

# **Holcombe Department of Electrical and Computer Engineering**

## **Graduate Student Handbook**

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# General Information

## Overview of ECE Graduate Program

The Holcombe Department of Electrical and Computer Engineering (ECE) at Clemson University (“the Department”) offers Master of Science (M.S.) and Doctorate of Philosophy (Ph.D.) degrees in both Electrical Engineering (EE) and Computer Engineering (CpE). The M.S. program includes a non-thesis option and a thesis option. The Ph.D. program is normally entered only after completion of an M.S. degree in the same major; however, highly qualified students may be allowed to enter the program directly after completion of a B.S. degree in the major. In addition, the Department offers a Master of Engineering (MENGR) degree in Electrical Engineering which is designed for students who are employed as full-time engineering professionals. The M.S. and Ph.D. degrees are offered on the Clemson main campus and at the Zucker Family Graduate Education Center (ZFGEC), whereas the MENGR degree is offered on the main campus, at the ZFGEC, and as an on-line program.

This handbook defines the requirements, policies, and procedures of the ECE Graduate Program; it also describes other operational aspects of the Department that pertain to the program. The requirements specified herein are in addition to those described in the Clemson University Graduate School Admissions Policies and Academic Regulations.

The Graduate School policies and regulations are specified in [The Graduate School Policy Handbook](#) and at the [Graduate School Web site](#). It is very important that each student familiarize himself or herself with all Graduate School and departmental requirements and information pertaining to the student’s program of study. (Note in particular that the Department may have additional requirements for a degree program beyond the requirements specified by the Graduate School.)

All new students are required to attend orientations held by the 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 make a more effective choice of advisory committee members. Dates and times of the 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 the graduate program coordinator.

## Personnel

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

Dr. Ian Walker, Chair of the ECE Graduate Committee. The Committee establishes and oversees the academic policies of the Graduate Program. Student petitions concerning academic policies should be submitted to the Committee Chair through the student's academic advisor.

Dr. Hai Xiao, Chair of the Department, exercises the final authority on all matters involving resources available to graduate students and final approval on all assistantship and fellowship offers.

Dr. Harlan Russell, Graduate Program Coordinator, 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.

Ms. Jennifer Gooch, Graduate Student Services Coordinator (102A Riggs Hall), assists the Graduate Program Coordinator with all aspects of Graduate Program administration. In general, she is the first person who a prospective student should contact with any questions regarding the Graduate Program. She coordinates all graduate students' applications and reviews of applications. She also coordinates the payroll for ECE graduate students. In addition, she assists in maintaining all records for the Graduate Program and has copies of all forms associated with the program.

Ms. Jeanine Hayes, Graduate Student Services, Registration Coordinator (102C Riggs Hall), maintains official copies of course syllabi, and maintains all records for the Graduate Program, including copies of all forms associated with the program. She prepares Graduate School forms (GS-5, GS-7) for students and distributes official notices of oral exams and thesis and dissertation presentations. She has copies of all documents associated with the Graduate Program. Maintains information for departmental assistantships.

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

Ms. Gale Black, Administrative Assistant (100G Riggs Hall), initiates all purchases for the Department.

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

Ms. Sommer Dobbins, Accountant/Fiscal Analyst II for Electrical and Computer Engineering Program (221B Riggs Hall), maintains accounting information for all ECE financial accounts.

Ms. Patty McNulty, Student Services Program Coordinator for Electrical and Computer Engineering Undergraduate Program (104 Riggs Hall), provides support for both electrical and computer engineering undergraduates.

Ms. Brooke Black, Administrative Assistant (337 EIB), maintains desk copies of texts and laboratory manuals for use by graduate students teaching lecture courses and some laboratory courses. She also coordinates student evaluations of graduate teaching assistants.

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

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. He is also responsible for oversight of the Department's electronics shop.

Mr. David Moline, Technical Support Manager (221F Riggs Hall), is in charge of key distribution for labs, classrooms, and graduate student office assignments and provides some lab support. He also 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; and provides electronic servicing of computer boards and peripheral devices. In addition, he assists with design projects for graduate students and undergraduate students.

### Relevant Phone Numbers

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

Campus Police	656-2222
Computer Center	656-3494
Graduate School Office	656-3195
Graduate Student Association Office	656-2697
Office of International Affairs	656-3614
ECE Graduate Student Services Coordinator	656-5902

# Prospective ECE Graduate Students

## Application Procedure and Requirements

To apply for our graduate program, please visit the Graduate School application at <https://www.clemson.edu/graduate/admissions/apply/index.html>.

Details regarding requirements for the application may be found on the ECE website, <https://www.clemson.edu/ces/departments/ece/academics/grad/apply.html>. Please pay special attention to the undergraduate prerequisite requirements.

Required application material includes the following items:

- On-line application, including Personal Statement/Statement of Purpose
- Transcripts of prior and current undergraduate and graduate course work
- Results from the Graduate Record Examination (GRE) General Test
  - GRE required for application to the M.S. or Ph.D. program
  - GRE *not* required for application to the MENG program
- Results from the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS) (for applicants whose native language is not English)
- A minimum of two Letters of Recommendation (three Letters are highly encouraged)

Completed applications will be reviewed as they are received, and there is no application deadline.

Students who seek admission for the fall semester are encouraged to apply no later than the preceding January 15; students who seek admission for the spring semester are encouraged to apply no later than the preceding September 1; students who seek admission for the first summer session are encouraged to apply no later than the preceding December 1. The department will review applications after these recommended dates, but failure to meet these dates may significantly reduce applicants' opportunities for financial assistance.

*Please note: International applicants **must** submit a completed application (with all the required application material) no later than the dates shown below to be considered for admission in the corresponding term.*

*Spring Term: September 15*

*Summer Term: February 15*

*Fall Term: April 15*



## Bachelor to Graduate Program for Electrical and Computer Engineering

The Bachelor to Graduate program is designed to allow Electrical and Computer Engineering (ECE) undergraduates with very strong academic credentials the opportunity to earn credit as undergraduates for a limited number of graduate courses that can be used to satisfy the requirements of both the Bachelor of Science (B.S.) degree and either a Master of Science (M.S.) with Thesis or direct-entry Doctor of Philosophy (Ph.D) degree in either CpE or EE. Interested undergraduates must apply for admission into the Bachelor to Graduate program and obtain approval of the application. See appendix C of this handbook for details.

### Undergraduate Course Deficiencies

Students who enter the M.S. or Ph.D. program in either computer engineering or electrical engineering typically hold a B.S. degree in the same major. A student with a B.S. degree in a different major and a strong academic record may also be granted admission into the program in some instances. Undergraduate course deficiencies may be specified for an admitted student deemed to lack some necessary foundational background for the M.S. or Ph.D. program in the major. In such an instance, the student must remedy the deficiencies in a manner specified by the Department prior to completing the normal requirements of the degree.

Students who enter the MENG program in electrical engineering typically hold a B.S. degree in an engineering major with a strong undergraduate-level course-work background in topics related to electrical engineering. Undergraduate course deficiencies may be specified for an admitted student deemed to lack some necessary foundational background for the MENG program in electrical engineering. In such an instance, the student must remedy the deficiencies in a manner specified by the Department prior to completing the normal requirements of the degree.

### Financial Aid

Admission to the graduate program in electrical and computer engineering is considered separately from offers of financial aid (graduate assistantships or fellowships).

