Girgis

Course Selection

Once you have chosen a focus area and a graduate program advisor, you should meet with your advisor and select courses for your first semester. The courses should be chosen so as to make significant progress towards meeting the requirements of your degree. The degree requirements are given in later sections of this handbook.
During your first semester (once you have made your "final" choice for graduate program advisor), you should work with your advisor to complete a GS-2 form. On the form you should list only those courses that are to be used to satisfy requirements for the degree. The form also requires the selection of a faculty advisory committee. The makeup of the committee depends on whether you are in the M.S. program or the Ph.D. program. Details are provided in later sections of the handbook.

All courses listed on the GS-2 form must be approved by the student's faculty advisory committee. Once the student and committee agree upon the courses to be included on the GS-2, a handwritten copy (without signatures) should be given to the Student Services Coordinator for the Graduate Program. The information will be entered into a database, and a typed copy will be provided for signatures from the committee. After the signatures are obtained, the GS-2 should be returned to the Coordinator.
For M.S. students, the Department requires submission of an approved GS-2 form prior to the completion of nine (9) hours of graduate study or the first semester enrolled, whichever is later. In addition, the Graduate School requires candidates for masters or specialist's degrees to submit the GS-2 form by the middle of their second semester, and doctoral candidates no later than the beginning of their second year of study. The Graduate School assesses significant late fees for students who do not meet these deadlines.

To help with planning your course of study and completing your GS-2 form, please see the list of planned course offerings. This list indicates when courses are intended to be offered for next several years. Note that this information is tentative and becomes increasingly tentative for semesters farthest in the future. Courses may be cancelled

due to low demand (less than 5 students). Demand is determined based on data compiled from GS-2 forms.

Sample GS-2 Form

List only those courses that are to be used to satisfy requirements for the degree. Once you and your committee agree upon the courses to be included on the GS-2, give a *handwritten* copy (without signatures) to the Student Services Coordinator for the Graduate Program. The information will be entered into a database, and a typed copy will be provided for signatures from the committee. After you obtain the signatures, return the GS-2 to the Coordinator.

Graduate School Forms page.

Registration

Information on graduate student registration can be found at the Registrar's web site and in the Graduate School Announcements. Pre-registration is required for all graduate students. The information obtained from pre-registration is essential to plan graduate course offerings properly. Failure on the part of students to pre-register may result in course cancellations and the inability to offer desired courses. Students are strongly encouraged to register early to ensure that courses are not canceled.

All ECE graduate students must also complete and keep up to date a Departmental Information Form, available from the Student Services Coordinator for the Graduate Program. Registration is not complete without completing the information on this form. This form is the starting point for student records in the Department.

Registration Requirements for Students Receiving ECE Assistantships
All graduate students receiving assistantships from the ECE Department (including graders) are required to register for 12 hours. The total should include the desired course hours and the appropriate number of 891 or 991 thesis hours to add to 12. Additional requirements for Graduate Assistants are given in the Handbook sections on assistantships. Every Graduate Assistant should read these sections carefully.

Master's Program: Other Policies

Minor Area Option

Each Master's candidate may include a minor area in the degree program. To accomplish a minor the student must take 2 courses (6 hours) in some area outside of their major, such as Math, Physics, Computer Science, or Industrial Engineering, as approved by their advisory committee. If a minor is declared, this area must be represented on the student's Advisory Committee.

Restrictions on Use of ECE 892

A maximum of 3 hours of ECE 892 Special Problems in Electrical and Computer Engineering may be included on any Master's candidate's GS-2 form. In addition, a student must obtain advance approval of his/her advisory committee before taking this course if it is to be used on the GS-2 form.

Miscellaneous

Thesis Guide

An online booklet entitled "The Guide: Manuscript Preparation and Graduation Clearance" should be read by all students before writing a thesis or dissertation.

Computer Facilities

All graduate students enrolled are automatically assigned a Clemson University Personal ID (CUPID) that allows access to the University mainframe and class registration system and to a variety of personal computer labs. Passwords for these systems may be (re)set with a picture ID at the CCIT Help Desk. Accounts to separate workstations and labs maintained by the College of Engineering and Science can be obtained at the CNS Help Desk. Accounts to machines under the control of particular research groups are arranged by the faculty members in charge of these machines.

Mailboxes

Each student will be assigned a mailbox. Mailboxes should be checked regularly for mail and other informational items.

Office Supplies

The department does not furnish office supplies to graduate students.

Copying Machines

Located in 104 Riggs is a copy machine for *graduate assistant* use only. Copying of text books is definitely not allowed. Such copying violates copyright laws and is strictly forbidden.

Telephone/Fax Policy

University funds are not available to support long distance telephone charges for graduate students. Graduate research assistants supported by external funds should

coordinate their telephone usage through their faculty supervisor. Calls must be charged to the appropriate contract number. An authorization code number from a faculty supervisor is required to use the Fax machine.

Desks

It is the goal of the Department to provide a desk for each graduate student employed by the department. However, due to the limited available space, it may not always be possible to accommodate each student. Therefore, a priority system is used which first assigns a desk to each Graduate Assistant and Graduate Fellow, and then allocates desks to as many other students as possible, based on seniority. New students should see the Technical Support Manager in Room 221-F Riggs concerning a desk assignment.

Note: Study facilities for graduate students are intended solely for the purpose of studying and, in some cases, interfacing with students during office hours. They are not to be used for socializing or temporary housing. Students abusing these privileges will forfeit them.

Keys

Each graduate student who is assigned a desk will be given a key to his/her office and to the building his/her office is in. Keys for labs and classrooms are available for students who have teaching responsibilities there. See the Technical Support Manager in 221-F Riggs for assignment of keys.

