SPRING 2019 – FALL 2020

GRADUATE STUDENT HANDBOOK

ELECTRICAL & COMPUTER ENGINEERING
TEXAS A&M UNIVERSITY

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People to Contact

Dr. Miroslav Begovic   Department Head

Dr. Jean-Francois Chamberland   Associate Dept. Head

Dr. Scott Miller   Co-Director of ECE Graduate Programs

Dr. Jiang Hu   Co-Director of ECE Graduate Programs

Ms. Katie Bryan   Academic Advisor IV
- Current registered students
- Degree plans
- MS and PHD defense processing
- ME final projects

Ms. Crystal Rodriguez   Academic Advisor II
- Current registered students
- International student issues, ISS forms
- Department letters
- Distance Learning

Ms. Melissa Sheldon   Academic Advisor II
- Admissions
- Prospective students
- Newly-enrolled students
- Department Scholarship

Ms. Anni Brunker   Payroll Administration

Ms. Yolanda Veals   Scholarship/Fellowship Administration

Graduate Studies Committee

Dr. Scott Miller: Co-Director of ECE Graduate Program
(Information Science and Systems)

Dr. Kamran Entesari:
(Analog and Mixed Signals)

Dr. Robert Nevels:
(Electromagnetics and Microwave)

Dr. Rafaella Righetti:
(Bio Medical Imaging and Genomic Signal Processing)

Dr. Jun Zou:
(Device Science and Nanotechnology)

Dr. Mark Ehsani:
(Energy and Power)

Dr. Peng Li:
(Computer Engineering and Systems)

Dr. Chao Tian:
(Information Science and Systems)

Research Area Websites

Analog and Mixed Signals
http://engineering.tamu.edu/electrical/research/analog-mixed-signal

Biomedical Imaging, Sensing and Genomic Signal Processing
http://engineering.tamu.edu/electrical/research/biomedical-imaging-sensing-genomic-signal-processing

Computer Engineering and Systems Group
http://engineering.tamu.edu/electrical/research/computer-engineering-systems-group

Electromagnetics and Microwaves Group
http://engineering.tamu.edu/electrical/research/electromagnetics-microwaves-group

Energy and Power
http://engineering.tamu.edu/electrical/research/electric-power-systems-power-electronics

Device Science and Nanotechnology
http://engineering.tamu.edu/electrical/research/device-science-and-nanotechnology

Information Science and Systems
http://engineering.tamu.edu/electrical/research/information-science-and-systems

Student Organizations

Electrical and Computer Engineering Graduate Student Association (ECE-GSA)
The goal of the ECE-GSA is to represent the graduate students in the Department Electrical and Computer Engineering and to facilitate building a sense of community, especially among graduate students and with faculty. All graduate students in the Department of Electrical and Computer Engineering are implicitly members of ECE-GSA. We are actively looking for motivated and enthusiastic students to be part of the ECE-GSA. For more information on ECE-GSA, contact **Fernando Lavalle Aviles** at ferlavalle@tamu.edu.

Women in IEEE, Texas A&M University Chapter
The purpose of this group is to be the voice for women studying Electrical and Computer Engineering at A&M. We wish to establish a platform where concerns can be raised and channels through which they could be addressed. We hope to invite speakers and raise awareness about the various opportunities for women in IEEE. Non-IEEE members are welcome too. For more information on Women in IEEE, contact wieee@tamu.edu or **Radhika Saraf** at saraf.radhika@tamu.edu.

Howdy Portal

The Howdy website is used by the students to register for classes, pay bills, apply for financial aid, and to find other information regarding the university.

Home Tab
- Used for general information about events going on around the university
- Emergency notifications and updates are viewable here as well as a link to register for Code Maroon (i.e. The Emergency Notification System)

Applicant Tab
- Admission Portal
- Scholarships, ISS & OGAPS

My Record Tab
- Register for classes, see what classes are available, and view restrictions/details about a class
- View unofficial transcript, order official transcript, view and print degree evaluations
- Links to optional services such as parking, athletics, funding, and campus directory
- Allow access for non-student to view grades
- Check for holds on your account

My Finances Tab
- Access account to check balance, pay tuition, view refunds or pay any other outstanding bill
- Apply for loans, scholarships, and other forms of financial aid
- Allow access for non-students to view and/or pay tuition, or any other bills on the student's account

Student Life Tab
- Register for parking, sporting events pass, or on campus dining
- Get information on housing both on and off campus
- Get information as well as links for employment opportunities on and off campus
- Other helpful links such as the student recreation center or computing center

E-campus
- Access useful course information be clicking on the ecampus link at the top of the Howdy portal.
- Under "My Organizations" registered graduate students in ECEN should see the group called "ECEN Graduate Students". This ecampus group has specific information about your graduate program.
- If you are registered for ECEN courses but do not see this group, please notify the Graduate Office and we will add you.
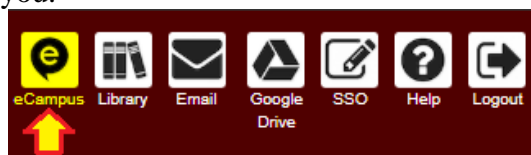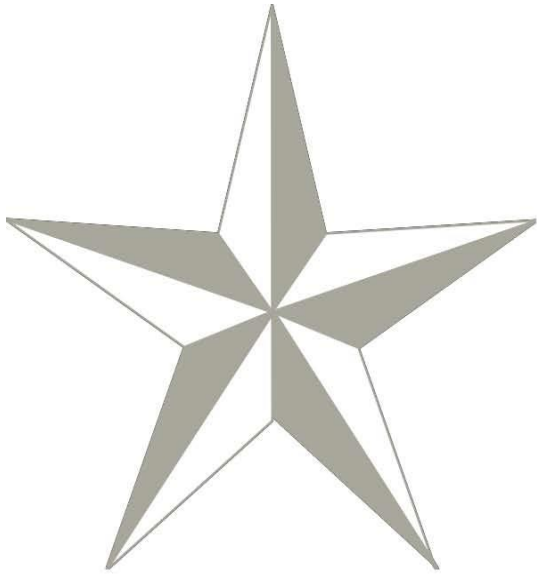
Electrical Engineering
Graduate Degrees
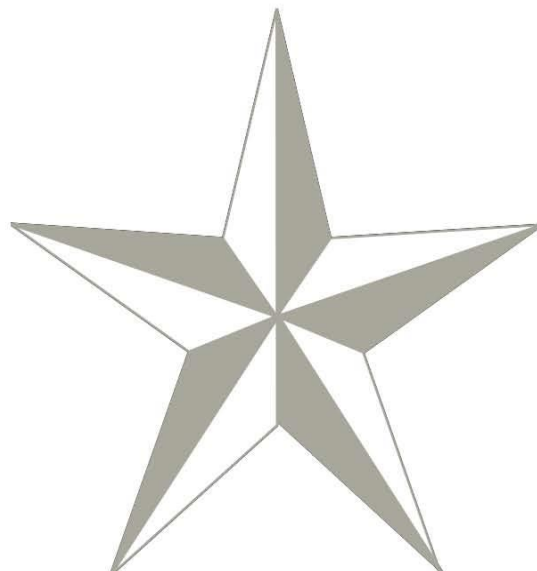
Requirements for Graduate Electrical Engineering Degrees
in the Department of Electrical and Computer Engineering

Master of Engineering Degree

1. Total Number of Hours (30)

2. A minimum of 27 classroom hours (excludes 681, 684, and 685).
    *   Classroom hours must be taken from courses within the College of Engineering and/or College of Science.
    *   At least 18 classroom hours must be ECEN courses.

3. Transfer hours allowed from another institution (6)
    *   Transfer hours must be from a U.S. peer institution; they cannot have been used on a previous degree plan.
    *   Students must send syllabi, transcript, and TAMU course equivalent to the Graduate Office. Transfer hours are subject to the approval of the GSC.

4. Undergraduate hours allowed (2 courses or 8 hours)
    *   Only 400 level undergraduate courses can be included on degree plan.
    *   Courses must be from the College of Engineering and/or College of Science.

5. Seminar (681), Internship (684), Directed Studies (685) no more than (3) hours allowed (combined).
    *   Research (691) hours are not allowed on an ME degree plan.

6. ** A **Final Project Report** is required to be submitted to the Graduate Office.
    *   A graded project from any ECEN and CSCE graduate course can be used to fulfill this requirement. The project requires a grade, the professor's signature, and a completed cover page. It must be submitted in the graduating semester; see ecampus page for submission deadlines and other requirements.

7. Composition of supervisory committee
    *   The Graduate Coordinator will be the chair of all ME committees. No other committee members are needed.

Requirements for Graduate Electrical Engineering Degrees
in the Department of Electrical and Computer Engineering

Master of Science Degree

1. Total Number of Hours (32)

2. A minimum of 24 classroom hours (excludes 681, 684, 685, and 691).
   - Classroom hours must be taken from courses within the College of Engineering and/or College of Science.
   - At least 15 classroom hours must be ECEN courses.

3. A minimum of 5 hours of research (ECEN 691) must be included on the degree plan. A maximum of 8 research hours can be included. All 691s must be ECEN.

4. Transfer hours allowed from another institution (6)
   - Transfer hours must be from a U.S. peer institution; they cannot have been used on a previous degree plan.
   - Students must send syllabi, transcript, and TAMU course equivalent to the Graduate Office. Transfer hours are subject to the approval of the GSC.

5. Undergraduate hours allowed (2 courses or 8 hours)
   - Only 400 level undergraduate courses can be included on degree plan.
   - Courses must be from the College of Engineering and/or College of Science.