All accepted applicants are automatically considered for departmental graduate teaching assistantships and graduate grading assistantships unless they have indicated otherwise on their application. Graduate research assistantships are awarded by individual faculty members.

Accepted applicants with strong academic credentials may also be considered for a fellowship. The ECE departmental fellowships, the College of Engineering, Computing and Applied Sciences fellowships, and the Clemson University recruitment fellowships are all supplemental; they can only be awarded in conjunction with an assistantship offer. All qualified accepted

applicants are considered automatically for supplemental fellowships; the applicant does not need to apply for consideration. A variety of fellowships funded by external organizations are also available (e.g., DOE, NDSEG, NSF, and SMART fellowships). Students should apply directly to the organization awarding an external fellowship.

Federal loans are another option for some graduate students in electrical and computer engineering. For more details on financial aid, please visit the Clemson University [Financial Aid website](#).

# Current ECE Graduate Students

## Selecting an Advisor

Each graduate student is admitted into a selected focus area (area of specialization) after review by faculty in that area based upon the student's expressed interests. The initial academic advisor for each entering M.S. student is the faculty chairperson of the student's focus area; the initial academic advisor of each entering Ph.D. student is the faculty member who has agreed to advise the student. The initial academic advisor should be consulted in selecting courses for the first semester of study. It is possible to change the area of focus after admission into the program, but it should be understood that acceptance criteria may vary from one focus area to another, and resource limitations may preclude a change. A change of focus area is subject to approval by the faculty in the new focus area.

After the first semester of study, the student should select a faculty member as the permanent academic advisor for the student's program of study. The academic advisor will serve as the chair of the student's advisory committee; thus, the selected advisor's research interests and expertise should relate closely to the student's focus area of study. The advisor serves as the student's first and primary contact for planning the student's program of study and selecting courses. The advisor and the rest of the advisory committee should be determined by the end of the student's 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:

Computing and Communications (CC)	<u>K.C. Wang</u>
Energy Systems (ES)	<u>J. Enslin</u>
Intelligent Systems (IS)	<u>R. R. Brooks</u>
Photonics, Electronics and Quantum Systems (PEQS)	<u>L. Dong</u>

## Course Selection

The student should meet with his or her initial academic advisor prior to the first semester of study to select courses for the first semester. Once the student has selected a permanent academic advisor, the student and the advisor should meet for an initial discussion of the student's program of study; this should be followed by a meeting at least once per semester to discuss courses for the subsequent semester. The courses should be chosen so as to make significant progress towards meeting the requirements of the student's degree program. The requirements are given in later sections of the Handbook. Suggestions based upon student interests can also be seen at the department website.

The student should work with his or her academic advisor to complete a GS-2 Committee Selection and GS-2 Plan of Study (Graduate Degree Curriculum) form. The Plan of Study form should list exactly those courses that are to be used to satisfy the requirements for the degree as well as the membership of the student's faculty advisory committee. The composition of the committee depends on whether the student is enrolled in the M.S. program, the MENG program, or the Ph.D. program; details are provided in later sections of the Handbook.

The student must first select an advisory committee. Once this is decided, the student must submit the GS-2 Committee Selection in iRoar. The courses listed on the GS-2 Plan of Study form must be approved by the student's advisory committee. Once the student and the committee agree upon the courses to be included on the GS-2, the student must complete the GS-2 Plan of Study in iRoar. Automated notifications will be sent to the Graduate Student Services Coordinator and each committee member **in turn** (not all at once) for approval. Each student enrolled in the M.S. or MENG program is required to submit an approved GS-2 form no later than mid-term during his or her second semester in the program. Each student enrolled in the Ph.D. program is required to submit an approved GS-2 form no later than the beginning of the fourth semester of the program. Students who do not meet these deadlines will be at a disadvantage in many areas, including advising throughout their graduate program, degree planning, timely application for graduation, and in applying for departmental assistantships.

## 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 Personal Data Sheet, available from the ECE Graduate Student Services Coordinator in Riggs 102A. Registration is not complete until the form has been completed. The form is the starting point for student records in the Department.

## Enrollment Requirements for Students Receiving an ECE Assistantship

Each graduate student receiving an assistantship in ECE (whether a research assistantship, a teaching assistantship, or a grading assistantship) is required to maintain full-time enrollment status during the semester of the assistantship. (If the student is conducting directed research with an ECE faculty member, the student should enroll in ECE 8910 (thesis research) or ECE 9910 (dissertation research) for enough credits to accurately reflect the level of research effort of the student, even if the resulting number of course and research credits for the semester exceeds the minimum number required to maintain full-time status.) Some additional

requirements for Graduate Assistants are given in Appendix B, and the requirements are detailed in the assistantship contract. Every Graduate Assistant should read Appendix B and the contract carefully.

## Conduct of ECE Graduate Students

Please be familiar with the following Clemson University and College of Engineering, Computing and Applied Sciences policies regarding the conduct of graduate students. ECE graduate students are expected to understand and abide by these policies.

[Clemson University Academic Integrity Policy](#)

[Clemson University Anti-Harassment and Non-Discrimination Policy](#)

[College of Engineering, Computing and Applied Sciences Honor Code](#)

College of Engineering, Computing and Applied Sciences Policy on Alcohol: Alcoholic beverages are prohibited for any activity held in a College of Engineering, Computing and Applied Sciences facility unless prior approval has been granted through University-defined procedures. Under no circumstance should alcohol be made available to or consumed by anyone under 21 years of age.

## Miscellaneous Information

### Students with Disabilities: Requesting Accommodations

Graduate students with disabilities requesting accommodations should make an appointment with [Accessibility Services](#) to discuss specific needs within the first month of classes. Accommodations are not retroactive and new Faculty Accommodation Letters must be presented each semester. Accommodation for graduate program events other than courses (e.g., the Ph.D. Qualifying Exam) should be discussed with the SDS office and the Graduate Program Coordinator at least one month in advance of the event.

### Thesis Guide

The Graduate School's [Thesis and Dissertation Guide](#) should be read by all students before writing a thesis or dissertation.

### Computer Facilities

All graduate students enrolled are automatically assigned a Clemson University ID (user ID) 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 machines under the control of particular research groups are arranged by the faculty members in charge of these machines.

## Desks

Desks are generally not available to graduate students due to the limited available space. In special circumstances when there is a new research project, space may be assigned. All such requests for space are initiated by the faculty member and negotiated with the department chair.

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 or cardkey access to his/her office and to the building his/her office is in. Access for labs and classrooms is available for students who have teaching responsibilities there. See the Technical Support Manager in 221F Riggs for keys or cardkey access.

## Mailboxes

Each student will be assigned a mailbox. Mailboxes should be checked regularly for mail and other informational items. Mailboxes are currently located in the basement hallway of Riggs Hall.

## Office Supplies

The department does not furnish office supplies to graduate students.

## Copying Machines

Located in 221 Riggs is a copy machine for *graduate assistant* use only. Copying of textbooks 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.

## 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 at [this link](#).

# Graduate Academic Programs in ECE

## Requirements of the Clemson University Graduate School

All degree requirements of the Clemson University Graduate School must be met in addition to the requirements specified in this Handbook. See the [Graduate School Website](#) for further information.