Graduate Student Government

The Graduate Student Government (GSG) is a university-wide organization of all graduate students for the purpose of promoting graduate student interests. At the start of the fall semester, department GSG representatives are elected. The senate meetings are open to all graduate students. See the GSG web site for more information.

IEEE/ACM Membership

Application forms for membership in IEEE, the IEEE Computer Society and the ACM may be obtained from the IEEE advisor. Graduate students are encouraged to associate with the national society, as well as the Piedmont section. Additional information is available on the ECE website.

College of Engineering and Science Policy on Alcohol

Alcoholic beverages are prohibited for any unapproved activity held in a College of Engineering and Sciences facility.

Maters' Requirements

Master's Advisory Committee

The committee must consist of at least three faculty members. The majority of the advisory committee, including the major advisor, must be comprised of Clemson University ECE full-time tenure-track faculty. The advisory committee for an interdisciplinary study program may include a co-advisor from outside the ECE department.

Master's Degree Option Selection

Each student's program, as specified by the GS-2 form, must satisfy one of the following two options.

Thesis Option - The student must write a M. S. Thesis that is approved by the advisory committee and the Graduate School. The GS-2 form must include a minimum of 30 credit hours, including exactly six hours of ECE 891 - Master's Thesis Research. As required by the Graduate School, at least 12 of the credit hours, excluding the six ECE 891 credits, on the GS-2 form must be at the 800-level. For this option, the GS-2 may not include any credits for ECE 890. Students supported as graduate assistants are almost always required by their advisors to choose the thesis option. In addition, those students anticipating continued studies toward the Ph.D. should strongly consider the thesis option.

All-Coursework Option - The GS-2 form must include a minimum of 33 credit hours, at least 18 of which must be at the 800-level. (No Thesis or Engineering Report is required with this option; therefore, neither ECE 891 nor ECE 890 can be included on the GS-2 form in this option.)

Master's Comprehensive Examination

Independent of which Option is chosen, the student must take a final examination (oral and/or written), administered by his/her advisory committee. A student selecting the Thesis Option must pass an exam consisting of an oral defense of the student's thesis or report. The advisory committee has the option of administering an additional written and/or oral exam on coursework.

For a student selecting the All-Coursework Option, this examination will consist of an oral review and a written summary of a published paper that has been approved by the student's advisory committee.

M.S. in Electrical Engineering Requirements

The following focus areas are acceptable for satisfying the core requirement in Electrical Engineering. Please see Appendix A on page 22 for details about each focus area.

Communications Systems and Networks
Digital Signal Processing
Electromagnetics
Electronics
Intelligent Systems
Power

Minor Area Requirement

Each Master's candidate may include a minor area in the degree program. To accomplish a minor the student must take 2 courses (6 hours) in some area outside of their major, such as Math, Physics, Computer Science, or Industrial Engineering, as approved by their advisory committee.

If a minor is declared, this area must be represented on the Advisory Committee.

Restrictions on Use of ECE 892

A maximum of 3 hours of ECE 892, Special Problems in Electrical and Computer Engineering, may be included on any Master's candidate's GS-2 form. In addition, a student must obtain advance approval of his/her advisory committee before taking this course if it is to be used on the GS-2 form.

M.S. in Computer Engineering Requirements

The following focus areas are acceptable for satisfying the core requirement in Computer Engineering. Please see Appendix A on page 22 for details about each focus area.

Communications Systems and Networks
Computer Systems Architecture
Digital Signal Processing
Intelligent Systems

Minor Area Requirement

Each Master's candidate may include a minor area in the degree program. To accomplish a minor the student must take 2 courses (6 hours) in some area outside of their major, such as Math, Physics, Computer Science, or Industrial Engineering, as approved by their advisory committee.

If a minor is declared, this area must be represented on the Advisory Committee.

Restrictions on Use of ECE 892

A maximum of 3 hours of ECE 892, Special Problems in Electrical and Computer Engineering, may be included on any Master's candidate's GS-2 form. In addition, a student must obtain advance approval of his/her advisory committee before taking this course if it is to be used on the GS-2 form.

M.S. Focus Area Core Requirements

Each M. S. student's program must include the core courses of the chosen focus area. Please see Appendix A on page 22 for details about each focus area..

Communications System and Networks
Computer Systems Architecture
Digital Signal Processing
Electromagnetics
Electronics
Intelligent Systems
Power

Master's Program: Other Policies

Minor Area Option

Each Master's candidate may include a minor area in the degree program. To accomplish a minor the student must take 2 courses (6 hours) in some area outside of their major, such as Math, Physics, Computer Science, or Industrial Engineering, as approved by their advisory committee. If a minor is declared, this area must be represented on the student's Advisory Committee.

Restrictions on Use of ECE 892

A maximum of 3 hours of ECE 892 Special Problems in Electrical and Computer Engineering may be included on any Master's candidate's GS-2 form. In addition, a student must obtain advance approval of his/her advisory committee before taking this course if it is to be used on the GS-2 form.

Master's: The Role of the Graduate Program Advisor and Advisory Committee

A student's graduate program advisor is his/her first contact in planning a program of study. The advisor, along with the student's advisory committee, will serve the following functions:

Specify co-requisite courses if required
Approve the coursework study plan (GS-2)
Supervise any thesis or engineering report research
Administer the final examination
Initiate recommendations for awarding the degree

Study plans documented on GS-2 forms must be completed during the first semester. Circumstances, however, can necessitate later changes to the plan. Proposals for changes in study plans should originate with the student and the advisory committee. Authorized changes must be recorded on a revised GS-2 form, which is given to the Student Services Coordinator for the Graduate Program.

Master's Program Timetable

The following is a list of the steps in a Master's program for both Electrical and Computer Engineering:

Appointment of advisory committee in consultation with faculty advisor.