6. Seminar (681), Internship (684), Directed Studies (685): no more than (3) hours allowed (combined).

7. Final defense of thesis is required for all MS students.
   - A thesis proposal must be approved by the supervisory committee and submitted to the Graduate Office ***at least 1 month before the defense***.
   - Date and location of the thesis defense must be scheduled through the Graduate Office ***at least 1 month in advance*** so that official notification can be provided to OGAPS.
   - Thesis must be submitted to committee members at least two weeks before defense.
   - Please see ecampus page for details.

8. Composition of supervisory committee – four members total
   - At least two members from within the ECEN Department and within the student's focus area.
   - At least one member from within the ECEN Department but outside the student's focus area.
   - At least one member from outside the ECEN Department
   - Note: Committee Chair must be ECEN faculty.

Requirements for Graduate Electrical Engineering Degrees
## *in the Department of Electrical and Computer Engineering*

Doctor of Philosophy Degree

1. Total Number of Hours (64 or 96)
   - For students who already hold a Master's degree, 64 total hours are required.
   - For "direct PHD" students, 96 hours are required.

2. A minimum of 18 (or 42) classroom hours (excludes 681, 684, 685, and 691).
   - 18 hours required for students with a previous Master's degree and 42 for direct PHD students.
   - Classroom hours must be taken from courses within the College of Engineering and/or College of Science.
   - At least 9 (or 24) classroom hours must be ECEN courses.

3. A maximum of (6-8) transfer hours allowed from another institution
   - Transfer hours must be from a U.S. peer institution; they cannot have been used on a previous degree plan.
   - Students must send syllabi, transcript, and TAMU course equivalent to the Graduate Office. Transfer hours are subject to the approval of the GSC.

4. Undergraduate hours allowed (2 courses or 8 hours)
   - Only 400 level undergraduate courses can be included on degree plan.
   - If you used 400 level hours on your Master's degree plan, then you must reduce the number of allowed undergraduate hours by that amount.

5. No more than 3 credit hours of Internship (684) are allowed.
   - PHD students cannot take 684 after dissertation defense.

6. No more than 2 credit hours of Directed Studies (685) are allowed.
   - Students working on a research project should enroll in Research (691) hours.

7. All PHD students are required to pass the **Departmental Qualifying Examination**
   - All incoming PHD students (64 and 96 hour) are required to take the exam within one year of starting the program.
   - Students entering the program with a previous degree outside of Electrical or Computer Engineering are allowed, with written approval from their advisor, an extra year and will be required to take the exam by the end of the second year.
   - Those students that fail the examination are given a second opportunity to retake the exam which must be taken at the next opportunity in which the exam is offered.
   - Those that fail the examination twice will be removed from the PHD program.
   - More details of the Qualifying Exam are given later in this handbook.

- Degree Plans are to be filed within one semester after passing the Qualifer for both 64 and 96 hour PHD students.

8. All PHD students with a degree plan on file are required to submit an **Annual PHD Review**.
   - The Graduate Office will provide this document to the student and his/her research advisor at the beginning of each spring semester.
   - PHD students are responsible for meeting with their research advisor to discuss their progress in the program.
   - After the student and research advisor sign the review document, the student should submit it to the Graduate Office by the specified deadline, which is typically by mid-May.

9. All PHD students are required to pass a **Preliminary Examination.**
   - 64 hours PHD students are required to schedule their prelim exam by the end of their 4th semester (excluding summers) and 6th semester for those with previous degree outside of Electrical or Computer Engineering and 96 hour PHD's.
   - Students who have not scheduled their prelim by the appointed time will be blocked from further registration until they do so.
   - Date and location of the prelim must be scheduled through the Graduate Office ***at least 1 month in advance*** so that official notification can be provided to OGAPS.
   - Students must download the checklist and signature page from the OGAPS web site. The checklist must be signed by your advisor and Graduate Coordinator prior to the exam.
   - The prelim exam consists of a written and an oral examination.
   - For students who have passed the departmental Qualifying Exam, the written portion of the prelim exam can be waived subject to the approval of the student's supervisory committee.
   - Students who fail the prelim exam will have one opportunity to retake the exam within 6 months of the original exam date.
   - ***The research proposal must be submitted to the Graduate Office within 5 business days after the prelim***. See pages 58-59 and ecampus page for details.

10. **Final Defense** of dissertation is required for all PHD students.
    - Date and location of the final defense must be scheduled through the Graduate Office ***at least 1 month in advance*** so that official notification can be provided to OGAPS.
    - Dissertation must be submitted to committee members at least two weeks before defense.
    - Please see ecampus page for details.

11. Composition of supervisory committee
    - At least two members from within the ECEN Department and within the student's focus area.
    - At least one member from within the ECEN Department but outside the student's focus area.
    - At least one member from outside the ECEN Department.
    - Note: Committee Chair must be ECEN faculty.

Degree Plans
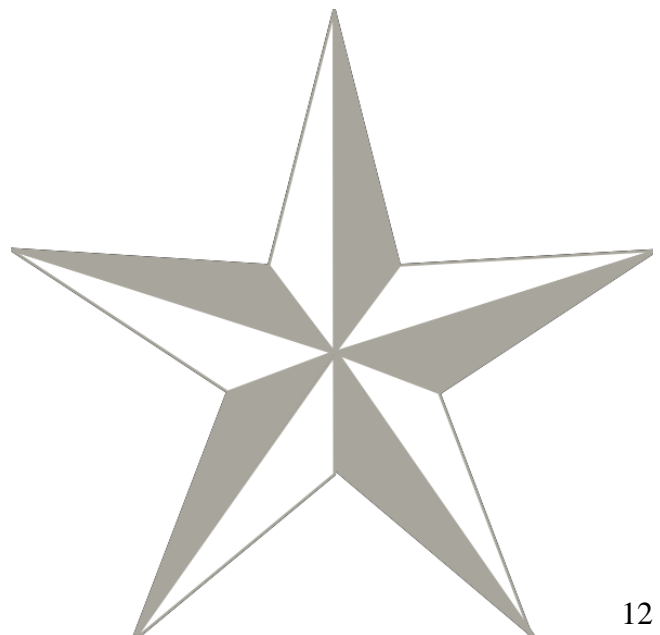
Degree Plans

A degree plan consists of:
- Degree program (e.g., Master of Science in Electrical Engineering)
- A list of courses to be taken to fulfill the degree requirements.
- A list of faculty who will form the supervisory committee.

Degree plan submission deadlines (excluding summers):
- All degree plans and petitions are submitted via DPSS (Document Processing Submission System) on the OGAPS website: https://ogsdpss.tamu.edu/
- ME/MS students must file a degree plan prior to the pre-registration period, starting your second (2nd) semester. Pre-registration dates are found on the Registrar's website.
- 64 hour PHD students must file a degree plan within one year from the date they started the program or one semester after passing the PHD qualifier. Those with a previous degree outside of Electrical or Computer Engineering and 96 hour PHDs must file a degree plan two years from the date they started the program or one semester after passing the PHD qualifier.
- Students who have not filed a degree plan by the deadlines indicated above will be blocked from registering for future semesters.
- The block will not be removed until the degree plan has been submitted.

Degree plan approval:
- Must be approved by all committee members, the Graduate Coordinator (or the Department Head), and the Office of Graduate and Professional Studies (OGAPS).
- Course changes can be made to the degree plan by submitting a long form petition which must be approved by all committee members.
- Changes of committee members, also made by submitting a long form petition, must be approved by all members of the committee (first by outgoing then by incoming).
- Changes in major, department, or degree are made by submitting an MDD petition.

Other degree plan & course information:
- There is no limit to ECEN 689 courses that can be added to the degree plan for ME, MS, or PHD students.
- Courses cannot be "converted" into other courses (ECEN 685 or 681 cannot be "converted" into ECEN 691 credit).
- **Students cannot add more than 2 credits over the requirement on their degree plan. For example, MS student must have 32 credits but cannot add more than 34 on the degree plan. ME students must have 30 credits but cannot add more than 32 credits on the degree plan, 64 hour PHDs cannot add more than 66 credits, and 96 hour PHDs cannot add more than 98.**
- Any changes to a degree plan, including course or committee member changes, take time to process. Keep this in mind as you make any changes and wait for approvals.
- Students are responsible for checking OGAPS deadlines each semester: http://ogaps.tamu.edu/Buttons/Calendars

The Office of Graduate and Professional Studies (OGAPS) website has important information regarding degree plans and degree completion: http://ogaps.tamu.edu/

Miscellaneous Requirements

Miscellaneous Requirements

Foundation Courses
- Required of students with non-electrical or computer engineering undergraduate degrees.
- Do not count towards graduate degree requirements.
- Specific foundation courses required should be determined in consultation with your advisor.

Electrical Engineering Foundation Courses	Computer Engineering Foundation Courses
ECEN 214 Electrical Circuit Theory	
ECEN 248 Intro to Digital Systems Design	
ECEN 314 Signals and Systems	
ECEN 325 Electronics	
ECEN 322 Electric and Magnetic Fields	CSCE 221 Data Structures and Algorithms
Two additional courses from one of the following areas of specialization: • Electronics • Power • Electro-physics, electro-optics, microwaves • Communications, Control, Signal Processing	CSCE 311 Analysis of Algorithms
	ECEN 350 (or CSCE 321) Computer Architecture

Preregistration - All students currently enrolled MUST pre-register for future semesters during the pre-registration periods (in order to ensure sufficient enrollment).
- Preregistration dates can be found at http://registrar.tamu.edu/

Restricted Courses
- STAT 651, STAT 652, and STAT 685 are for non-science majors and are not allowed on ELEN or CEEN degree plans.
- Business courses will not be allowed on ELEN or CEEN degree plans (exception: ME students in CEEN can include one course from the ISYS department).
- Traditionally no courses from Engineering Technology (ESET) will be allowed because of the non-calculus based curriculum.
- Additional restrictions which apply to CEEN majors:
  - CSCE 601 and 602 may not be taken for credit.
  - Credit for both CSCE 614 and ECEN 651 is not allowed. CSCE 614 is only allowed in special circumstances with the research advisor's approval.
  - Credit for CSCE 619 and CSCE 612 may not be allowed in addition to ECEN 602. Please check with your advisor.
  - No credit will be given for the following foundation courses ECEN 214, ECEN 248, ECEN 314, ECEN 325, ECEN 350, CSCE 321, CSCE 211 and CSCE 311.