### Definition of Term “ECE T/TT Faculty” and “positive-time ECE faculty” in Degree Requirements

The term “ECE T/TT faculty” in subsequent descriptions refers to full-time tenured or tenure-track faculty with a majority-time appointment in Clemson University’s Holcombe Department of Electrical and Computer Engineering. The term “positive-time ECE faculty appointment” refers to full-time tenured or tenure-track faculty that are either ECE T/TT faculty or hold a majority-time appointment in another department and a secondary appointment in ECE that is greater than zero percent.

### How to Remedy Undergraduate Course Deficiencies

Undergraduate course deficiencies may be specified as a condition of admission for a student deemed to lack some necessary foundational background for the M.S., MENG, or Ph.D. degree program. The student must remedy the deficiencies in a manner specified by the Department prior to completing the normal requirements of the degree. The Department provides several options for remedying an undergraduate course deficiency. For any option that requires a grade (such as a proficiency examination or the completion of a graded undergraduate course), a grade of A, B or C is required. All deficiencies must be resolved at least one semester prior to the student’s anticipated graduation.

### Courses Applicable to the ECE Graduate Program Requirements

Graduate credit can be earned only for courses numbered “6000” or above. Courses enumerated “6xxx” (6000-level courses) are the graduate-course counterparts of undergraduate courses enumerated “4xxx” (4000-level courses). (A student enrolled in a 6000-level course must perform additional work beyond that required of a student enrolled in the corresponding 4000-level course.) Courses enumerated “7xxx” (7000-level courses) are graduate-only courses emphasizing professional practice. Courses enumerated “8xxx” (8000-level courses) are graduate-only courses providing research-oriented preparation. Courses enumerated “9xxx” (9000-level courses) are graduate-only courses providing advanced research-oriented preparation.



## Restrictions on 6000-Level Courses

A student may not enroll in a 6000-level course for which the corresponding undergraduate 4000-level credit has been awarded, nor can graduate credit be awarded retroactively for undergraduate courses already completed.

## Other Graduate School Policies

Consult the [Graduate School Policy Handbook](#) for other policies that apply to all graduate programs at Clemson University, including time limits for completing a degree, requirements for satisfactory academic progress, minimum grade point average levels, and requirements to maintain continuous enrollment.

## **Master of Science Program in Electrical Engineering and Computer Engineering**

### **M.S. Advisory Committee**

Each M.S. student must have an advisory committee of at least three members all of whom hold appointments as graduate advising or directing faculty with the Clemson University Graduate School. A majority (more than 50%) of the committee members must be ECE T/TT faculty. One of the faculty on the committee must serve as the student's academic advisor and as the chair of the committee. The chair must hold a graduate directing faculty position and also hold a positive-time ECE faculty appointment. A committee member that is a Clemson University employee from outside the ECE T/TT faculty may serve as a co-chair.

The student's academic 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:

- Work with the student to determine course selection for each semester.
- Approve the student's program of study (specified in the GS-2 form).
- Approve the thesis proposal (if the thesis option is chosen).
- Supervise the thesis research (if the thesis option is chosen).
- Administer the final examination (if the thesis option is chosen).
- Initiate recommendations for awarding the degree.

### **M.S. Plan of Study**

The student's planned program of study, documented on the GS-2 form, must be submitted no later than the mid-term of the second semester of the program. All GS-2 forms are submitted electronically via iRoar. If circumstances necessitate later changes to the plan a revised GS-2 form must be completed and submitted electronically to the Graduate School.

### **Summary of M.S. Degree Requirements**

The requirements of the M.S. degrees in CpE and EE are as follows:

- Satisfy any undergraduate course deficiencies specified at the time of admission.
- Complete the graduate course-work requirements specific to the thesis option or the non-thesis option as detailed below.
- Propose and secure approval for your thesis and submit form (thesis option only).
- Complete a written M.S. thesis (thesis option only).
- Pass the final examination (thesis option only).

Click [here](#) for Graduate School deadlines.

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

### Thesis Option

The GS-2 form for the thesis option must include a minimum of 30 credit hours of graduate-level course work at the 6000-level, 8000-level, or 9000-level, including the following:

- Exactly six (6) credit hours of ECE 8910 (M.S. Thesis Research)
- A minimum of 24 credit hours of letter-graded course work.
  - The Focus Area Requirements for one of the focus areas in the major must be satisfied as detailed below.
  - At least twelve (12) credit hours of the letter-graded course work must consist of ECE courses.
  - At least twelve (12) credit hours of the letter-graded course work must be at the 8000-level or 9000-level.
  - No credit for course work at the 7000-level can be applied towards the degree requirements.
  - No credit for either ECE 8900 or MATH 6000 can be applied towards the degree requirements.

The department strongly recommends that students list exactly the minimum degree requirements on the GS-2 Plan of Study. Additional courses should only be listed if necessary for the student's Plan of Study GPA to meet the 3.0 requirement. A student electing the thesis option in the M.S. program must write a thesis that is approved by the student's advisory committee and the Graduate School. Prior to substantive work on the thesis, the student must submit a thesis proposal to their committee, and the proposal must be approved. The GS-ResearchApproval form must be submitted as evidence of approval of the project as proposed. The student must also take a final examination administered by his/her advisory committee. At a minimum, the student must pass an examination consisting of an oral defense of the student's thesis. The advisory committee has the option of administering an additional written and/or oral examination on coursework.

Note: Each M.S. student receiving a graduate teaching assistantship or a graduate grading assistantship from the Department is required to select the thesis option. An M.S. student supported as a graduate research assistant is almost always required by his or her advisor to select the thesis option as well. M.S. students anticipating entry into the Ph.D. program are strongly encouraged to consider selecting the thesis option.

### Non-Thesis Option

The GS-2 form for the non-thesis option must include a minimum of 30 credit hours of graduate-level course work at the 6000-level, 8000-level, or 9000-level, including the following:

- The Focus Area Requirements for one of the focus areas in the major must be satisfied as detailed below.
- At least twelve (12) credit hours of the letter-graded course work must consist of ECE courses.
- At least 18 credit hours of the letter-graded course work must be at the 8000-level or 9000-level.
- No credit for course work at the 7000-level can be applied towards the degree requirements.
- No credit for ECE 8900, ECE 8910, or MTHSC 6000 can be applied towards the degree requirements.

The department strongly recommends that students list exactly the minimum degree requirements on the GS-2 Plan of Study. Additional courses should only be listed if necessary for the student's Plan of Study GPA to meet the 3.0 requirement. No thesis or engineering report is required with the non-thesis option, and there is no final examination.

### Focus Area Requirements for the M.S. Program

Each student must satisfy the course requirements for one approved focus area in the corresponding M.S. degree program, regardless of whether the thesis option or the non-thesis option is selected.

### M.S. Thesis

The M.S. thesis (required of each M.S. student electing the thesis option) must demonstrate mastery of available scholarship in the presentation of a substantive idea or problem solution

in the major field of the student.

### Minor Subject Option

Each M.S. candidate may include a minor subject in the degree program. To accomplish a minor the student must take 2 courses (6 credit hours) in a subject outside of electrical and computer engineering, such as Math, Physics, Computer Science, or Industrial Engineering, as approved by their advisory committee. If a minor is declared, this subject must be represented on the Advisory Committee by a faculty member from the corresponding department. The minor is designated on the GS-2 form only. A minor discipline will not be listed on the student's transcript.

### Restrictions on Use of ECE 8920

A maximum of 3 hours of ECE 8920, Special Problems in Electrical and Computer Engineering, may be included on the GS-2 form for an M.S. degree in computer engineering or electrical engineering. An M.S. 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.