Complete with advisor prior to end of 1st semester of graduate study.
Preparation of study program in consultation with advisor.

Complete prior to the end of 1st semester of graduate study.
Filing of study plan (GS-2).

Complete prior to the end of 1st semester of graduate study.
Approval of thesis or project proposal (if appropriate).

Complete before end of second semester.
Admission of candidacy for degree (GS-4).

Complete after finishing at least 15 hours of course work and at least one semester before degree is expected.
Submittal of thesis or project (if applicable).

Provide first draft at least four weeks before date of final examination; provide final (approved) copies at least two weeks before final examinations, unless the advisory committee provides a different deadline.
Final examination form (GS-7) to be filed after examination is completed.

Complete at least three weeks prior to date on which degree is expected (see Graduate School schedule for latest possible date of submission).
Click here for Graduate School deadlines.

Doctorate of Philosophy

Summary of the Requirements

Each Ph.D. student must submit an approved GS-2 form designating the student's program of study no later than the beginning of the second year of study. The GS-2 form is completed after the student's advisory committee has been formed and has approved the student's plan of study.
The student's advisory committee must include at least four tenure track faculty members (see ECE list). Three of the members must be from within the ECE Department and one must be from outside the ECE Department.

For the Advisory Committee the student selects the major advisor who, in consultation with the student, selects the additional committee members. Keep in mind that faculty members must consider their existing workloads before consenting to serve.

As pointed out in the Graduate School Announcements, admission to the Graduate School does not qualify a student as a candidate for an advanced degree. Candidacy depends upon acceptance of the student's GS-4 form by the Graduate Dean. This form is completed after a major share of course work has been taken and after completion of the Comprehensive Examination.

Following are the requirements of the ECE Ph.D. Program after successful completion of the M. S. Degree:

Passing the Ph.D. Qualifying Exam.
Passing the Ph.D. Comprehensive Exam.
Completion of a minimum of 24 hours of graduate course work and 18 hours of research beyond the Master's degree. There are also special ECE departmental requirements.
Completion and oral defense of a dissertation. (Includes public colloquium.).

Ph.D. Qualifying Examination

Every student enrolled in the ECE Ph.D. program is required to pass a written qualifying examination. The objective of this examination is to ensure the adequacy of each student's background. The examination tests undergraduate ECE material.
The exam is given once each year in January. Students beginning the Ph.D. program in the summer or fall semesters (May or August) must take the exam at the first opportunity. Students beginning in spring (January) may choose to take it the following January. Students who are currently Clemson M. S. students are encouraged to take the exam while they are still in the M. S. program. Note that the longer the gap between the exam and the undergraduate degree, the more "rusty" the material is likely to become.

Students are required to complete the Qualifying Examination Signup Form and turn it in to the Student Services Program Coordinator for the Graduate Program. The signup form, deadline and the dates and times of the next exam can be found at this link.

The examination takes place over two days. On each day the duration of the exam is three hours. The first part of the examination is on the afternoon of the first day, and the second part is on the morning of the second day. The first day of the examination is closed book, and the second day is open book.

On the signup form, the student must select three topics. Electrical engineering majors must choose their topics from the following list:

Electrical Engineering Exam Topics
Electronics
Circuits
Power
Controls
Electromagnetics
Systems, Signals, and Probability
Communications and Networks

Computer engineering majors must choose their topics from the following list:

Computer Engineering Exam Topics
Circuits
Controls
Systems, Signals, and Probability
Computer Hardware and Architecture
Programming Systems and Software Engineering
Communications and Networks
Computer System Structures

The examination consists of 12 questions, four from each exam topic the student has selected. The student must answer all 12 questions. On each day, the student answers two questions from each topic. The questions are handed out and collected two at a time (topic by topic) each hour. The student may not go back to questions given in an earlier hour.

Test solutions are identified only with a two-digit code given to each student by the proctor prior to the start of the examination. Students should not put their names on their exams, but should only use the two-digit code.

A committee of at least two faculty members writes the questions for a given topic. The same committee evaluates each student's performance on the four questions from this topic and assigns a single score that is one of the following:

10: Exceptional competence
8: Reasonable competence
6: Minimum competence
4: Some knowledge, but not enough to declare competence
2: Rudimentary knowledge
0: No knowledge

Scores between these values are not given. Note that the score measures overall competence on the topic. It is not a measure of the percentage correct. Students will be informed in writing of their scores on each topic.

To pass the exam, the sum of the scores on the three topics must equal 24 or more points. If the exam is failed, it must be retaken at the next opportunity. Only one retake is allowed. To sign up for the test as a retake, the student must complete the Qualifying Examination Retake Signup Form and turn it in to the Student Services Program Coordinator for the Graduate Program. The deadline for submitting this form is given at this link. For the retake, the student may again choose any three topics. However, for a topic that was also taken the first time, the *maximum* of the scores of that topic from both tests will be used. For a topic that was not taken the first time, only the second score is used. For the retake, a student may choose to only retake part of the test, accepting scores from the first test on certain topics. This must be decided in advance and is entered on the signup form. For the retake, passing again requires 24 points or more.

A Qualifying Examination Study Guide is available to help you prepare for this exam. This document specifies what should be studied for each topic. Please find it in Appendix B, page 29, of this handbook.

Ph.D. Comprehensive Examination

The student's advisory committee administers this exam. The content and scope of the exam are at the discretion of the committee. The exam may be written or a combination of written and oral. Further details may be found in the Graduate School Announcements.

Ph.D. Coursework

The Department requires a minimum of 24 hours of graduate coursework beyond the Master's degree; however, the student's advisory committee may specify additional hours. This is in addition to the 18 hours of ECE 991 - Doctoral Research hours required by the Graduate School.