Internships – ECEN 684
- If an internship is taken, you will receive graduate credit for 684 (1 credit hour per semester of internship). ECEN 684 must be on your degree plan and approved by your advisor prior to starting the internship.

- Students may take ECEN distance learning courses while on internship.
- An Internship Report and an evaluation by your supervisor must be submitted to the Grad Office before a course grade is given.
- Students on internship must be physically present for at least 50% of the term or they will receive an "I" (incomplete) for the course. The student will receive an "S" once the internship is complete, including submission of the Internship Report.
- International students must submit CPT (Curricular Practical Training) paperwork to the Graduate Office in advance. CPT forms can be found at http://iss.tamu.edu/
- Please see ecampus page for additional details and FAQs on CPT processing. Students must fill out the Department Form according to the e-campus example prior to submitting CPT paperwork to the Graduate Office. Further questions about CPT should be directed to Crystal Rodriguez at cbrodriguez@tamu.edu.

Directed Studies – ECEN 685
- Enrollment in directed studies (ECEN 685) requires approval of the instructor in whose section you are enrolling. The instructor must be ECEN faculty or joint-faculty.
- The 685 request form is available on the ECEN ecampus site. A hard copy with original signatures of both the instructor and student must be submitted to the Graduate Office prior to enrollment. This form will describe the scope of the project and will indicate the basis on which a letter grade will be assigned.
- ECEN 685 is a letter-graded course.

Change of Degree Programs
- If you have received financial support from the department (through either an RA, TA, GANT, fellowship or scholarship), you may not switch to the ME program from the MS or PHD program.
- If you are in the ME program you may switch to the MS or PHD program with the approval of a supervising professor. Also, a transfer to the PHD program requires a minimum GPR of 3.6.
- MS and ME students switching to the PHD program have two options:
  - 1) Change during MS/ME program: Identify a PHD advisor and submit an MDD petition via DPSS. The Graduate Office must have email confirmation from PHD advisor before approving the MDD petition.
  - 2) Change after MS/ME program: Submit a *Letter of Intent* (found on the OGAPS website) to the Graduate Office **after defending.** The Graduate Office must have email confirmation from PHD advisor.
- PHD and MS students switching to ME:
  - 1) If you have a degree plan on file, submit an MDD petition via DPSS. After the MDD petition is approved by OGAPS, submit a ME degree plan.
  - 2) If you do **not** have a degree plan on file, simply submit the ME degree plan directly.

Change of Focus Area & Major
- You may not change your focus area during your first semester.
- After your first semester, you may change focus areas with the approval of both groups. Approval via email from group leaders is sufficient.
- ELEN students who want to change to CEEN may apply by following the directions posted on ecampus.
- Students interested in changing departments should contact the advising office of the new department for requirements.

Class Schedule Changes

- *Students <u>may not</u> request course changes after the 12th class day of a new semester without providing the following to the Grad Office*: statement explaining why course change is being requested, email from student's advisor approving the schedule change, email from the instructor approving the student be added to the course.
- Late Fee Waivers will not be provided unless under extenuating circumstances.

Financial Aid

Financial Aid

- Many forms of financial aid are available to graduate students in the ECE department:
    - Research Assistantship (RA)
        - Offered by individual faculty members.
        - Pay rate varies from $1,350-$2,000 per month for MS and PHD students (for 20 hours per week).
        - Usually pays tuition.
    - Teaching Assistantship (TA)
        - Offered through the department; course instructors can make recommendations.
        - International students must pass ELPE to be eligible. (see pages 22-23)
        - Pays $2,000 per month for MS and PHD students (for 20 hours per week).
        - Tuition paid for PHD's only.
        - Apply through the ECE website.
    - Graduate Assistant Non-Teaching (GANT) – Offered through a variety of sources.
    - Fellowships – Offered through OGAPS, the College of Engineering, the Department, and individual faculty.
    - One-Time Scholarships
        - $1,000 - offered on a competitive basis through the department.
        - Qualifies student to pay in-state tuition rate.
            - Awarded at beginning of fall semester to incoming students.
            - Apply through the ECE website.
- Assistantships (RA, TA, GANT) require up to 20 hours per week of service.
- Those receiving financial aid will be required to maintain full time status:
    - o 9 semester hours during Fall/Spring
    - o 6 hours during 10 week summer session
    - o 3 hours during each 5 week summer session (Cannot combine course work from 10 week and 5 week in the summer session)

- TA's should make requests for continued funding by submitting the online application each semester.

- RA's should check with funding source on number of hours to register for.

- *If you received funding from the department, you cannot change your status to the Master of Engineering Program from the Master of Science or PHD program*.

- Students in non-degree status or probationary status are NOT eligible for financial aid.

Probation

Probation

- A Grade Point Ratio (GPR) equal to or better than 3.0 is required to maintain good academic standing. For purposes of probationary action, GPR is measured in three different manners:
  - Semester GPR,
  - Cumulative GPR,
  - Degree Plan GPR.

- A student will be placed on probation and blocked from pre-registration if any of the three indicated GPRs falls below 3.0. The student will be allowed to register once they have signed an acknowledgement letter stating that they understand the terms of the probation.

- One semester is allowed to correct the GPR deficiency and return it back up to 3.0 or better.

- If a student's GPR deficiency is not corrected after one semester, the Graduate Studies Committee (GSC) will meet to discuss the case and may recommend a dismissal from the graduate program.

- A student being removed from the graduate program will be notified by the Graduate Office of such action. They will have 14 calendar days from the date of notification to file an appeal to the Graduate Studies Committee. If the student does not appeal the decision or the GSC does not uphold the appeal, the GSC will then request the removal of the student from the program.

- A student who is on probation will not be allowed to hold any type of departmental financial support.

English Language Proficiency

English Language Proficiency

An international graduate student whose native language is not English must fulfill an English proficiency requirement through either English Proficiency Verification or English Language Certification. **This proficiency requirement should be met early in a student's program, and it must be completed before scheduling either the final examination for the master's degree or the preliminary examination for the doctoral degree.**

Two levels of English Proficiency Status for a graduate student include: English Proficiency Verified and English Proficiency Certified. **English Proficiency Certification is required by the State of Texas, before a graduate student is eligible to serve as a Graduate Assistant-Teaching, or any other position considered to be a teaching position (e.g., instructor, lecturer, etc.).** All other students must be either English Proficiency Verified or English Proficiency Certified.

English Proficiency Verification can be achieved by presenting:

- a TOEFL score of at least 80 on TOEFL iBT (550 paper-based), or

- an IELTS score of at least 6.0, or

- a GRE Verbal Reasoning score of at least 146 (400 on the old scale), or

- GMAT Verbal score of at least 22, or

- a PTE Academic score of at least 53, or

- acquiring alternative verification from the Office of Graduate and Professional Studies via a departmental request. An international graduate student holding a master's degree from an accredited U.S. institution qualifies for alternative verification.

Individual colleges may choose to establish minimum TOEFL standards that exceed the University minimum for English Proficiency Verification. Scores from TOEFL examinations administered more than two years before submission of the application for admission shall not be eligible for English Proficiency Verification.

English Proficiency Certification can be achieved by:

- scoring an 80 or higher on the oral skills section of the English Language Proficiency Examination (ELPE),

- acquiring alternative certification from the Office of Graduate and Professional Studies via a departmental request.

A student who has received a baccalaureate degree following four years of study at an accredited U.S. institution or institutions qualifies for alternative certification. All other requests for alternative certification require strong department justification and review in compliance with Office of Graduate and Professional Studies policies and guidelines.

An international student who has completed an equivalent English training program at an institution other than Texas A&M may request English Proficiency Verification or Certification.

Verification or Certification is requested through the Departmental Graduate Advisor. The student should provide the Departmental Graduate Advisor with documentation to support Verification or Certification. If the department concurs with the request, the Departmental Graduate Advisor will submit a letter recommending and requesting Verification or Certification (with documentation attached) to the Office of Graduate and Professional Studies. The Office of Graduate and Professional Studies will determine on a case-by-case basis whether Verification or Certification is granted.