### Transferring Coursework

A maximum of one third ( $1/3$ ) of the required graded coursework may be transferred to an ECE graduate program. All transfer coursework must be approved by the student's advisor and advisory committee prior to being included on the GS-2. Coursework eligible for transfer must be: from a regionally accredited institution, graded with a B or higher, and is subject to the Graduate School's six-year time limit for validity. Please note all limitations for transfer work set forth by the Graduate School apply (see [Graduate School Policy Handbook](#)). An official transcript must be available prior to transferring the coursework. Coursework applied towards the requirements of a prior degree earned by the student cannot be used for transfer credit. (If requested by the Department, the student must be able to provide verification of eligibility for each course requested for transfer.)

## **Master of Engineering Program in Electrical Engineering (MENGR)**

The MENGR degree is designed and intended for professionals who are working full-time as practicing engineers. Courses taught on campus and courses delivered via distance-learning methods (such as on-line delivery) can both be applied towards the requirements of the degree. Thus the degree is available to off-campus students who enroll in distance-education courses. The MENGR degree is different from the M.S. degree in several respects: the MENGR applicant is not required to take the Graduate Record Examination (GRE), the MENGR student is not required to satisfy focus-area requirements, and the student must submit an Engineering Report instead of a conventional M.S. thesis. (The Engineering Report addresses the solution of a problem in engineering design, whereas the M.S. thesis details original discoveries in engineering research.) The Engineering Report must conform to a format specified by Clemson University's College of Engineering, Computing and Applied Sciences (whereas the M.S. thesis must satisfy the University's thesis format requirements).

### **MENGR Advisory Committee**

Each MENGR student must have an advisory committee of at least three members all of whom hold appointments as graduate advising or directing faculty with the Clemson University Graduate School. A majority (more than 50%) of the committee members must be ECE T/TT faculty. One of the faculty on the committee must serve as the student's academic advisor and as the chair of the committee. The chair must hold a graduate directing faculty position and also hold a positive-time ECE faculty appointment. A committee member that is a Clemson University employee from outside the ECE T/TT faculty may serve as a co-chair.

The student's academic 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:

- Work with the student to determine course selection for each semester.
- Approve the student's program of study (specified in the GS-2 form).
- Supervise the engineering report project.
- Administer the final examination.
- Initiate recommendations for awarding the degree.

### **MENGR Plan of Study**

The student's planned program of study, documented on the GS-2 form, must be submitted no later than the mid-term of the second semester of the program. Please note that as of Fall 2015, all GS-2 forms are submitted electronically via iRoar. If circumstances necessitate later changes to the plan a revised GS-2 form must be submitted electronically to the Graduate School.

## Summary of MENGGR Degree Requirements

The requirements of the MENGGR degree in EE are as follows:

- Satisfy any undergraduate course deficiencies specified at the time of admission.
- Complete the graduate course-work requirements as detailed below.
- Complete a written engineering report.
- Pass the final examination.

Click [here](#) for Graduate School deadlines.

The GS-2 form for the MENGGR degree must include a minimum of 30 credit hours of graduate-level course work at the 6000-level, 7000-level, 8000-level, or 9000-level, including the following:

- Exactly six (6) credit hours of ECE 7010 (MENGGR Design Report)
- A minimum of 24 credit hours of letter-graded course work.
  - At least twelve (12) credit hours of the letter-graded course work must consist of ECE courses.
  - At least twelve (12) credit hours of the letter-graded course work must be at the 8000-level or 9000-level.
  - No credit for ECE 8910 can be applied towards the degree requirements.
  - No credit for MTHSC 6000 can be applied towards the degree requirements.

The department strongly recommends that students list exactly the minimum degree requirements on the GS-2 Plan of Study. Additional courses should only be listed if necessary for the student's Plan of Study GPA to meet the 3.0 requirement. A student in the Master of Engineering Program must write an Engineering Report which is approved by the student's advisory committee. (Administratively, the Engineering Report is approved by the Dean of Engineering.) The project serving as the basis for the Engineering Report must be focused on a problem in engineering design.

The student must also pass a final examination administered by the student's advisory committee, which includes an oral presentation of the student's work in the Engineering Report.

### MENGGR Engineering Report

The MENGGR Engineering Report must demonstrate the solution to a substantive problem in engineering design following best practices of the electrical-engineering profession.

## Minor Subject Option

Each MENG candidate is eligible to include a minor subject in the degree program. To accomplish a minor the student must take 2 courses (6 credit hours) in a subject outside of electrical and computer engineering, such as Math, Physics, Computer Science, or Industrial Engineering, as approved by their advisory committee. If a minor is declared, this subject must be represented on the Advisory Committee by a faculty member from the corresponding department. The minor is designated on the GS-2 form only. A minor discipline will not be listed on the student's transcript.

## Restrictions on Use of ECE 8920

A maximum of 3 hours of ECE 8920, Special Problems in Electrical and Computer Engineering, may be included on any MENG 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.

## Transferring Coursework

A maximum of one third ( $1/3$ ) of the required graded coursework may be transferred to an ECE graduate program. All transfer coursework must be approved by the student's advisor and advisory committee prior to being included on the GS-2. Coursework eligible for transfer must be from a regionally accredited institution, graded with a B or higher, and is subject to the Graduate School's six-year time limit for validity. Please note all limitations for transfer work set forth by the Graduate School apply (see [Graduate School Policy Handbook](#)). Coursework applied towards the requirements of a prior degree earned by the student cannot be used for transfer credit. (If requested by the Department, the student must be able to provide verification of eligibility for each course in which transfer credit is requested.)



## **Doctorate of Philosophy Program in Electrical Engineering and Computer Engineering**

There are two circumstances in which a student can enter the Ph.D. program in electrical engineering or computer engineering. In one circumstance, the student enters the Ph.D. program with a prior M.S. degree in the same major. (A prior M.S. degree in a closely related engineering major may be treated as equivalent to a prior M.S. degree in the major of the Ph.D. program if so determined by the Department at the time of admission into the Ph.D. program.) In the other circumstance, the student enters the Ph.D. program with only a prior B.S. degree in the same major. (Direct entry to the doctoral program from the baccalaureate is permitted only for students with an exceptionally strong academic record and exceptional potential for research as determined by the ECE faculty during evaluation of the student's application.) The requirements listed in the next several pages apply to both circumstances except where otherwise specified.

A student currently enrolled in the M.S. program in computer engineering or electrical engineering at Clemson University can petition for entry into the Ph.D. program in the same major at any time during the M.S. program. If the student is admitted into the Ph.D. program as a result (prior to receiving the M.S. degree), the requirements for the Ph.D. degree will correspond to those for a student entering the Ph.D. program with only a prior B.S. degree. (Graded coursework taken while enrolled in the M.S. program can normally be applied towards the requirements of the Ph.D. program in this instance, subject to the course-level restrictions of the Ph.D. program.)

A student who enters the Ph.D. program with only a prior B.S. degree may obtain a thesis-option M.S. degree in the major while enrolled in the Ph.D. program (i.e., "en route"). If the student receives the M.S. degree under this circumstance, the student is subsequently considered to have entered the Ph.D. program with a prior M.S. degree. The student must subsequently satisfy only the lesser coursework requirements for the Ph.D. degree required of someone entering with an M.S. degree. The coursework applied towards the requirements for the en-route M.S. degree cannot also then be applied towards the requirements for the Ph.D. degree, however.