Ph.D. Dissertation

The Ph.D. thesis or dissertation must constitute original research that makes a "contribution to knowledge" in the major field of the candidate.

Direct Entry to the Ph.D. Program

For suitably qualified, high-caliber students, direct entry to the doctoral program from the baccalaureate is a possibility. Transfer from the M. S. degree to the Ph.D. program is also permitted.

Direct Entry from the Bachelor's Degree

The appropriate focus area reviews all application material and makes a recommendation to the Graduate Coordinator.

Transfer from the Master's Program

Students who wish to transfer from the Master's program prior to obtaining the degree may do so at any time during the course of their Master's program. The appropriate focus area reviews all application material and makes a recommendation to the Graduate Coordinator.

Entry and Probationary Periods

In consultation with the student, the Graduate Coordinator appoints a mentor. The mentor may be the focus area chairperson or an appointed representative and acts as temporary advisor to the student during the early part of the program. Students who are on an assistantship will be paid at the M. S. rate during this probationary period prior to successfully completing the Ph.D. qualifying examination.

Ph.D. Qualifying Examination

The requirements are as listed under the section on the Ph.D. qualifying examination on page 12 of this handbook. After successful completion of the Ph.D. qualifying examination, the student is reclassified as a "Ph.D. student" and should promptly complete a GS-2 form naming an advisor and advisory committee. The advisor may or may not be the mentor. If the student is on a departmentally-offered assistantship, the stipend will be raised to the Ph.D. level at this time.

Coursework

The course work requirements are 42 hours beyond the B. S. degree and 18 hours of dissertation work. At least 9 of these course work hours must be taken outside the ECE Department and no more than 9 hours can be at the 600-level.

Dissertation

The dissertation requirements are the same as those for the standard Ph.D. program.

Assistantships

Work Requirements
Workload

The normal half-time graduate assistantship workload is 20 hours per week (average). Students are often hired for 25% (10 hours) or some other fraction of full-time work.
Employment Schedule and Leave without Pay

Graduate students with 9-month and 12-month graduate teaching assistantship appointments work on the same calendar as faculty with 9-month and 12-month appointments, respectively. The duties over holiday periods for graduate research assistants should be agreed upon by the student and the immediate faculty advisor in charge of the research program. The policy concerning leave without pay is outlined in the financial section of the Graduate School Announcements.

Termination of Pay

Pay for any session will end when the student leaves Clemson and/or is no longer available for work assignments, except for the 2-week Christmas vacation policy for continuing students, stated above. Normal termination dates for the spring and fall semesters for students not continuing into the next session will be Graduation Day. Any deviations from these dates must be approved by the student's research supervisor, or by his/her teaching supervisor, through the Graduate Program Coordinator.

Reduction of Pay

Normally, 20 hours/week will be submitted on each payroll for each half-time graduate assistant. However, less than 20 hours may be submitted for a student, with the pay reduced accordingly if the amount of time worked by the student consistently deviates from the required 20-hours/week average. Due to the procedure currently used for time sheets, it may be necessary to implement any pay reductions in the pay period following the one in which the work deficiency actually occurred. Pay may also be withheld from students who violate the policy on duties over holiday periods.

Mechanisms for Funding Graduate Students

The ECE Department uses two different mechanisms for funding graduate students. One is the Department-offered assistantship that is normally offered at the beginning of a student's enrollment at Clemson. The offer for this assistantship comes from the ECE Department Chair or Graduate Program Coordinator. This assistantship is subject to the four or six semesters time limit as described in the first two bullets below (depending upon the degree being pursued) and is contingent upon satisfactory performance and progress towards the degree by the student.

The other type of assistantship is a research assistantship offered directly by a faculty member. In this case, the funding commitment is from the faculty researcher, and the Department is not obligated to sustain the support if the faculty member withdraws support.

In many cases, an entering student is offered an assistantship both by the Department and by a faculty researcher. In this case, if the student elects to accept the research assistantship and the research funding ends, the Department's offer will still be available if the time limit of the original offer has not expired. Some students have a joint assistantship consisting of both a part-time teaching assistant position and a part-time research assistant appointment.

In addition to financial support from within the department, there are also various fellowships available from the College of Engineering and Science, the University, industry, philanthropic organizations, and from several U.S. government agencies. Information is available through the graduate program office in Riggs Hall or from the Graduate School office in Martin Hall. Many of these fellowships are restricted to U.S. citizens.

Note the following additional information:

Assistantships for Master's students will normally be awarded for a maximum of 4 regular (Fall/Spring) semesters. The same time limit applies to fellowships controlled by the Department.

Assistantships for Ph.D. students will normally be awarded for a maximum of 6 regular (Fall/Spring) semesters beyond the Master's degree. The same time limit applies to fellowships controlled by the Department.

Some assistantships are available in the summer but are not guaranteed. Efforts will be made to distribute summer support equitably, based on needs of the Department and on the qualification and seniority of students.

Continuation of assistantships and fellowships is contingent upon satisfactory academic performance, as well as satisfactory performance of assigned duties associated with the assistantship.

Students are encouraged to work with faculty on sponsored research projects. If a research project is terminated before a student has completed his/her degree program, the Department will endeavor (on an individual basis) to provide financial support to allow continuation of the student's program. This might involve a teaching assistant assignment, if appropriate. The foregoing statement should not be construed as an assurance of funding. The student is expected to complete his/her degree program in a timely fashion.

Each year, the Department establishes fixed rates for state-supported assistantships. The rates are a function of the type of assistantship, the number of hours per week assigned, and whether the student is a Master's or Ph.D. candidate. Rates for externally funded assistantships are at the discretion of the individual faculty providing support. If the Department has committed an assistantship to a student at a particular biweekly rate, and a faculty researcher offers the student partial support, the Department reserves the right to reduce the level of support from state funds so as to maintain the same total biweekly or semester rate. (This reduction of state funding may be necessary due to overall budgetary constraints of the Department.)