Areas of Specialization

Analog and Mixed-Signals
Area Leader: Dr. A. Karsilayan

Recommended Courses
<u>**Fall**</u>
(Undergraduate courses)
ECEN 454 Digital Integrated Circuit Design
ECEN 457 Operational Amplifiers
ECEN 474/704 VLSI Circuit Design
(Graduate courses)
ECEN 620 Network Theory
ECEN 622 Active Network Synthesis
ECEN 665 Integrated CMOS RF Circuits and Systems

<u>**Spring**</u>
(Graduate courses)
ECEN 607 Advanced Analog Circuit Design Techniques
ECEN 610 Mixed-Signal Interfaces
ECEN 625 Millimeter-Wave Integrated Circuits
ECEN 650 High Frequency GaAs/SiGe Analog IC Design
ECEN 651 Microprogrammed Control of Digital Systems
ECEN 654 Very Large Scale Integrated Systems Design
ECEN 671 Solid State Devices
ECEN 720 High Speed Links Circuits and Systems
<u>Other courses that may be taken:</u>
ECEN 458 Active Filter Analysis and Design
ECEN 609 Adaptive Control
ECEN 606 Nonlinear Control Systems
ECEN 639 Microwave Circuits
ECEN 644 Discrete-Time Systems
ECEN 680 Testing and Diagnosis of Digital Systems

<u>**Master of Engineering:**</u>
(Undergraduate/graduate courses)
ECEN 474/704 VLSI Circuit Design
ECEN 607 Advanced Analog Circuit Design Techniques
ECEN 610 Mixed-Signal Interfaces
ECEN 620 Network Theory
ECEN 665 Integrated CMOS RF Circuits and Systems
<u>**At least two from the following:**</u>
ECEN 457 Operational Amplifiers
ECEN 622 Active Network Synthesis
ECEN 625 Millimeter-Wave Integrated Circuits
ECEN 650 High Frequency GaAs/SiGe Analog IC Design
ECEN 654 Very Large Scale Integrated Systems Design
ECEN 671 Solid State Devices
ECEN 720 High Speed Links Circuits and Systems
ECEN 689 Special Topics

Biomedical Imaging and Genomic Signal Processing
Area Leader: Dr. A. Han

Recommended Courses
Master of Science:
(Undergraduate)
ECEN 410 Introduction to Medical Imaging
ECEN 411 Introduction to Magnetic Resonance Imaging and Magnetic Resonance Spectroscopy
ECEN 412 Ultrasound Imaging
ECEN 414 Biosensors
ECEN 419 Genomic Signal Processing
ECEN 444 Digital Signal Processing
ECEN 447 Digital Image Processing
ECEN 451 Antenna Engineering
ECEN 452 Ultra High Frequency Techniques
ECEN 463 Magnetic Resonance Engineering (Stacked with 763)

(Graduate)
ECEN 601 Linear Network Analysis (Mathematical Methods in Signal Processing)
ECEN 617 Advanced Signal Processing for Medical Imaging
ECEN 635 Electromagnetic Theory
ECEN 636 Phased Arrays
ECEN 637 Numerical Methods in Electromagnetics
ECEN 642 Digital Image Processing
ECEN 644 Discrete-Time Systems
ECEN 645 Pattern Recognition by Neural Networks
ECEN 648 Principles of Magnetic Resonance Imaging
ECEN 649 Pattern Recognition
ECEN 660 BioMems & Lab-on-a-Chip
ECEN 661 Modulation Theory (Advanced Digital Communications)
ECEN 662 Estimation and Detection Theory
ECEN 663 Data Compression with Applications to Speech and Video
ECEN 669 Engineering Applications in Genomics
ECEN 678 Statistical Optics
ECEN 760 Introduction to Probabilistic Graphical Models
ECEN 761 Biosensors Lab
ECEN 762 Advanced Ultrasound Imaging Techniques
ECEN 763 Magnetic Resonance Engineering (Stacked with 463)

Master of Engineering:
MEN students must take at least <u>five ECEN courses</u> chosen from the list above or from 689 courses in the biomedical imaging area.

<u>Two of these five</u> must be chosen from the following courses:

(Undergraduate/graduate courses)
ECEN 410/764 Medical Imaging
ECEN 411 Intro. MRI and MRS

ECEN 412 Ultrasound Imaging
ECEN 444 Digital Signal Processing
ECEN 447 Digital Image Processing
ECEN 642 Digital Image Processing
ECEN 646 Statistical Communication Theory (Probability and Random Processes for Information Science)
ECEN 649 Pattern Recognition

Please check the webpage http://bio.ece.tamu.edu .

Electromagnetics and Microwaves
Area Leader: Dr. R. Nevels

Recommended Courses for Master of Science and Master of Engineering

(Undergraduate courses)

ECEN 351 Applied Electromagnetic Theory

ECEN 451 Antenna Engineering

ECEN 452 Ultra High Frequency Techniques

ECEN 453 Microwave Solid-State Circuits and Systems

ECEN 480 RF and Microwave Wireless Systems

(Graduate courses)

ECEN 626 Antenna Theory and Technique

ECEN 635 Electromagnetic Theory

ECEN 636 Phased Arrays

ECEN 637 Numerical Methods in Electromagnetics

ECEN 638 Antennas and Propagation

ECEN 639 Microwave Circuits

ECEN 641 Microwave Solid State Integrated Circuits

ECEN 730 CMOS RFIC Engineering

ECEN 735 Electromagnetic Field Theory

Energy and Power
Area Leader: Dr. T. Overbye

Recommended Courses

Master of Science:

(Undergraduate courses)
ECEN 415 Physical and Economical Operations of Sustainable Energy Systems
ECEN 459 Power System Fault Analysis and Protection
ECEN 460 Power System Operation and Control
ECEN 438 Power Electronics
ECEN 441/741 Electronic Motor Drives
ECEN 442/742 DSP Based Electromechanical Motion Control

(Graduate courses)
ECEN 611 General Theory of Electromechanical Motion Devices
ECEN 612 Computer Aided Design of Electromechanical Motion Devices
ECEN 613 Rectifier and Inverter Circuits
ECEN 614 Power Systems State Estimation
ECEN 615 Methods of Electric Power Systems Analysis
ECEN 616 Power System Electromagnetic Transients
ECEN 630 Analysis of Power Electronics Systems
ECEN 632 Motor Drive Dynamics
ECEN 643 Electric Power System Reliability
ECEN 666 Power System Faults and Protective Relaying
ECEN 667 Power System Stability
ECEN 668 High Voltage Direct Current (HVDC) Transmission
ECEN 677 Control of Electric Power Systems
ECEN 679 Computer Relays for Electric Power Systems
ECEN 686 Electric and Hybrid Vehicles
ECEN 689 Special Topics
ECEN 710 Switching Power Supplies
ECEN 711 Sustainable Energy and Vehicle Engineering
ECEN 712 Power Electronics for Photovoltaic Energy Systems
ECEN 715 Physical and Economical Operations of Sustainable Energy Systems
ECEN 738 Power Electronics
ECEN 741/441 Electronic Motor Drives
ECEN 742/442 DSP Based Electromechanical Motion Control

Master of Engineering:
15 credit hours to be taken in the Energy and Power courses that are listed above.

Device Science and Nanotechnology
Area Leader: Dr. P.R. Hemmer

Recommended Courses

Master of Science:

(Undergraduate courses in Solid State)
ECEN 370 Electronic Properties of Materials
ECEN 472 Microelectronic Circuit Fabrication
ECEN 473 Microelectronic Device Design

(Graduate courses in Solid State)
ECEN 656 Physical Electronics
ECEN 658 Low Noise Electronic Design
ECEN 671 Solid State Devices
ECEN 673 Fundamentals of Microelectronics
ECEN 770 Organic Semiconductor
ECEN 771 Fluctuations & Noise Electronics
ECEN 772 Introduction to Microelectromechanical Devices and Systems

(Undergraduate courses in Electro-optics)
ECEN 462 Optical Communication Systems
ECEN 464 Optical Engineering

(Graduate courses in Electro-optics)
ECEN 631 Fiber-Optic Devices
ECEN 657 Quantum Electronics
ECEN 670 Fiber-Optic Networks
ECEN 672 Semiconductor Lasers and Photodetectors
ECEN 675 Integrated Optoelectronics
ECEN 678 Statistical Optics

Non-ECEN
PHYS 408 Thermodynamics and Statistical Mechanics
PHYS 412 Quantum Mechanics I
PHYS 606 Quantum Mechanics
PHYS 617 Physics of Solid State
STAT 601 Statistical Analysis
MATH 601 Methods of Applied Mathematics I
MATH 602 Methods and Applications of Partial Differential Equations

Master of Engineering- Solid State:

(Undergraduate courses in Solid State)
ECEN 472 Microelectronic Circuit Fabrication
ECEN 473 Microelectronic Device Design

(Graduate courses in Solid State)
ECEN 656 Physical Electronics
ECEN 658 Low Noise Electronic Design
ECEN 671 Solid State Devices
ECEN 673 Fundamentals of Microelectronics
ECEN 770 Organic Semiconductor
ECEN 772 Introduction to Microelectromechanical Devices and Systems
Non-ECEN
MATH 601 Methods of Applied Mathematics I
MATH 602 Methods and Applications of Partial Differential Equations

Master of Engineering –Electro-optics:

(Undergraduate courses in Electro-optics)
ECEN 462 Optical Communication Systems
ECEN 464 Optical Engineering
(Graduate courses in Electro-optics)
ECEN 601 Linear Network Analysis (Mathematical Methods in Signal Processing)
ECEN 602 Computer Communication and Networking
ECEN 631 Fiber-Optic Devices
ECEN 657 Quantum Electronics
ECEN 670 Fiber-Optic Networks
ECEN 672 Semiconductor Lasers and Photodetectors
ECEN 675 Integrated Optoelectronics
ECEN 678 Statistical Optics
Non-ECEN
PHYS 412 Quantum Mechanics I
PHYS 606 Quantum Mechanics
STAT 601 Statistical Analysis
MATH 417 Numerical Analysis I
MATH 601 Methods of Applied Mathematics I
MATH 602 Methods and Applications of Partial Differential Equations
MATH 610 Numerical Methods in partial Differential Equations

Alternatives:
ECEN 639 Microwave Circuits
ECEN 689 Special Topics

Information Science and Systems
Area Leader: Dr. S. Miller

Recommended first-level graduate courses
ECEN (undergraduate courses)
   410, 412, 419, 420, 421, 444, 447, 448, 455, 478
ECEN (graduate courses)
   601, 604, 605, 629, 642, 644, 646, 647, 649, 655, 661, 662, 663, 683

Foundation Courses (no graduate credit)
ECEN 214 Electrical Circuit Theory
ECEN 248 Introduction to Digital Systems Design
ECEN 303 Random Signals and Systems
ECEN 314 Signals and Systems
ECEN 325 Electronics
ENGL 301 Technical Writing