### **Ph.D. Advisory Committee**

Each Ph.D. student must have an advisory committee of at least four members all of whom hold appointments as graduate advising or directing faculty with the Clemson University Graduate School. A majority (more than 50%) of the committee members must be ECE T/TT faculty. At least one committee member must be a faculty member who does not hold an ECE T/TT appointment. One of the faculty on the committee must serve as the student's academic advisor and as the chair of the committee. The chair must hold a graduate directing faculty

position and also hold a positive-time ECE faculty appointment. A committee member that is a Clemson University employee from outside the ECE T/TT faculty may serve as a co-chair.

The student selects the academic advisor, also chair of the committee, 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.

A student's academic 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:

- Work with the student to determine course selection for each semester.
- Approve the student's program of study (specified in the GS-2 form).
- Supervise the dissertation research.
- Administer the Comprehensive Exam and approve the dissertation proposal.
- Administer the final examination.
- Initiate recommendations for awarding the degree.

## Ph.D. Plan of Study

The student's planned program of study, documented on the GS-2 form, must be submitted no later than the beginning of the fourth semester of the program. All GS-2 forms are submitted electronically via iRoar. If circumstances necessitate later changes to the plan a revised GS-2 form must be submitted electronically to the Graduate School.

## Summary of Ph.D. Requirements

The requirements of the ECE Ph.D. Program are as follows:

- Satisfy any undergraduate course deficiencies specified at the time of admission.
- Pass the Ph.D. Qualifying Examination.
- Pass the Ph.D. Comprehensive Examination.
- Submit the dissertation research approval form.
- Complete the graduate course-work requirements.
- Complete a written Ph.D. dissertation.
- Pass the final examination.

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

### Entry to the Ph.D. Program with a Prior Master's Degree

The student must pass the Ph.D. Qualifying Examination, pass the Ph.D. Comprehensive Examination, propose and secure approval for their dissertation, and write a dissertation that is approved by the student's advisory committee and the Graduate School.

The GS-2 form for the Ph.D. degree with a prior M.S. degree must include a minimum of 42 credit hours of graduate-level course work at the 6000-level, 8000-level, or 9000-level, including the following:

- Exactly 18 credit hours of ECE 9910 (Ph.D. Dissertation Research)
- A minimum of 24 credit hours of letter-graded course work.
  - No credit for course work at the 7000-level can be applied towards the degree requirements.

The department strongly recommends that students list exactly the minimum degree requirements on the GS-2 Plan of Study. Additional courses should only be listed if necessary for the student's Plan of Study GPA to meet the 3.0 requirement. No credit for MTHSC 6000 can be applied towards the degree requirements.

The student must pass a final examination administered by his/her advisory committee, which includes at a minimum an oral defense of the student's dissertation. The advisory committee has the option of administering an additional written and/or oral exam on coursework, however.

### Direct Entry to the Ph.D. Program after the Bachelor's Degree

The student must pass the Ph.D. Qualifying Examination, pass the Ph.D. Comprehensive Examination, propose and secure approval for their dissertation, and write a dissertation that is approved by the student's advisory committee and the Graduate School.

The GS-2 form for the Ph.D. degree without a prior M.S. degree must include a minimum of 60 credit hours of graduate-level course work at the 6000-level, 8000-level, or 9000-level, including the following:

- Exactly 18 credit hours of ECE 991 (Ph.D. Dissertation Research)

- No credit for course work at the 7000-level can be applied towards the degree requirements.
- A minimum of 42 credit hours of letter-graded course work.
  - At least nine (9) credit hours of the letter-graded course work must be for non-ECE courses.
  - No more than nine (9) credit hours of the letter-graded course work can be at the 6000-level.

The department strongly recommends that students list exactly the minimum degree requirements on the GS-2 Plan of Study. Additional courses should only be listed if necessary for the student's Plan of Study GPA to meet the 3.0 requirement. No credit for MTHSC 6000 can be applied towards the degree requirements.

The student must pass a final examination administered by his/her advisory committee, which includes at a minimum an oral defense of the student's dissertation. The advisory committee has the option of administering an additional written and/or oral exam on coursework, however.

#### Earning an M.S. Degree While Enrolled in the Ph.D. Program

A student who has entered the Ph.D. program directly after the Bachelor's Degree may earn an M.S. degree in the same major en route to the Ph.D. The student must satisfy all the requirements of the M.S. degree with the thesis option (including 6 credits of research). A special form, the GS2-14 (Master's En Route to Ph.D. Degree Curriculum) form must be submitted before receipt of the en route M.S. degree. (A separate GS-2 form is required for the Ph.D. degree following receipt of the M.S. Degree.) If a direct-entry Ph.D. student receives an en route M.S. degree, the remaining requirements for the Ph.D. program (beyond the requirements for the M.S. degree) are the normal direct-entry Ph.D. degree requirements minus the 24 hours of letter-graded course work used to satisfy the M.S. degree requirements. Ph.D. students interested in earning an M.S. degree en route should discuss the option with their academic advisor and the ECE Graduate Student Services Coordinator.

A student who has entered the Ph.D. program directly after the Bachelor's Degree and wishes to earn an M.S. degree with the non-thesis option must request a change of program to the M.S. degree program in the major. If the student later wishes to re-enter the Ph.D. program, he or she must submit a new application for admission into the program. If the student is admitted into the Ph.D. program again after having received an M.S. degree in the major, the remaining requirements for the Ph.D. program are the requirements for a student entering the program with a prior M.S. degree.

## Ph.D. Candidacy Requirements

A student in the Ph.D. program is classified as a “candidate for the doctorate” (or is "admitted to candidacy") upon successful completion of the Comprehensive Examination and dissertation proposal. Completion is documented by submitting the [GS5-D](#) form and the [GS-ResearchApproval](#) form.

## Ph.D. Qualifying Examination

The Ph.D. Qualifying Examination is intended to provide an early, general assessment of a student’s mastery of content and/or conceptual understanding of the research process. Prior to 2021, the format of the Ph.D. Qualifying Examination was a written examination. The final offering of the written exam was given in March 2021. Beginning in January 2021, and thereafter, the format and requirements of the examination are as follows.

Each student who enters the Ph.D. program must take the Ph.D. Qualifying Examination. The purpose of the examination is to evaluate the ability of the student to conduct independent research. The examination will be administered by the student’s Ph.D. dissertation committee. The material to be examined is a specific research topic within the student’s general area of research. This topic is to be determined jointly by the student and their Ph.D. advisor(s). A document focusing on the selected topic must be written by the student and both submitted to and approved by the Ph.D. dissertation committee prior to the examination. The Ph.D. advisor will determine when the written document is suitable for submission to the Ph.D. dissertation committee. At this point, the student and advisor will provide a copy of the document to each committee member. This must take place at least one week prior to the examination. Committee members may request more than one week to review the document.

The examination consists of an oral presentation by the student on their selected research topic, given to their Ph.D. dissertation committee. The committee will evaluate the student’s understanding and independent investigation of the material. An acceptable topic for the examination is a literature review within the student’s research area. Another acceptable procedure is for prior submission by the student to the Ph.D. dissertation committee, and subsequent oral presentation to the committee of one of: (1) a published or accepted first-authored, peer-reviewed conference paper (in an IEEE, ACM, or similarly archived proceedings); or (2) a published or accepted first authored journal article. In each of cases (1) or (2) the paper should be the result of research conducted by the student at Clemson University. An unacceptable procedure is to repeat a presentation used for a MS thesis defense. However, expanding upon material from a MS thesis is permissible. Also, a student who is an author but not a first author on a paper can extract the portions of the paper in which the student contributed and prepare a document and presentation using this material.