Individual faculty members are not empowered to offer teaching assistantships or grading positions to graduate students.

The department maintains a list of all current students who have been awarded an assistantship by the department and of all non-supported students who have requested assistantship support. Faculty researchers will normally review this list and consult with the Graduate Program Coordinator before committing assistantship support to a student.

Twelve-hour Rule for Students on Assistantships

Graduate Assistants, Fellows or Trainees enrolled in a doctoral program or in a master's program requiring a thesis must enroll in 12 semester hours of credit. To be eligible to pay fees at the (reduced) graduate assistant rate, students must be employed for the full semester or through the time of completion of all degree requirements in the semester.

Description of Dept.-Offered Assistantships

There are four classes of departmental-offered assistantships:

Graduate Laboratory Assistantship (GLA)
Graduate Grading Assistantship (GGA)
Graduate Special Teaching Assistantship (GSTA)
Graduate Special Research Assistantship (GSRA)

A GLA assignment is made to a regular laboratory section that requires students to meet for a specified 2 or 3 hour time slot on a weekly basis. Recipients of GLAs are expected to prepare and present lab lecture and pre-lab materials, assist students in conducting the laboratory, and collect and grade lab reports. The GLA recipient is expected to be responsible for the portion of the student's grade related to that lab. Every regular laboratory section must have an official course number and be entered into the campus scheduling computer. Laboratories that do not have credit hours associated or do not meet on a regular basis should not be assigned course numbers and will not have a GLA automatically assigned.

A GGA assignment is made to a regular lecture section for the purpose of grading student homework and other assignments. The GGA is not expected to meet with students except as to explain the grading of a particular assignment when needed. Assignments are only made to lectures that have need of a GGA. The department does not have funds to provide a grader for every lecture section.

A GSTA assignment can be made for a variety of reasons. The GSTA recipient is assigned to a particular faculty member and is responsible for assisting the faculty member in executing one or more courses. The GSTA recipient is not responsible for meeting with or lecturing to regular lab sections, and is not responsible for a portion of the student's grade. Typical GSTA assignments might include updating laboratory materials, updating course materials, and management of software or hardware used by students.

GSTA assignments are limited and must be justified to the department head on a per-semester basis. Priority is given to new requests for assistance in creating or updating course and lab materials. A GSRA assignment is only made through an agreement with the department chair. This includes all assignments that are not directly connected to any class. The pay rate may be at the GLA or GSTA rate, depending on the agreement with the department chair.

The Graduate Program Coordinator in charge of making assistantships is the point of contact for faculty wishing to request graduate student positions. Note the following information:

All regular laboratory sections will automatically have a GLA assigned. Each laboratory section carries a 5-hour assignment.

Instructors must request a GGA to grade any regular lecture section. Hours assigned depend on enrollment as approved by the department chair.

Faculty must request special assignments (GSTA, GSRA) from the graduate program coordinator in charge of making assistantships and include an assignment summary, hours per week, and expected duration of the assignment. The request is subject to approval by the department chair.

Award Policy for Dept.-Offered Assistantships

The Graduate Program Coordinator in charge of making assistantships assigns graduate students to departmental-offered assistantships. The following priority list is used in making assignments:

1. Students who have a financial commitment in writing from the department up to the amount of that commitment.
2. Students specifically requested for certain positions by the faculty member supervising that position.
3. Students with prior experience in a given position.
4. Students who have requested a given position.
5. Students whose focus area indicates a good match for a position.
6. Ph.D. students have priority over Master's students.
7. Any qualified student.

Complete application information is available from the Student Services Program Coordinator for the Graduate Program in 102A Riggs Hall. Do not contact the Graduate Program Coordinators for this information.

Students need a total of 10 hours of support to receive a tuition waiver from the university. Thus, students who do not have an externally funded RA will be assigned at least 10 hours. A "normal" load for students is 15 hours (3 lab sections). Students can be given an extra load in order to fill gaps in the schedule or satisfy a financial commitment.

Effort is made to limit the number of different subjects a student must cover in a semester. If a student can be assigned to multiple sections of one lab, that is preferred. Two different subjects is considered a maximum, except in special cases. In the event there are many more applicants than positions, assignments are spread as much as possible by assigning 10 hours rather than 15. Of course, financial commitments must still be honored.

In making grader assignments, effort is made to have students grade as few different courses as possible, and to have faculty interacting with as few students as possible. Often this does not work out, but we try.

Information for Non-native American Students

International students who wish to become laboratory teaching assistants must first pass two English communications tests. The first test is the SPEAK test administered by the English Department. The second test is one administered by the ECE Department. The SPEAK test is required for all international students at Clemson University wishing to become teaching assistants. It is given throughout the year and can be arranged by signing up with the Student Services Coordinator for the Graduate Program. There are sample booklets available with examples of each kind of question you will be asked, as

well as the time allowed for the answers. These booklets are the property of the English Department and must be returned.

The ECE exam lasts about 10 minutes and consists of a technical presentation of 5 minutes followed by a question and answer session. This exam is designed to assess a candidate's ability to present technical information orally to a typical group of undergraduates. The audience will consist of at least two faculty members from the ECE department. The presentation should be organized ahead of time by the candidate and be typical of what would be presented to an undergraduate laboratory class. For example, a suitable topic might be how a low-pass filter works and how the student will build and test this filter in the lab.