Tentative List of Courses for Graduate ISS Students

Communications/Information Theory
ECEN 601 Linear Network Analysis (Mathematical Methods in Signal Processing)
ECEN 604 Channel Coding for Communications Systems
ECEN 646 Statistical Communication Theory (Probability and Random Processes for Information Science)
ECEN 629 Convex Optimization for Electrical Engineering (Applied Convex Optimization)
ECEN 647 Information Theory
ECEN 655 Advanced Topics in Channel Coding
ECEN 661 Modulation Theory (Advanced Digital Communications)
ECEN 663 Data Compression with Applications to Speech & Video
ECEN 683 Wireless Communications Systems
ECEN 689 Special Topics
ECEN 760 Introduction to Probabilistic Graphical Models

Signal and Image Processing:
ECEN 601 Linear Network Analysis (Mathematical Methods in Signal Processing)
ECEN 629 Convex Optimization for Electrical Engineering (Applied Convex Optimization)
ECEN 642 Digital Image Processing
ECEN 644 Discrete-Time Systems
ECEN 646 Statistical Communication Theory (Probability and Random Processes for Information Science)
ECEN 649 Pattern Recognition
ECEN 662 Estimation and Detection Theory
ECEN 663 Data Compression with Applications to Speech & Video
ECEN 760 Introduction to Probabilistic Graphical Models

Controls:
ECEN 601 Linear Network Analysis (Mathematical Methods in Signal Processing)
ECEN 605 Linear Multivariable Systems
ECEN 606 Nonlinear Control Systems
ECEN 608 Modern Control
ECEN 609 Adaptive Control
ECEN 628 Robust and Optimal Control
ECEN 633 Optimum Control Systems

Genomics:
ECEN 669 Engineering Applications in Genomics

Networks:
ECEN 423 Computer and Wireless Communication Network
ECEN 602 Computer Communication and Networking
ECEN 619 Internet Protocols and Modeling
ECEN 621 Mobile Wireless Networks
ECEN 689 Special Topics

MATH / STAT / MEEN / NUEN:
MATH 415 Modern Algebra I
MATH 416 Modern Algebra II
MATH 446 Principles of Analysis
MATH 447 Principles of Analysis II
STAT 601 Statistical Analysis
MATH 606 Theory of Probability I
MATH 607 Real Variables I
MATH 608 Real Variables II
MATH 619 Applied Probability
MATH 651 Optimization I
MATH 652 Optimization II
MATH 653 Algebra I
MATH 654 Algebra II
MEEN 641 Quantitative Feedback Theory
MEEN 651 Control System Design
MEEN 652 Multivariable Control System Design
MEEN 674 Modern Control
MATH 601 Methods of Applied Mathematics I
NUEN 689 Special Topics

Hardware/VLSI:
ECEN 449 Microprocessor System Design
ECEN 454 Digital Integrated Circuit Design
ECEN 468 Advanced Logic Design
You may want to talk to professors in the Computer Engineering and Systems Group about courses that will suit your background and interests.

Graduate Degrees

Computer Engineering and Systems

Requirements for Graduate Computer Engineering Degrees
in the Department of Electrical & Computer Engineering

A. MASTER OF ENGINEERING IN COMPUTER ENGINEERING (Non-Thesis)

1. Total number of hours (30)
2. A minimum of 27 classroom hours (Excludes 681, 684, & 685).
   - Classroom hours must be taken from courses within the College of Engineering and/or College of Science.
   - One course from the ISYS Dept. in the College of Business is allowed.
   - A minimum of 24 classroom hours from the Departments of CSCE and ECEN
   - *At least 13 of these 24 hours must be in ECEN.*
     At least 6 courses from the CEEN ME student course list – see p. 43.

3. Transfer hours allowed from another institution (6)
   - Transfer hours must be from a U.S. peer institution; they cannot have been used on a previous degree plan.
   - Students must send syllabi, transcript, and TAMU course equivalent to the Graduate Office. Transfer hours are subject to the approval of the GSC.

4. Undergraduate hours allowed (6)
   - Only 400 level undergraduate courses can be included on degree plan.
   - Courses must be from the College of Engineering and/or College of Science.

5. One hour of seminar is allowed (ECEN/CSCE 681) but is NOT required.

6. Seminar (681), Internship (684), Directed Studies (685) no more than (3) hours allowed (combined).
   - Research (691) are not allowed on the ME degree plan.

7. ** A **Final Project Report** is required to be submitted to the Graduate Office.
   - A graded project from any ECEN and CSCE graduate course can be used to fulfill this requirement. The project requires a grade, the professor's signature, and a completed cover page. It must be submitted in the graduating semester; see ecampus page for submission deadlines and other requirements

8. Composition of supervisory committee
   - The Graduate Coordinator will be the chair of all ME committees. No other committee members are needed.

9. Additional course requirements are listed in D.

B. MASTER OF SCIENCE IN COMPUTER ENGINEERING (Thesis)

1. Total number of hours (32)
2. A minimum of 24 classroom hours (excludes 681, 684, 685, & 691).
   - A minimum of 21 classroom hours from the College of Engineering and/or College of Science.
   - ***Courses on degree plan must be approved by Research Advisor.***

3. Transfer hours allowed from another institution (6)
   - Transfer hours must be from a U.S. peer institution; they cannot have been used on a previous degree plan.
   - Students must send syllabi, transcript, and TAMU course equivalent to the Graduate Office. Transfer hours are subject to the approval of the GSC.

4. Undergraduate hours allowed (6)
   - Only 400 level undergraduate courses can be included on the degree plan.
   - ***Courses must be approved by Research Advisor.***

5. Seminar, seminar, and research (681, 685, & 691)
   - 8 hours maximum of these courses
   - 4 hours minimum of 691
     - Note: If co-chair is outside of ECEN, research credits must be split 50/50 between chair and co-chair.
   - 1 hour of seminar (ECEN/CSCE 681) is required
   - No more than 3 hours (in combination) of ECEN 681, 684, and 685.

6. Final defense of thesis is required for all MS students.
   - A thesis proposal must be approved by the supervisory committee and submitted to the Graduate Office ***at least 1 month before the defense***.
   - Date and location of the thesis defense must be scheduled through the Graduate Office ***at least 1 month in advance*** so that official notification can be provided to OGAPS.
   - Thesis must be submitted to committee members at least two weeks before defense.
   - Please see ecampus page for details.

7. Composition of supervisory committee – at least 3 members total
   - At least two members within Computer Engineering Group from ECEN
   - At least one member from outside ECEN
   - Note: Committee Chair must be ECEN faculty (or CSCE joint faculty appointment). Co-chair may be from outside department.

8. Additional course requirements are listed in D.

C. Ph.D. IN COMPUTER ENGINEERING

1. Total number of hours (64 or 96)
   - For students who already hold a Master's Degree, 64 total hours are required.
   - For "direct PhD" students, 96 hours are required.

2. A minimum of 18 (or 42) classroom hours (excludes 681, 684, 685, and 691).
   - 18 hours required for students with a previous Master's degree and 42 for direct PHD students.
   - Classroom hours must be taken from courses within the College of Engineering and College of Science.
   - ***Courses on degree plan must be approved by Research Advisor.***

3. A maximum of (6) transfer hours allowed from another institution.
   - Transfer hours must be from a U.S. peer institution; they cannot have been used on a previous degree plan.
   - Students must send syllabi, transcript, and TAMU course equivalent to the Graduate Office. Transfer hours are subject to the approval of the GSC.

4. Undergraduate hours allowed (2 courses or 8 hours)
   - Only 400 level courses can be included on degree plan.
   - If you used 400 level hours on your Master's degree plan, then you must reduce the number of allowed undergraduate hours by that amount.

5. No more than 3 credit hours of Internship (684) are allowed.
   - PHD students cannot take 684 after dissertation defense.

6. Three (3) hours of Seminar (ECEN/CSCE 681) are required.

7. No more than 2 credit hours of Directed Studies (685) are allowed.
   - Students working on a research project should enroll in Research (691) hours.

8. All PhD students are required to pass the **Departmental Qualifying Examination**
   - All incoming PHD students (64 and 96 hour) are required to take the exam within one year of starting the program.
   - Students entering the program with a previous degree outside of Electrical or Computer Engineering are allowed, with written approval from their advisor, an extra year and will be required to take the exam by the end of the second year.
   - Those students that fail the examination are given a second opportunity to retake the exam which must be taken at the next opportunity in which the exam is offered.
   - Those that fail the examination twice will be removed from the PHD program.
   - More details of the Qualifying Exam are given later in this handbook.
   - Degree Plans are to be filed within one semester after passing the Qualifier for both 64 and 96 hour PHD students.

9. All PHD students with a degree plan on file are required to submit an **Annual PHD Review**.
   - The Graduate Office will provide this document to the student and his/her research advisor at the beginning of each spring semester.

- PHD students are responsible for meeting with their research advisor to discuss their progress in the program.
- After the student and research advisor sign the review document, the student should submit it to the Graduate Office by the specified deadline, which is typically by mid-May.

10. All PHD students are required to pass a **Preliminary Examination.**
   - 64 hour PHD students are required to schedule their prelim exam by the end of their 4th semester (excluding summers) and 6th semester for those with previous degree outside of Electrical or Computer Engineering and 96 hour PHD's.
   - Students who have not scheduled their prelim by the appointed time will be blocked from further registration until they do so.
   - Date and location of the prelim must be scheduled through the Graduate Office ***at least 1 month in advance*** so that official notification can be provided to OGAPS.
   - Student must download the checklist and signature page from the OGAPS web site. The checklist must be signed by your advisor and Graduate Coordinator prior to the exam.
   - The prelim exam consists of a written and an oral examination.
   - For students who have passed the departmental Qualifying Exam, the written portion of the prelim exam can be waived subject to the approval of the student's supervisory committee.
   - Students who fail the prelim exam will have one opportunity to retake the exam within 6 months of the original exam date.
   - ***The research proposal must be submitted to the Graduate Office within 5 business days after the prelim***. See pages 58-59 and ecampus page for details.