The student should schedule the oral presentation with enough time for committee review and for each committee member to be in attendance (in person or virtually). Ph.D. Qualifying Examinations are public events — members of the Clemson University community are invited to attend the examination. Examinations not open to the public should be rare and for good cause. Personal preference does not constitute “good cause” but reasonable University accommodations for documented accessibility needs do constitute “good cause.” The student must schedule the examination with the Student Services Program Coordinator for the Graduate Program at least one week prior to the event. The department will announce the time and location of the examination.

The possible outcomes of the examination are pass or fail. The student will be informed in writing of the result. A majority decision from synchronously participating committee members in support of the oral examination is required for a student to be considered to have passed the examination; dissenting members of the examining committee may forward a minority report to the Chair of the ECE Graduate Committee. A vote of “pass” at a defense should only be rendered when each participating committee member indicates final approval (or dissent) by signing the ECE Qualifying Examination Approval form. A committee member who is unable to participate synchronously in the oral examination, either in person or via audio or video conference, may not vote on the result of the examination. They must be counted as an abstention, as they did not participate in the oral examination. Meeting individually with the student is not an acceptable substitute for participating in the oral examination. A student must still receive a passing vote from the majority of the committee members (two out of four counts as majority where the Ph.D. dissertation committee contains four members). If one member is absent and counted as an abstention, a student would then need two affirmative passing votes if a committee contains four members, or three passing votes if five or six members constitute the thesis committee. Note that students are not allowed to provide refreshments, snacks, gifts, or inducements at the oral examination.

A Ph.D. student who fails the Ph.D. Qualifying Examination in the first attempt must retake and pass the examination before the end of the semester following the semester in which their first attempt was made. A minimum of two months must pass before the student can undergo the second examination. If a student fails the second attempt at the examination or fails to attempt the examination by their specified deadline for the second attempt, the Department will request that the Graduate School dismiss the student from the ECE Ph.D. program. A student is only allowed two attempts to pass the ECE Ph.D. Qualifying Exam while enrolled as a graduate student in the ECE department, regardless of the program of study (EE or CpE).

Each student who enters the Ph.D. program with a prior M.S. degree must take the Ph.D. Qualifying Examination before the end of the second semester following their entry into the program. Each student entering the Ph.D. program with only a prior B.S. degree (i.e., direct-entry Ph.D. students) must take the examination before the end of the fourth semester following their entry into the program, unless they register to defend a M.S. thesis in their fourth semester, in which case they must take the Ph.D. Qualifying Examination by the end of

the fifth semester following their entry into the program (whether or not they successfully defend a M.S. thesis in the fourth semester). A direct entry Ph.D. student may not defend a M.S. thesis in the same semester they take the Ph.D. Qualifying Examination. Each student will be informed of their deadline for taking the examination during their first semester in the Ph.D. program. Failure by a student to attempt the examination by a student's specified deadline is treated as a failed attempt in the Ph.D. Qualifying Examination.

Students attempting the examination for the first time in their final semester of eligibility must complete the Qualifying Examination Signup Form and turn it in to the Student Services Program Coordinator for the Graduate Program. The signup form can be found at the link: [https://www.clemson.edu/cecas/departments/ece/academics/grad/phd\\_qualifier.html](https://www.clemson.edu/cecas/departments/ece/academics/grad/phd_qualifier.html). The deadline for submitting this form is three weeks following the first day of classes of the student's final semester of eligibility for the Qualifying Examination. If the examination is taken earlier than the final semester of eligibility, then the Qualifying Examination Signup Form must be completed and turned in to the Student Services Program Coordinator for the Graduate Program at least one week before the date of the examination. Students are required to have a Ph.D. GS-2 form approved at the time the Qualifying Examination Signup Form is submitted (this establishes the Ph.D. dissertation committee). The examination must be completed at least two weeks prior to the last day of classes in the semester in which it is attempted.

Note: summer terms are not semesters. Subject to approval and availability of your committee, the Qualifying Examination may be attempted in the summer prior to the student's final semester of eligibility.

If after passing the qualifying examination, a student changes one or more members of their advisory committee a new qualifying exam is not required.

Special cases (advisor/student conflicts, advisor leaving Clemson, etc.) are to be considered by the ECE Graduate Committee. Any student petition regarding the results of the Ph.D. Qualifying Examination must be submitted in writing to the Chair of the ECE Graduate Committee within 30 days of the date the Examination was held.

## 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. As part of the comprehensive exam, the student must submit a proposal to their advisory committee outlining the details of the research planned to fulfill the dissertation requirement. The advisory committee evaluates the research proposal and may require an oral defense. Additionally, the advisory committee may require a written or a combination of written and oral exam. Satisfactory completion of the comprehensive examination must occur at least six months prior to the date of graduation. The GS5D (Doctoral Candidacy) form is required for documentation of the completion of the requirement. In addition, the Graduate School requires the student to file a completed GS-ResearchApproval form with their committee members' signatures concurrently with the GS5D form. Further details may be found in the [Graduate School Policy Handbook](#).

## Ph.D. Dissertation

The Ph.D. dissertation must constitute an original, unique, substantive contribution to scholarship in the major field of the candidate.

## Transferring Coursework

A maximum of one third (1/3) of the required graded coursework may be transferred to an ECE graduate program. All transfer coursework must be approved by the student's advisor and advisory committee prior to being included on the GS-2. Coursework eligible for transfer must be: from a regionally accredited institution, graded with a B or higher, and is subject to the Graduate School's six year time limit for validity. Please note all limitations for transfer work set forth by the Graduate School apply (see [Graduate School Policy Handbook](#)). Coursework applied towards the requirements of a prior degree earned by the student cannot be used for transfer credit. (If requested by the Department, the student must be able to provide verification of eligibility for each course in which transfer credit is requested.)



# Appendix A – Focus Area Requirements

## Computing and Communications

Courses in this focus area can be used to satisfy the focus-area requirements for either the M.S. in computer engineering or the M.S. in electrical engineering.

Four (4) courses must be selected from this list:

- ECE 6170 Elements of Software Engineering
- ECE 6290 Organization of Computers
- ECE 6300 Digital Communications
- ECE 6310 Introduction to Computer Vision
- ECE 6380 Computer Communications
- ECE 6400 Performance Analysis of Local Computer Networks
- ECE 6490 Computer Network Security
- ECE 6670 Introduction to Digital Signal Processing
- ECE 6680 Embedded Computing
- ECE 6730 Introduction to Parallel Systems
- ECE 6740 Fault Tolerance and Reliability in High-Performance Computing
- ECE 6780 General Purpose Computation on Graphical Processing Units
- ECE 8010 Analysis of Linear Systems
- ECE 8180 Random Process Application in Engineering
- ECE 8190 Detection and Estimation Theory
- ECE 8210 Digital Communication Systems II
- ECE 8470 Digital Image Processing
- ECE 8480 Telecommunications Network Modeling and Analysis
- ECE 8490 Advanced Topics in Computer Communications
- ECE 8500 QoS in Wireless Networks
- ECE 8510 Advanced Topics in Computer Architecture
- ECE 8550 Artificial Intelligence
- ECE 8560 Pattern Recognition
- ECE 8570 Coding Theory
- ECE 8720 Artificial Neural Networks
- ECE 8730 Parallel and Distributed Systems
- ECE 8750 Peer-to-Peer Wireless and Cloud Computing
- ECE 8770 Computer Vision
- ECE 8780 High-Performance Computing w/ GPUs
- ECE 8790 FPGA Design and Applications
- ECE 8830 Malware Reverse Engineering

- ECE 8860 Distributed Denial of Service (DDoS) Attacks

**Additional Course Options:**

Subject to enrollment, Computing and Communications faculty offer ECE 6930 and 8930 Selected Topics courses dealing with advanced topics. These courses may be used to satisfy one or more of the focus-area requirements subject to approval of the student's advisory committee. Before taking courses, each student's proposed selection of courses must be approved by the student's advisor and the other members of the advisory committee.