Appointment Procedure for New Appointments

New appointments for formal assistantships must be initiated, in writing, by the Graduate Coordinator or the Principal Investigator of the research project. Temporary appointments are made on a semester-by-semester basis as the need arises. Students must fill out tax forms obtained from the Student Services Graduate Coordinator for the Graduate Program. Students are responsible for providing tax forms promptly. Delays in receiving these forms can cause delays in checks since they are only issued every two weeks.

Appendix A – Focus Area Requirements

Applied Electromagnetics

This focus area is only available to electrical engineering students. There are four course requirements:

1. ECE 830 Electromagnetics
2. ECE 829 Special Functions in Engineering
3. One (1) of the following:
   - ECE 636 Transmission Lines and Microwave Circuits
   - ECE 827 Finite Difference Time Domain Method
   - ECE 831 Advanced Electromagnetic Theory
   - ECE 834 Asymptotic Methods and Diffraction Theory
   - ECE 835 Finite Element Method in Electromagnetics
   - ECE 839 Integral Equations in Electromagnetics
4. One (1) of the following, unless taken as an undergraduate:
   - ECE 646 Antennas and Propagation
   - ECE 693 Special Topics (Grounding and Shielding)
   - ECE 893 Special Topics (CMOS RFIC Design)

Appendix A – Focus Area Requirements

Communication Systems and Networks

There are three separate tracks; one for computer engineering students and two for electrical engineering students.

Computer Engineering Track

There are three (3) course requirements:

1. ECE 638 Computer Communications
2. ECE 848 Telecommunication Network Modeling and Analysis
3. One (1) of the following:
    - ECE 640 Performance Analysis of Local Computer Networks
    - ECE 841 Distributed Computing and Networks
    - ECE 845 Computer System Design and Operation
    - ECE 850 QoS in Wireless Networks

Electrical Engineering Communication Networks Track

There are three (3) course requirements:

1. ECE 638 Computer Communications
2. ECE 848 Telecommunications Network Modeling and Analysis
3. One (1) of the following:
    - ECE 818 Random Process Applications in Engineering
    - ECE 820 Digital Communications Systems I
    - ECE 857 Coding Theory

Electrical Engineering Digital Communication Systems Track

There are four (4) course requirements:

1. ECE 818 Random Process Applications in Engineering
2. ECE 820 Digital Communications Systems I
3. ECE 821 Digital Communication Systems II
4. ECE 857 Coding Theory

Appendix A – Focus Area Requirements

Computer Systems Architecture

Students must take at least one (1) course from each of the following three areas:

Software

- ECE 617 - Elements of Software Engineering
- ECE 852 - Software Engineering
- ECE 855 - Artificial Intelligence
- ECE 873 - Parallel and Distributed Systems

Architecture

- ECE 629 - Organization of Computers
- ECE 668 - Embedded Computing
- ECE 842 - Computer Architecture
- ECE 851 - Advanced Topics in Computer Architecture

Networks

- ECE 640 - Performance Analysis of Local Computer Networks
- ECE 649 - Computer Network Security
- ECE 848 - Telecommunication Networks Modeling and Analysis
- ECE 849 - Advanced Topics in Computer Communications

Note: A student cannot receive 600-level credit for a course taken as part of the undergraduate degree.

Appendix A – Focus Area Requirements

Digital Signal Processing

There are two separate tracks; one for computer engineering and one for electrical engineering:

Computer Engineering

There are three (3) course requirements:

1. ECE 667 Introduction to Digital Signal Processing
2. ECE 844 Digital Signal Processing
3. Three (3) of the following:
    - ECE 642 Knowledge Engineering
    - ECE 846 Digital Processing of Speech Signals
    - ECE 847 Digital Image Processing
    - ECE 855 Artificial Intelligence
    - ECE 856 Pattern Recognition
    - ECE 872 Artificial Neural Networks
    - ECE 877 Computer Vision

Electrical Engineering

There are three (3) course requirements:

1. ECE 667 Introduction to Digital Signal Processing
2. ECE 844 Digital Signal Processing
3. Three (3) of the following:
    - ECE 818 Random Process Application in Engineering
    - ECE 819 Detection and Estimation Theory
    - ECE 820 Digital Communication Systems I
    - ECE 846 Digital Processing of Speech Signals
    - ECE 847 Digital Image Processing
    - ECE 856 Pattern Recognition
    - ECE 872 Artificial Neural Networks
    - ECE 877 Computer Vision

Appendix A – Focus Area Requirements

Electronics

This focus area is only available to electrical engineering students.

Core Courses:

1. ECE 604 Semiconductor Devices
2. ECE 606 Introduction to Microelectronics Processing
3. ECE 622 Electronic System Design 1
4. ECE 659 Integrated Circuit Design
5. ECE 811 Integrated Circuit Design (advanced)
6. ECE 823 Integrated Circuit Technology
7. ECE 840 Physics of Semiconductor Devices

Additional courses:
Subject to enrollment, Electronics faculty offer ECE 893 courses, dealing with current research topic in Microelectronics.

Appendix A – Focus Area Requirements

Intelligent Systems (fall 2007)

This focus area is available to computer engineering and electrical engineering students.

There are four (4) course requirements:

1. ECE 801 Analysis of Linear Systems
2. ECE 847 Image Processing
3. ECE 859 Intelligent Robotic Systems
4. One (1) of the following:
    - ECE 642 Knowledge Engineering
    - ECE 649 Computer Network Security
    - ECE 655 Robot Manipulators (offered as ECE 693 prior to Fall 2005)
    - ECE 668 Embedded Computing

The courses listed below are electives for students in the Intelligent Systems focus area. Students will usually select their remaining four (4) courses from this list of courses, with possible substitutions based on their specific interests and discussions with their advisor.