11. **Final Defense** of dissertation is required for all PHD students.
   - Date and location of the final defense must be scheduled through the Graduate Office ***at least 1 month in advance*** so that official notification can be provided to OGAPS.
   - Dissertation must be submitted to committee members at least two weeks before defense.
   - Please see ecampus page for details.

12. Composition of supervisory committee – at least 4 members total
   - At least two members from within Computer Engineering Group from ECEN.
   - At least one member not in CE Group, but in ECEN Department.
   - At least one member from outside the ECEN Department.
   - Note: Committee Chair must be ECEN faculty (or CSCE joint faculty appointment). Co-chair may be from outside department.

13. Additional course requirements are listed in D.

D. ADDITIONAL COURSE REQUIREMENTS

- STAT 651 and STAT 652 (statistics courses) are for non-science majors and are not allowed. Traditionally no courses will be admitted from Engineering Technology because of the non-calculus based curriculum and no approved graduate program.

- Credit for CSCE 614 may not be allowed in addition to ECEN 651 unless approved by your research advisor.

- Credit for CSCE 619 and CSCE 612 may not be allowed in addition to ECEN 602. Please check with your advisor.

- No credit will be given for CSCE 601 & 602.

- No credit will be given for the following foundation courses ECEN 214, ECEN 248, ECEN 314, ECEN 325, ECEN 350, CSCE 321, CSCE 221 and CSCE 311.

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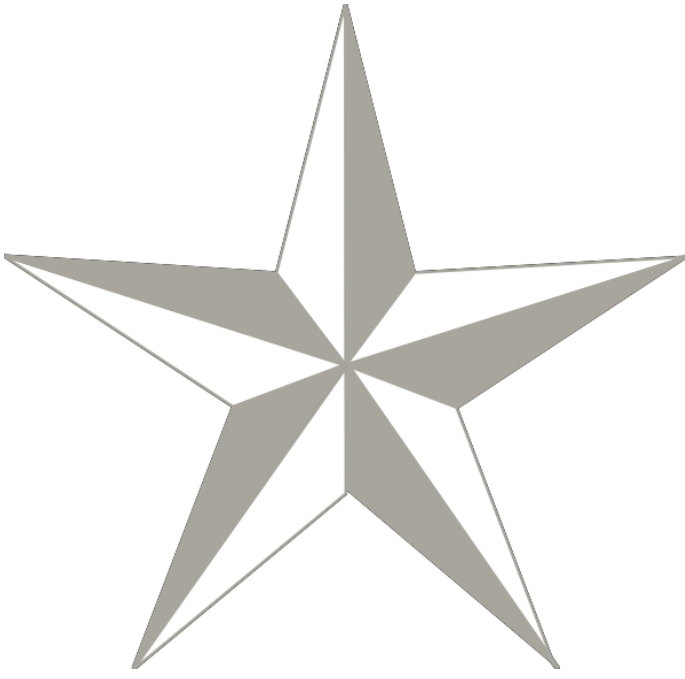
Computer Engineering and Systems Courses
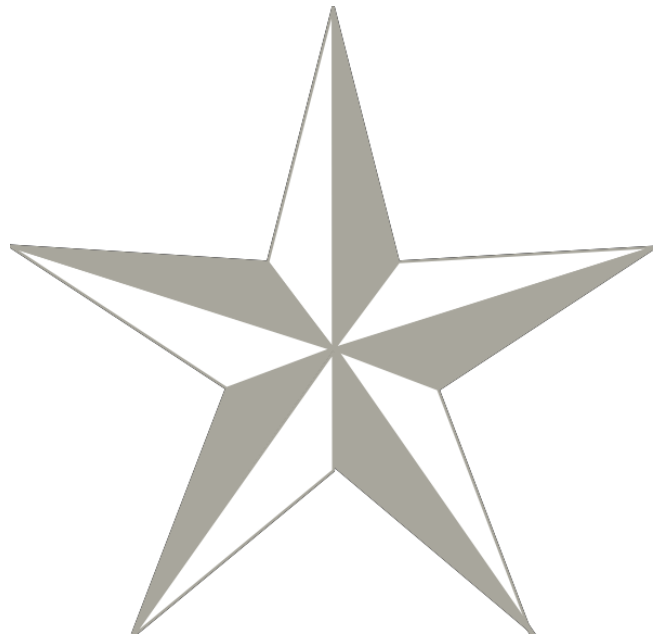
Computer Engineering and Systems Group
Area Leader: Dr. P. Cantrell

Recommended first-level graduate courses

ECEN (undergraduate courses)
      468

CSCE (undergraduate courses)
      410

ECEN (graduate courses)
      602, 621, 651, 653, 654, 687, 714, 754, 749

CSCE (graduate courses)
      614 – with advisor approval, 629, 662

Foundation Courses (no graduate credit)

ECEN 214   Electrical Circuit Theory

ECEN 248   Introduction to Digital Systems Design

ECEN 314   Signals and Systems

ECEN 325   Electronics

ECEN 350   Computer Architecture and Design

ECEN 423   Computer and Wireless Communications Networks

CSCE 221   Data Structures and Algorithms

CSCE 311   Analysis of Algorithms

Tentative List of Courses for Graduate CEEN MS & PHD Students
8/13/19

Hardware/VLSI:
ECEN 468 Advanced Digital System Design
ECEN 654 VLSI Systems Design
CSCE 661 Integrated Systems Design Automation
ECEN 680 Test and Diagnosis of Digital Systems
ECEN 687 Introduction to VLSI Physical Design Automation
ECEN 689 Special Topics Courses in Hardware/VLSI
ECEN 699 Advances in VLSI Logic Synthesis
ECEN 714/454 Digital Integrated Circuit Design
ECEN 749/449 Microprocessor Systems Design
ECEN 751 Advanced Computational Methods for Integrated System Design

ECEN 752 Advances in VLSI Circuit Design
ECEN 759 Hardware Security

Networks:
ECEN 602 Computer Communication and Networking
ECEN 619 Internet Protocols and Modeling
ECEN 621 Mobile Wireless Networks
CSCE 663 Real-time Systems
CSCE 664 Wireless and Mobile Systems
CSCE 665 Advanced Networking and Security
ECEN 689 Special Topics Courses in Networks

Computer Architecture:
CSCE 605 Compiler Design
ECEN 651 Microprogrammed Control of Digital Systems (not CSCE 614)
ECEN 653 Computer Arithmetic Unit Design
ECEN 659 Parallel/Distributed Numerical Algorithms and Applications
ECEN 676 Advanced Computer Architecture
ECEN 689 Special Topics Courses in Computer Architecture

Systems and Software:
CSCE 410 Operating Systems (OR CSCE 611 Operating Systems and Applications)
CSCE 606 Software Engineering
CSCE 629 Analysis of Algorithms
CSCE 662 Distributed Processing Systems
CSCE 670 Information Retrieval and Storage
ECEN 689 Special Topics Courses in Systems and Software

Network and Systems Theory:
ECEN 663 Data Compression with Applications to Speech and Video
ECEN 689 Special Topics Courses in Networking and Systems Theory
ECEN 757 Distributed Systems and Cloud Computing
ECEN 750 Design and Analysis of Communication Networks
ECEN 753 Theory and Applications of Network Coding
ECEN 754/434 Optimization for Electrical and Computer Engineering
ECEN 755 Stochastic Systems
ECEN 756 Game Theory

Math / Stat:
MATH 415 Modern Algebra I
MATH 416 Modern Algebra II
MATH 446 Principles of Analysis I
MATH 447 Topics in Analysis II
STAT 601 Statistical Analysis
MATH 606 Theory of Probability I
MATH 607 Real Variables I
MATH 608 Real Variables II
MATH 652 Optimization II

Data Science:
ECEN 689 Special Topics Courses in Data Science
ECEN 748 Data Stream Algorithms and Applications
ECEN 758 Data Mining and Analysis

Seminar:

ECEN 681 Computer Engineering Seminar (with advisor's approval)

Tentative List of Courses for CEEN ME Students
(Must take at least 6 courses out of the list below) *8/13/19*

Hardware/VLSI:
ECEN 468 Advanced Digital System Design
ECEN 654 VLSI Systems Design
CSCE 661 Integrated Systems Design Automation
ECEN 680 Test and Diagnosis of Digital Systems
ECEN 687 Introduction to VLSI Physical Design Automation
ECEN 689 Special Topics Courses in Hardware/VLSI
CSCE 689 Special Topics Courses in Hardware/VLSI
ECEN 699 Advances in VLSI Logic Synthesis
ECEN 714/454 Digital Integrated Circuit Design
ECEN 749/449 Microprocessor System Design
ECEN 751 Advanced Computational Methods for Integrated System Design
ECEN 752 Advances in VLSI Circuit Design
ECEN 759 Hardware Security

Networks:
ECEN 602 Computer Comm. and Networking
ECEN 619 Internet Protocols and Modeling
ECEN 621 Mobile Wireless Networks
CSCE 663 Real-time Systems
CSCE 664 Wireless and Mobile Systems
CSCE 665 Advanced Networking and Security
ECEN 689 Special Topics Courses in Networks
CSCE 689 Special Topics Courses in Networks

Computer Architecture:
CSCE 605 Compiler Design
ECEN 651 Microprogrammed Control of Digital Systems (not CSCE 614)
ECEN 653 Computer Arithmetic Unit Design
ECEN 659 Parallel/Distributed Numerical Algorithms and Applications
ECEN 676 Advanced Computer Architecture
ECEN 689 Special Topics Courses in Computer Architecture
CSCE 689 Special Topics Courses in Computer Architecture

Systems and Software:

CSCE 611/410 Operating Systems
CSCE 606 Software Engineering
CSCE 629 Analysis of Algorithms
CSCE 662 Distributed Processing Systems
CSCE 670 Information Retrieval and Storage

Networking & Systems Theory:
ECEN 663 Data Compression with Applications to Speech and Video
ECEN 757 Distributed Systems and Cloud Computing
ECEN 689 Special Topics Courses in Networking and Systems Theory
CSCE 689 Special Topics Courses in Networking and Systems Theory
ECEN 750 Design and Analysis of Communication Networks
ECEN 753 Theory and Applications of Network Coding
ECEN 754/434 Optimization for Electrical & Computer Engineering Applications
ECEN 755 Stochastic Systems
ECEN 756 Game Theory

Data Science:
ECEN 689 Special Topics Courses in Data Science
CSCE 689 Special Topics Courses in Data Science
ECEN 748 Data Stream Algorithms and Applications
ECEN 758 Data Mining and Analysis

PHD Qualifiers

Department of Electrical and Computer Engineering
PHD Qualifying Examination

The Departmental Qualifying Exam is based on material covered in a set of nine fundamental undergraduate courses in Electrical and Computer Engineering.