## Appendix A – Focus Area Requirements

### Energy Systems

Courses in this focus area can be used to satisfy the requirements for either the M.S. in computer engineering or the M.S. in electrical engineering.

Four (4) courses must be selected from the list of acceptable courses below:

- ECE 6160 Smart Grid
- ECE 6180 Power System Analysis
- ECE 6190 Electric Machines and Drives
- ECE 6200 Renewable Energy Penetration on the Power Grid
- ECE 6570 Fundamentals of Wind Power
- ECE 6610 Fundamentals of Solar Energy
- ECE 8020 Electric Motor Control
- ECE 8070 Computer Methods for Power Systems Analysis
- ECE 8160 Electric Power Distribution System Engineering
- ECE 8170 Power System Transients
- ECE 8240 Power System Protection
- ECE 8260 Solar Cells
- ECE 8620 Real Time Computer Application in Power Systems
- ECE 8630 Power System Dynamics and Stability
- ECE 8640 MicroGrids in Virtual Power Plants

#### **Additional Course Options:**

Subject to enrollment, Energy Systems faculty offer ECE 6930 and 8930 Selected Topics courses dealing with advanced topics. These courses may be used to satisfy one or more of the focus-area requirements subject to approval of the student's advisory committee. Before taking courses, each student's proposed selection of courses must be approved by the student's advisor and the other members of the advisory committee.

## Appendix A – Focus Area Requirements

### Intelligent Systems

Courses in this focus area can be used to satisfy the focus-area requirements for either the M.S. in computer engineering or the M.S. in electrical engineering.

Four (4) courses must be selected from the list of acceptable courses below:

- ECE 6160 Smart Grid
- ECE 6310 Introduction to Computer Vision
- ECE 6420 Knowledge Engineering
- ECE 6490 Computer Network Security
- ECE 6550 Robot Manipulators
- ECE 6680 Embedded Computing
- ECE 8010 Analysis of Linear Systems
- ECE 8040 Networked Dynamical Systems
- ECE 8470 Digital Image Processing
- ECE 8540 Analysis of Tracking Systems
- ECE 8550 Artificial Intelligence
- ECE 8560 Pattern Recognition
- ECE 8690 Advanced Kinematics in Robotics
- ECE 8720 Artificial Neural Networks
- ECE 8740 Advanced Nonlinear Control
- ECE 8830 Malware Reverse Engineering
- ECE 8860 Distributed Denial of Service (DDoS) Attacks

#### **Additional Course Options:**

Subject to enrollment, Intelligent Systems faculty offer ECE 6930 and 8930 Selected Topics courses dealing with advanced topics. These courses may be used to satisfy one or more of the focus-area requirements subject to approval of the student's advisory committee. Before taking courses, each student's proposed selection of courses must be approved by the student's advisor and the other members of the advisory committee.

## Appendix A – Focus Area Requirements

### Photonics, Electronics and Quantum Systems

Courses in this focus area can be used to satisfy the focus-area requirements for either the M.S. in computer engineering or the M.S. in electrical engineering.

Four (4) courses must be selected from the list of acceptable courses below:

- ECE 6040 Semiconductor Devices
- ECE 6060 Introduction to Microelectronics Processing
- ECE 6080 Silicon Photonic Integrated Circuits
- ECE 6320 Instrumentation
- ECE 6330 Optical Fiber Communication Systems
- ECE 6340 Optoelectronics and Photonics
- ECE 6360 Transmission Lines and Microwave Circuits
- ECE 6370 Microelectromechanical Systems
- ECE 6460 Antennas and Propagation
- ECE 6580 Algorithms for VLSI Design Automation
- ECE 6590 Integrated Circuit Design
- ECE 6610 Fundamentals of Solar Energy
- ECE 8090 CMOS Radio-Frequency Integrated Circuit Design
- ECE 8120 Advanced Electronic Materials & Devices
- ECE 8230 Integrated Circuit Technology
- ECE 8260 Solar Cells
- ECE 8270 Finite Difference Time Domain Method
- ECE 8290 Special Functions in Engineering
- ECE 8300 Electromagnetics
- ECE 8330 Fourier Optics and Optical Signal Processing
- ECE 8360 Lasers and Detectors
- ECE 8370 Advanced Fiber Optics
- ECE 8400 Physics of Semiconductor Devices

#### **Additional Course Options:**

Subject to enrollment, Photonics, Electronics and Quantum Systems faculty offer ECE 6930 and 8930 Selected Topics courses dealing with advanced topics. These courses may be used to satisfy one or more of the focus-area requirements subject to approval of the student's advisory committee. Before taking courses, each student's proposed selection of courses must be approved by the student's advisor and the other members of the advisory committee.

# Appendix B – ECE Department Assistantships

## 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.

Affordable Care Act:

After you are on payroll, you will be asked to report paid service hours worked in a timely manner in the Time Capture System.

Please contact the Office of Human Resources at [Ask-HR](#) with any questions related to ACA and the Time Capture System.

## 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.

## Travel

Students on assistantships (TA and RA) are responsible for arranging travel during breaks so that they are able to return to campus and resume their assigned duties in a timely manner. This is often an issue for international students, especially when Visa issues become involved. Inability to return by the first day of classes may result in your being removed from your assistantship, in which case you would not receive the tuition waiver.

## 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.

## Appendix B – ECE Department Assistantships

### Standards of Performance

Teaching and Grading Assistants will be reviewed by the ECE department on a semester basis using evaluation standards issued by the Graduate School. Research Assistants will be evaluated by the faculty member leading the research project.

### 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.

### 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. This assistantship is subject to the four or six semester time limit as described 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 some 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, Computing and Applied Sciences, 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.

## Appendix B – ECE Department Assistantships

Note the following additional information:

- Assistantships for M.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 M.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 or grading 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 M.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.



## Appendix B – ECE Department Assistantships

### Enrollment Requirements for Students Receiving an ECE Assistantship

Each graduate student receiving an assistantship in ECE (whether a research assistantship, a teaching assistantship, or a grading assistantship) is required to maintain full-time enrollment status during the semester of the assistantship. The student is eligible for the (reduced) graduate assistant rate for tuition and fees only if he or she is employed as a graduate assistant for the full semester or through the time of completion of all degree requirements in the semester. Each graduate student receiving an assistantship in ECE during fall semester or spring semester must take nine credit hours of course work (including research credits), and each student receiving an assistantship during a summer semester must take three credit hours of course work (including research credits). Additional stipulations may be specified in the student's assistantship contract with the Department; thus, each graduate assistant should read the contract carefully.