- ECE 642 Knowledge Engineering
- ECE 655 Robot Manipulators
- ECE 668 Embedded Computing
- ECE 693 Introduction to Robotics
- ECE 854 Analysis of Robot Systems
- ECE 855 Artificial Intelligence
- ECE 856 Pattern Recognition
- ECE 869 Advanced Robot Kinematics
- ECE 872 Neural Networks
- ECE 874 Nonlinear Control System
- ECE 877 Compuer Vision

Intelligent Systems (fall 2008)

Electrical Engineering

There are four (4) course requirements:

1. ECE 801 Analysis of Linear Systems
2. ECE 847 Image Processing
3. One (1) of the following:
   - ECE 642 Knowledge Engineering
   - ECE 655 Robot Manipulators
   - ECE 668 Embedded Computing
4. One (1) of the following:
   - ECE 854 Analysis of Robot Systems
   - ECE 855 Artificial Intelligence
   - ECE 856 Pattern Recognition
   - ECE 859 Intelligent Robotic Systems
   - ECE 869 Advanced Robot Kinematics
   - ECE 872 Neural Networks
   - ECE 874 Nonlinear Control Systems
   - ECE 877 Computer Vision

Computer Engineering

There are four (4) course requirements:

4. ECE 801 Analysis of Linear Systems
5. ECE 847 Image Processing
6. One (1) of the following:
   - ECE 642 Knowledge Engineering
   - ECE 649 Computer Network Security
   - ECE 668 Embedded Computing
4. One (1) of the following:
   - ECE 854 Analysis of Robot Systems
   - ECE 855 Artificial Intelligence
   - ECE 856 Pattern Recognition
   - ECE 859 Intelligent Robotic Systems
   - ECE 869 Advanced Robot Kinematics
   - ECE 872 Neural Networks
   - ECE 877 Computer Vision

Appendix A – Focus Area Requirements

Power

This focus area is only available to electrical engineering students. The thesis option and the non-thesis option have slightly different requirements.

Thesis Option
Four (4) courses selected from the list of acceptable courses below.

Non-thesis Option
Six (6) courses selected from the list of acceptable courses below. A final project report is also required.

List of acceptable courses:

- ECE 802 Electric Motor Control
- ECE 807 Computer Methods for Power Systems Analysis
- ECE 816 Electric Power Distribution System Engineering
- ECE 817 Power Systems Transients
- ECE 824 Power System Protection
- ECE 862 Real Time Computer Applications in Power Systems
- ECE 863 Power Systems Dynamics and Stability
- ECE 893 Advanced Power Electronics
- ECE 893 Special Topics in Power Systems

Appendix B - Ph.D. Qualifying Exam Study Guide

Circuits

Courses at Clemson covering exam material:
ECE 202, ECE 211 (lab)
ECE 262, ECE 212 (lab)

Textbook:
Electric Circuits, 6th edition, by Nilsson and Riedel
Chapters 1-14, 16, and 18.

Topics of coverage:

- Power, energy, voltage, current, charge concepts
- Circuit elements and circuit topologies
- DC steady-state and transient analysis
- AC steady-state analysis, phasor analysis, single and three-phase systems
- Sinusoidal steady-state power computations in single and three-phase circuits.
- Mutual Inductance, ideal transformers
- Laplace transforms and applications in circuit analysis
- Frequency selective circuits and resonance
- Fourier series
- Two-port circuits and transfer functions
- Ideal operational amplifiers

Appendix B - Ph.D. Qualifying Exam Study Guide

Communications and Networks

Courses at Clemson covering exam material:
ECE 438
ECE 427

Textbooks:
ECE 438:
Peterson and Davie, Computer Networks: A Systems Approach
Portions of textbook covered: Chapters 1-6
Supplemental texts: (1) Tanenbaum, Computer Networks, 3rd edition, (2) Stallings, Computer Networks, and (3) Spragins, Telecommunications Protocols and Designs

ECE 427:
(1) Bernard Sklar, Digital Communications, Fundamentals and Applications, 2nd ed., Prentice-Hall, 2001
Portions of textbook covered: Chapters 1-4, Sections 5.1-5.6, 9.1-9.9
(2) Ferrel G. Stremler, Introduction to Communication Systems, 3rd ed., Addison-Wesley, 1990
Portions of textbook covered: Chapters 5-6, Section 9.6

Topics of coverage:
ECE 438

- Introduction to Telecommunication Networks
- Fundamental Limits
- Introduction to Computer Networks
- OSI Network Architecture
- TCP/IPn
- ATMn
- Various protocols from the physical layer to the network: Ethernet, error detection, error correction, flow control, routing, congestion control
- Various protocols from presentation/application: ftp, telnet, http, snmp

ECE 427

- Review of linear systems
- Review of probability and statistics
- Autocorrelation
- Sampling, quantization, pulse code modulation, and formatting
- Baseband detection, maximum likelihood receiver, matched filter, correlation receiver
- Amplitude and frequency modulation, noise in AM and FM, noise in PCM, repeaters
- Bandpass detection, coherent and noncoherent, binary and M-ary signals
- System noise figure and temperature, link budget analysis
- Channel capacity, bandwidth efficiency, power limited and bandwidth limited systems

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Computer Hardware/Architecture

Courses at Clemson covering exam material:
ECE 201
ECE 272
ECE 327
ECE 371

Textbooks:
Mano, Digital Design
Tanenbaum, Structured Computer Organization
Nelson, Nagel, Carroll, Irwin, Digital Logic Circuit Analysis and Design
Yalimanchili, Introduction to VHDL

Topics of coverage:

- Boolean algebra
- Combinational logic
- Synchronous sequential logic
- Asynchronous sequential logic
- Computer organization
- Microprogramming
- Machine language
- Assembly language
- Addressing and addressing modes
- I/O
- Hardware definition languages (HDLs)
- Simulation of digital systems

Appendix B - Ph.D. Qualifying Exam Study Guide

Computer Systems Structures

Courses at Clemson covering exam material:
CpSc 241/340
ECE 329

Textbooks:
Silberschatz, Operating Systems Concepts
Stallings, Operating Systems, (chapters 1-8,10-11)

Topics of coverage:

- Classic data structures (stacks, queues, lists, trees, heaps, etc.)
- Processor management
- Processes, threads, execution frames, and scheduling
- Signals, inter-process communication
- Concurrency (deadlock, monitors, semaphores, locks, etc.)
- Memory management
- Paging
- Segmentation
- Address translation
- Virtual I/O
- Device drivers
- File systems
- Computer communications
- Classic problems (dining philosophers, smokers, readers/writers, etc.)