ECEN 214 – Electrical Circuit Theory
ECEN 248 – Introduction to Digital Systems Design
CSCE 221 – Data Structures and Algorithms
ECEN 303 – Random Signals and Systems
ECEN 314 – Signals and Systems
ECEN 322 – Electric and Magnetic Fields
ECEN 325 – Electronics
ECEN 350 – Computer Architecture and Design
ECEN 370 – Electronic Properties of Materials

Any student that has graduated from either of the undergraduate programs in our department should have taken at least 8 of these courses. Students who have degrees from peer programs should have taken courses similar to many of these.

Exam Format: The exam consists of two questions from each of the areas listed above. Each question is designed to be completed in 20-25 minutes. Each student is required to answer any 6 of the 18 questions on the exam. This insures that each student has at least some proficiency outside of their main focus area, but does not require students to study extensively outside of their area of expertise. The exam is closed book, in-class, and time limited to 3 hours. Students must use department-issued calculators for the exam; personal calculators are not permitted. Students can check-out an ECEN calculator 1 week prior to the exam to become accustomed to it if needed. If the student answers more than 6 questions, only the first 6 questions are graded.

Exam Location: The exam is administered at the Texas A&M College Station and Qatar campuses. When you sign up for the test online, you will indicate your campus location.

Exam Syllabus: Included at the end of this document is an exam syllabus explicitly outlining the material that might be tested for each of the courses listed above. Hence the students will have an explicit list of topics to prepare for rather than a general "material from course xxx" type statement. Previous qualifying exams and sample questions are not provided.

Timing: The exam is offered twice a year, once in mid-January shortly before the start of the spring semester, and once in mid-June. In both cases, the exam date is about one month after the end of finals. This encourages students not to spend more than one month preparing for the exam. 1-2 months before the test dates, the Graduate Office will send an email with a link for students to sign up for the exam. Incoming PHD students (64 and 96 hour) are required to take the exam within one year of starting the program. Students entering the program with a previous degree outside of Electrical or Computer Engineering will be allowed, with written approval from their advisor, an extra year and will be required to take the exam by the end of the second year. Those students that fail the examination will be given a second opportunity to retake the exam which must be taken at the next opportunity in which the exam is offered. Those that fail the examination twice will be removed from the PHD program. Current MS or ME students are not allowed to take the qualifying exam.

STARTING SEMESTER IN PHD PROGRAM	WHEN TO TAKE QUALIFYING EXAM
Fall	June of the next year
Spring	January of the next year
Summer	June of the next year

Grading: The faculty who composed each problem will grade their perspective problems in the written exams. Once grading is complete, the GSC will meet to determine passing thresholds for the examination. The GSC may elect to normalize grades from each problem in order to maintain fairness across the various problems. Results of the exam will be available within four weeks of the date of the exam. Appeals regarding the results of the exam by either students or faculty must be submitted in writing to the Graduate Office and will be handled by the GSC.

Note: PHD students who pass the Qualifier are required to submit degree plans within 1 semester after passing the exam. Failure to submit the degree plan within this time frame will result in a registration hold.

PHD Qualifying Examination
Electric Circuit Analysis – ECEN 214

1. **Basic Circuit Theory**
   a. Ideal Voltage/Current Sources
   b. Circuit elements and governing equations: Resistors, capacitors, inductors
   c. Kirchhoff's Laws

2. **Basic Circuit Analysis**
   a. Node-Voltage method
   b. Mesh-current method
   c. Source transformation
   d. Thevenin/Norton equivalent circuits
   e. Maximum power transfer
   f. Superposition

3. **Ideal Op Amp Circuits**
   a. Ideal op amp equations
   b. Analysis of common op amp configurations
        i. Inverting/non-inverting amplifiers
       ii. Summing amplifiers
      iii. Difference amplifiers

4. **DC Transient Circuit Analysis**
   a. Natural and step responses of first order RC and RL circuits.
   b. First order op amp circuits
   c. Natural and step responses of second order RLC circuits

5. **AC Circuit Analysis**
   a. Phasors
   b. Impedance
   c. Finding sinusoidal steady state solutions using phasors

PHD Qualifying Examination
Digital System Design – ECEN 248

1. **Logic gates and Boolean Algebra**
   a. Theorems of Boolean Algebra
   b. Variables, literals, minterms, maxterms, cubes
   c. Two-level logic minimization
   d. Incompletely specified logic functions
   e. Canonical representations of logic functions

2. **Combinational Logic**
   a. Shannon's Expansion Theorem
   b. Multi-level logic optimization
   c. Timing analysis
   d. Special circuits – MUXes, Decoders, Encoders, PLAs, FPGAs, CPLDs,

3. **Arithmetic Circuits**
   a. Addition
   b. Subtraction and 2's complement
   c. Multiplication
   d. Division
   e. Arithmetic Sums-of-products
   f. Floating point arithmetic

4. **Sequential Design**
   a. Latches, Flip-flops, Registers
   b. Counters
   c. State machines
   d. Incomplete specification and non-determinism

5. **MOS based Logic Circuits**
   a. Basic MOS based realization of logic elements
   b. Circuit design styles
   c. Design of gates and memory elements

PHD Qualifying Examination
Data Structures and Algorithms – CSCE 221

1. **Data Structures**
   a. Stacks
   b. Queues
   c. Linked lists
   d. The tree abstract data type and data structures for representing trees
   e. Properties of binary trees
   f. Binary search trees
   g. AVL trees
   h. Red-black trees
   i. The priority queue abstract data type
   j. The heap data structure
   k. Hash tables
   l. Data structure of graphs
      i. The edge list
      ii. The adjacency list
      iii. The adjacency matrix

2. **Algorithms**
   a. Sorting
      i. Merge-sort
      ii. Quick-sort
   b. The Huffman coding algorithm
   c. Solving the longest common subsequence problem using dynamic programming
   d. Basic algorithms on trees
      i. Pre-order traversal
      ii. Post-order traversal
   e. Graph traversal
      i. Depth-first search
      ii. Breadth-first search
   f. Topological order and sorting of directed acyclic graphs
   g. Shortest paths: Dijkstra's algorithm
   h. Minimum spanning trees
      i. Kruskal's algorithm
      ii. Prim's algorithm

3. **Complexity Analysis**
   a. Asymptotic notations: the "big-Oh" notation
   b. Asymptotic analysis using the big-Oh notation

PHD Qualifying Examination
Probability and Random Variables – ECEN 303

1. **Discrete Probability**
   a. Joint/Conditional probabilities
   b. Independence
   c. Bayes' theorem
   d. Discrete random variables

2. **Continuous Random Variables**
   a. Cumulative distribution functions (CDFs) and probability density functions (PDFs)
   b. Gaussian random variables, standardized Gaussian integrals
   c. Conditional distribution and density functions
   d. Expected values, moments and conditional expected values
   e. Transformations of random variables
   f. Characteristic functions and moment generating functions
   g. Chernoff Bounds

3. **Multiple random variables**
   a. Joint and conditional CDFs and PDFs
   b. Independence
   c. Jointly Gaussian random variables
   d. Transformations of multiple random variables
   e. Random sequences – definitions of convergence modes and relationships between various modes
   f. Law of large numbers
   g. Central limit theorem

PHD Qualifying Examination
Signals and Systems – ECEN 314

1. **Signals**
   a. Mathematical description and pictorial representation of commonly used continuous-time signals and discrete time signals such as rectangular signal, unit step, dirac-delta, ramp, sinusoidal, complex exponential signals, sinc
   b. Even and odd signals, periodic signals
   c. Transformations of the independent variable – shift in time, scaling of the time axis
   d. Signal energy, power, auto-correlation, cross correlation, sifting property of the impulse

2. **Basic properties of systems**
   a. Systems with and without memory, linearity, invertibility, causality, stability, time invariance.