### Description of Dept.-Offered Assistantships

There are two types of departmental-offered assistantships:

Graduate Teaching Assistantship (GTA)

Graduate Grading Assistantship (GGA)

A GTA 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 GTAs 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 GTA 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 GTA 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.

The Graduate Program Coordinator 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 GTA 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.

At the beginning of each semester, students (whether they have an existing GTA/GGA or not) indicate TA and/or Grading preferences. This is done via a 'preference form' distributed from the Student Services Program Coordinator for the Graduate Program in 102C Riggs Hall.

Students need a total of 10 hours of support to receive a tuition reduction from the university. Thus, students who do not have an externally funded RA will be assigned at least 10 hours.

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 are considered a maximum, except in special cases. 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 International Students

International students who wish to become graduate teaching assistants must first pass the ECE test of spoken English. It is given at the beginning of each fall and spring semester and can be arranged by signing up with the Student Services Coordinator for the Graduate Program.

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. A topic will be selected prior to registration for the test. [ECE Laboratory Manuals](#) are available on the ECE website. Computer presentations are not allowed due to the brief amount of time each student has to present.

### 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 either with the Office of International Affairs or the College of Engineering, Computing and Applied Sciences Budget Center. Students are responsible for providing tax forms promptly. Delays in receiving these forms can cause delays in checks since they are only issued twice a month.

# Appendix C – Bachelor-to-Graduate Program

## Application to the Bachelor to Graduate Program

A student must satisfy the following criteria in order to apply for the program:

1. Current enrollment in the B.S. program in CpE or EE at Clemson.
2. One to two semesters of course work remaining in the B.S. program.
3. Minimum overall GPR of 3.4 or higher at the end of the junior year of the program.

A student must take the following steps to apply for the program:

1. Complete and submit the GS6 Bachelor-to-Graduate form (Bachelor-to-Graduate Request for Combined Education Plan). The form is available on the Graduate School's website, and application details are available in the Academic Regulations section of the Graduate School Announcements.
2. Specify one of the following focus areas (areas of specialization) on the GS6 Bachelor-to-Graduate form. Indicate the focus area in parenthesis after the EE or CpE 'major.' The focus areas in the list below are the only options for the Combined BS/MS program.

### Approved M.S. Focus Areas

Computing and Communications  
Energy Systems  
Intelligent Systems  
Photonics, Electronics and Quantum Systems

### Admission into the Bachelor-to-Graduate Program and Provisional Admission into the M.S. or Direct Entry Ph.D. Program.

Each application to the Bachelor-to-Graduate program will be evaluated by the ECE Department and the Graduate School to determine the applicant's suitability for the program. The applicant will be informed by the Graduate School of the resulting admission decision. (An applicant who is not accepted into the Bachelor-to-Graduate program can still submit an application in his or her senior year for standard admission into the M.S. or Ph.D. program upon graduation.)

## Appendix C – Bachelor to Graduate Program

Students admitted to the Bachelor-to-Graduate program in ECE are considered to have gained *provisional* admission into the M.S. or Direct Entry Ph.D. program in ECE.

### Additional Requirements to be met for Full Admission into the Graduate Program

1. Each student admitted into the Bachelor to Graduate program must provide the ECE Department with Graduate Record Examination (GRE) scores no later than the mid-term date of the semester in which the student will complete the requirements for the B.S. degree. (Earlier submission of the scores is encouraged so that the student will be considered for opportunities for financial support during in the Graduate program – see the ECE Department’s Web site for recommended dates for submission of graduate application material.)
2. Each student admitted into the Bachelor to Graduate Program must complete the B.S. degree in ECE with a minimum GPR that depends on the student’s selected focus area. (The minimum GPR for each focus area is at least 3.4.)

### Graduate-Level Course Work taken Prior to Completion of the B.S. Degree

Each student admitted to the Bachelor to Graduate program in ECE is eligible to apply up to nine credit hours of 6000-level and 8000-level ECE course work towards the technical-elective requirements of the B.S. degree in CpE or EE. The same credit hours will also be applied towards the course requirements of the M.S. degree in CpE or EE. Several conditions and restrictions apply.

1. Only the 6000-level and 8000-level courses approved for the student’s specified M.S. focus area may be applied towards the graduate degree requirements. (See the 6000-level and 8000-level courses listed below by M.S. focus area.)
2. For questions on what 6000 and 8000 level courses are applicable to the technical depth requirement of the B.S. program, see the technical electives list provided by the department or speak with the Undergraduate Student Services Coordinator.

## Appendix C – Bachelor to Graduate Program

3. Students must have instructor approval to take an 8000 level course as an undergraduate student.
4. Graduate-level course work taken prior to the completion of the B.S. degree can be applied only towards the requirements of the M.S. degree with the thesis option or towards the Ph.D. It *cannot* be applied towards the requirements of the M.S. degree with the non-thesis option. (For details on the requirements of the M.S. thesis option, please refer to the M.S. thesis requirements in the ECE Graduate Student Handbook.)

### Other Policies Regarding the Bachelor to Graduate Program in ECE

1. In the event that a student participating in the Bachelor to Graduate program does not subsequently qualify for full admission into the graduate program, the 6000-level and 8000-level course credits earned by the student prior to completion of the B.S. degree are still applicable to the requirements of the B.S. degree.
2. If a student participating in the Bachelor to Graduate degree program is subsequently admitted to the Ph.D. program in ECE under the direct-entry option, the 6000- and 8000-level courses that were to be applied towards the requirements of the M.S. degree may be applied towards the requirements of the Ph.D. degree instead.
3. No student can hold a graduate assistantship prior to completion of the B.S. degree, including students enrolled in the Bachelor to Graduate program in ECE.  
Opportunities for financial support for Bachelor to Graduate students after completion of the B.S. degree depend on the availability of funds in alignment with ECE departmental policy.

Below please find a list of the participating focus areas for the graduate programs in ECE along with the courses that are eligible for use toward the graduate degree if also used toward the B.S. degree.

#### Computing and Communications

ECE 6170, ECE 6290, ECE 6300, ECE 6310, ECE 6380, ECE 6400,  
ECE 6670, ECE 6680, ECE 6730, ECE 6740  
ECE 8010, ECE 8180, ECE 8190, ECE 8210, ECE 8220  
ECE 8420, ECE 8470, ECE 8480, ECE 8510, ECE 8560, ECE 8570  
ECE 8720, ECE 8730, ECE 8770, ECE 8780, ECE 8790, ECE 8830, ECE 8860

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### Energy Systems

ECE 6180, 6190

ECE 8020, ECE 8070, ECE 8160, ECE 8170, ECE 8240, ECE 8620, ECE 8630, ECE 8640

### Intelligent Systems

ECE 6160, ECE 6310, ECE 6420, ECE 6490, ECE 6550, ECE 6680

ECE 8010, ECE 8040, ECE 8470, ECE 8540, ECE 8560, ECE 8690, ECE 8720, ECE 8740

ECE 8830, ECE 8860

### Photonics, Electronics and Quantum Systems

ECE 6040, ECE 6060, ECE 6080, ECE 6320, ECE 6330, ECE 6340

ECE 6360, ECE 6370, ECE 6460, ECE 6580, ECE 6590

ECE 8090, ECE 8120, ECE 8230, ECE 8290

ECE 8300, ECE 8330, ECE 8360, ECE 8370, ECE 8400

For information about which of the above courses are applicable to each technical-elective subject area of the B.S. CpE and B.S. EE curricula, consult the information about the curricula on the ECE Department's Web site.