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Controls

Course at Clemson covering exam material:
ECE 409

Textbook:
Modern Control Engineering, K. Ogata
Chapters 1-9, 11-12

Topics of coverage:

- Laplace Transforms, transfer functions
- Block diagrams, signal flow graphs
- Physical system models, PD control
- Transient, steady-state error analyses
- Stability analysis
- Root locus techniques
- Frequency response analysis
- Compensation (lead-lag, PID)
- State space control analysis
- State space design

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Electromagnetics

Courses at Clemson covering exam material:
ECE 380
ECE 381

Textbook:
Elements of Electromagnetics, by Sadiku
Chapters 1 through 12

Topics of coverage:
ECE 380

- Vector calculus
- Electrostatic fields and potentials
- Work and energy storage (electrostatic)
- Boundary conditions and boundary value problems
- Capacitance
- Stationary currents and resistance
- Magnetostatic fields and vector potentials
- Work and energy storage (magnetostatic)
- Inductance

ECE 381

- Time-varying fields and waves; Maxwell's equations
- Circuit theory as a specialization of electromagnetic theory
- Plane-wave propagation in unbounded medium
- Reflections at interfaces, power density
- Skin effect, resistance at AC
- Transmission lines (sinusoidal analysis)
- Transmission lines (transient analysis)
- Waveguides
- Radiation concepts; basic antenna theory

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Electronics

Courses at Clemson covering exam material:
ECE 320
ECE 321

Textbook:
Microelectronics Circuit Analysis and Design, 3rd. ed., McGraw Hill Publishing, 2006, by Donald A. Neamen. ISBN 007328596x.
All chapters

Topics of coverage:
ECE 320

- Semiconductor materials
- Pn-junction operation and circuits
- Bipolar transistor operation and circuits
- Field effect transistor operation and circuits
- Design principles

ECE 321

- Biasing and intermediate frequency design for BJT's and FET's
- Low and high frequency design of BJT and FET amplifiers
- Analysis and design of single ended and differential multi stage amplifiers
- Feedback and stability
- Operational amplifier basics and applications
- Non-ideal operational amplifiers
- Oscillator circuits
- Power amplification
- Integrated circuits and applications

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Power

Courses at Clemson covering exam material:
ECE 360
ECE 418
ECE 419

Textbooks:
Electric Machinery and Power System Fundamentals, Chapman
Principles of Electric Machines and Power Electronics, Sen, 2nd edition
Power System Analysis, Grainger and Stevenson

Note: These textbooks are only examples. Many other textbooks (for example, Elements of Power Systems, Stevenson, 3rd or 4th edition) cover the same material.

Topics of coverage:

- Power transformers(single phase and three phase)
- DC, induction, and synchronous machines
- Power electronics applications
- Per unit system, system admittance and impedance matrices
- Load flow analysis
- Economic dispatch
- Fault analysis

Appendix B - Ph.D. Qualifying Exam Study Guide

Programming Systems/Software Engineering

Courses at Clemson covering exam material:
CpSc 210
ECE 352
ECE 417

Textbooks:
Slonneger and Kurtz, Format, Syntax, and Semantics
Woodcock and Davies, Using Z: Specification, Refinement and Proof
Sethi, Programming Languages (chapters 1-8, 10-12)
Somerville, Software Engineering, (chapters 1-17, 22)

Topics of coverage:

- Programming Languages
- Compilers and computing systems
- Executive programs and time-sharing
- Programming paradigms
- Imperative (procedural) languages
- Object-based languages
- Functional languages
- Declarative (logic) languages
- Formal semantics
- Software Engineering
- Overview and history of software engineering
- Object-oriented development
- Object-oriented modeling
- UML
- Object-oriented design
- CASE tools, (Unix) development tools
- Introduction to formal methods, systematic program development
- Requirements analysis and safety-critical systems
- Formal specification
- Refinement
- Verification and validation

Appendix B - Ph.D. Qualifying Exam Study Guide

Systems, Signals, and Probability

Courses at Clemson covering exam material:
ECE 317
ECE 330
ECE 467

Textbooks:
ECE 317: Random Signal Analysis in Engineering Systems, John J. Komo, 1987, Academic Press, Chapters 1-4, 6-7

ECE 330: Signals and Systems, 2nd Edition, Alan V. Oppenheim and Alan S. Willsky, 1997, Prentice Hall, Chapters 1-4, 5.1-5.3, 6, 7.1-7.3, 9, 10
Note: An entire course in DSP is not necessary. The relevant DSP material is taught in many Signals and Systems courses and is included in the chapters listed for the ECE 330 textbook.

Topics of coverage:

- Probability
- Random variables and vectors
- Functions of random variables
- Expectation
- Random processes
- Signal representations
- System representations and properties
- LTI systems
- Discrete- and continuous-time Fourier series
- Discrete- and continuous-time Fourier transforms
- Sampling
- Laplace and Z-transforms
- Analysis of discrete- and continuous-time LTI systems via transform techniques