3. **Linear Time – Invariant Systems**
   a. Impulse response of a system
   b. Convolution in discrete-time and continuous-time
   c. Properties of LTI systems – commutative property, distributive property, associative property, invertibility, causality, stability
   d. LTI systems described by differential (or, difference) equations
   e. Block diagram representation of systems represented by differential (or, difference) equations
   f. Eigen functions of LTI systems

4. **Fourier series representation of periodic signals**
   a. Determination of trigonometric and complex exponential Fourier series for continuous time and discrete time periodic signals
   b. Convergence of the Fourier series
   c. Properties of the FS – linearity, shifting in time, scaling of the time axis, multiplication, conjugation, conjugate symmetry, Parseval's identity (See also section of properties of the Fourier Transform)

5. **Continuous-time and discrete-time Fourier transform**
   a. Development of the Fourier transform of an aperiodic signal
   b. Dirichlet conditions, convergence of the Fourier transform
   c. Computing the Fourier transform from the definition
   d. Memorize Fourier transform of basic signals such as rectangular signal, sinc, delta, exponential signal
   e. Properties of the Fourier transform – linearity, time shift, frequency shift, scaling of the time axis and frequency axis, conjugation and symmetry, time reversal, differentiation and integration, duality, Parseval's relation. Be conversant in using the properties of Fourier transforms to compute the FT of signals that can be obtained from simpler signals through a series of the above operations.
   f. Convolution and multiplication property
   g. Inverse Fourier transform – be able to compute this from definition as well as from looking up the transform for elementary signals. Be able to use partial fraction expansions to compute the Inverse Fourier transform.
   h. Magnitude and phase representation of the Fourier transform and frequency response of LTI systems

6. Applications of the Frequency domain analysis of signals and systems
   a. Filtering – Frequency response and impulse response of ideal filters, first order and second order approximations to filters.
   b. Sampling – Nyquist theorem, effects of aliasing, ideal reconstruction of the signal from its samples
   c. Modulation – Amplitude modulation, Hilbert transform, DSB and SSB carrier modulation

7. Laplace Transforms
   a. Definition, region of convergence, inverse Laplace transform
   b. Pole-Zero plot
   c. Properties of the Laplace transform - – linearity, time shift, frequency shift, scaling of the time axis and frequency axis, conjugation and symmetry, time reversal, differentiation and integration, duality, Parseval's relation, initial and final value theorems
   d. Solving differential equations using Laplace transforms

PHD Qualifying Examination
Electric and Magnetic Fields - ECEN 322

1. **Vector Analysis**
   a. Rectangular, cylindrical and spherical coordinate systems
   b. Gradient of scalar fields
   c. Divergence of vector fields
   d. Curl of vector fields
   e. Divergence theorem
   f. Stokes' theorem

2. **Maxwell's Equations and Fields**
   a. Static and dynamic
   b. Time-varying, static, and time-harmonic fields
   c. Boundary conditions
   d. Poisson and Laplace's equations
   e. Continuity equation
   f. Constitutive relations
   g. Current relations

3. **Wave Equations and Waves**
   a. Time-varying and time-harmonic wave equations
   b. Helmholtz's equations
   c. Plane electromagnetic waves in lossless and lossy media
   d. Parameters and properties of plane waves propagating in media (fields, velocity, propagation constant, etc.)
   e. Material properties (loss, skin depth, etc.)
   f. Poynting vector
   g. Instantaneous and average power flow
   h. Normal and oblique incidence of plane waves at boundaries
   i. Reflection and transmission coefficients
   j. Standing waves and voltage standing wave ratio (VSWR)
   k. Incident, reflected and transmitted waves

4. **Transmission Lines**
   a. Transmission-line equations
   b. Transmission-line equivalent circuit
   c. Wave propagation on transmission lines
   d. Transmission-line parameters (resistance, inductance, conductance and capacitance per unit length; characteristic impedance, propagation constant, wavelength, velocity, dispersion, distortion, etc.)
   e. Input impedance of transmission lines
   f. Open- and short-circuited transmission lines
   g. Reflection coefficient, voltage standing wave ratio (VSWR)

5. **Smith Chart**
   a. Construction of Smith chart

b. Determination of reflection coefficient, VSWR, input impedance/admittance, and maximum/minimum voltage locations using Smith chart
c. Design single-stub impedance matching network using Smith chart

PHD Qualifying Examination
Electronic Circuits – ECEN 325

1. **Linear circuit analysis**
   a. Magnitude and phase bode plots
   b. Phase and magnitude margin
   c. Root locus and stability
   d. Basics on feedback theory and properties

2. **Operational Amplifiers**
   a. Basic linear circuits employing operational amplifiers
   b. Instrumentation amplifier – differential and common mode gain, and CMRR
   c. 1st and second order filters –lowpass, bandpass and highpass
   d. OPAMP finite parameters – input and output impedance, finite DC gain and their effects
   e. Open loop and closed loop parameters – gain, input impedance and output impedance

3. **Diodes**
   a. Basic non-linear model
   b. Linear models and Taylor series expansions
   c. Rectifiers, peak detectors and other non-linear applications
   d. AC-to-DC conversion – half and full wave rectifiers and filters, ripple

4. **Bipolar Junction Transistor**
   a. Basic non-linear model
   b. Linear models and Taylor series expansions - π - Hybrid and T models
   c. DC and AC analysis
   d. Basic configurations- common-emitter, common-base and common-collector
   e. Input and output impedance, and voltage and power gain
   f. High-frequency transistor model – effects of the transistor and coupling capacitors
   g. Amplifier's linearity

5. **CMOSTransistors**
   a. Basic non-linear model
   b. Linear models and Taylor series expansions - π - Hybrid and T models
   c. DC and AC analysis
   d. Basic configurations- common-source, common-gate and common-drain
   e. Input and output impedance, and voltage and power gain
   f. High-frequency transistor model – effects of the transistor and coupling capacitors
   g. Amplifier's linearity

PHD Qualifying Examination
Computer Organization and Design - ECEN 350

1. **Instruction Set Architectures**
   a. Representing Instruction Set Architectures
   b. Arithmetical and Logical Instructions
   c. Memory access instructions
   d. Control flow instructions
   e. Function call instructions

2. **Computer Arithmetic**
   a. Signed and unsigned numbers
   b. Addition and subtraction
   c. Multiplication and Division
   d. Floating point operations

3. **Translating and starting a program**
   a. Compilers, compiler optimization
   b. Object code generation
   c. Assemblers
   d. Linking
   e. Run-time execution environment

4. **Performance evaluation**
   a. CPU performance and its factors
   b. Performance metrics
   c. Performance factors
   d. Comparing performance
   e. SPEC benchmarks

5. **Datapath and Control**
   a. Single-cycle implementation

6. **Pipelining**
   a. Pipelined datapath
   b. Pipelined control
   c. Pipeline hazards
      ii. Structural
      iii. Control
      iv. Data hazards
      v. Hazard detection and resolution

7. **Memory Hierarchy**
   a. Overview of SRAM and DRAM design
   b. Basic of caches
   c. Framework for memory hierarchy
   d. Measuring memory performance

8. Peripherals and disk storage

PHD Qualifying Examination
Electronic Properties of Materials - ECEN 370

1. **Electrons at metal-vacuum interface**
   a. Electron reflection/transmission at metal-vacuum interface
   b. Electrons inside a potential (quantum) well
   c. Electron tunneling through a potential barrier

2. **The free electron model in metals**
   a. Density of states, Fermi-Dirac distribution, work function
   b. Thermionic emission
   c. Schottky effect
   d. Field emission
   e. Photoelectric effect

3. **Band Models of Solids**
   a. Conduction band, valence band, band gap
   b. Electrical conduction of electrons in an energy band
   c. Energy band diagrams of metals, semiconductors and insulators
   d. Energy-momentum (E-k) curves
   e. Effective mass
   f. Holes

4. **Semiconductors**
   a. Intrinsic and extrinsic semiconductors
   b. Dopants of semiconductors
   c. Electron/hole concentration in intrinsic and extrinsic semiconductors
   d. Fermi level of intrinsic and extrinsic semiconductors
   e. Conductivity of semiconductors

5. **Principles of Semiconductor Devices**
   a. Energy band diagram of a p-n junction at equilibrium and under bias
   b. Built-in field, built-in potential, transition region width
   c. I-V characteristics at equilibrium and under bias
   d. Junction capacitance

PHD Prelim Examination

Department of Electrical and Computer Engineering
PHD Prelim Examination

Before scheduling your prelim, you must update your degree plan to *remove courses you haven't taken*. You can file a petition through DPSS to do this. Students must be registered at least 1 credit hour in the semester in which they take the prelim.

Scheduling the Exam: Unlike the qualifying exam, the PHD prelim exam must be scheduled individually by each student through the Graduate Office. After consulting with your committee, email the Graduate Advisor the date/time of your prelim *at least 1 month in advance*. The Graduate Office will schedule a conference room and process a memo to notify your committee. **Please see ecampus for specific directions on scheduling your prelim.**

What to Bring: You need to download the Prelim Exam Checklist and Report forms from the OGAPS website. *You must print and bring these forms with you the day of the prelim.* **Please pre-type all relevant information on the forms before printing**. **Please see ecampus for detailed directions and examples on how to fill out the prelim forms.**

Exam Format: The prelim exam has two parts. During the oral part of the prelim exam, the student is expected to make an oral presentation on the thesis topic to the student's thesis committee. For students who have passed the Qualifying Exam, the written portion of the prelim can be waived subject to the approval of the student's supervisory committee. Each student is expected to submit a written thesis proposal to the thesis committee *before* the prelim exam.

Exam Syllabus – There is no set syllabus for the PHD prelim exam.

Timing: PHD (64 hour) students who already have a Master's degree in Electrical Engineering should take the exam within 2 years of beginning their graduate program. PHD (96 hour) students who only hold a Bachelor's degree or no degree in Electrical Engineering when they start their PHD program should take the exam within 3 years of beginning their graduate program. If a student started in a Master's program and then converted to the PHD program, the student should take the prelim exam within 2 years after switching to the PHD program. Students can have up to 6 credits of coursework remaining in order to schedule their prelim.

Grading: Each member of the thesis committee will provide a PASS/FAIL vote. The student is deemed to pass or fail the exam depending on whether the majority of the votes are pass or fail, respectively.

When to File the Proposal: *The proposal must filed within 5 business days after the prelim; this is departmental policy.* Complete and print the Proposal Approval Form. **Please pre-type your information and the names of your committee members on this form before printing**. You must obtain the signatures of your committee members on this form **before** bringing to the Graduate Office. Once complete, bring the **Proposal Approval Form** and **2 hard copies of your proposal to the Graduate Office**. The 2 copies of the proposal should be *stapled separately and double-side print.* The Proposal Approval Form should NOT be stapled; please print only the first 2 pages, single-side print. The Graduate Office will send your proposal to OGAPS for approval. **Please see ecampus for detailed directions and examples on how to fill out and submit proposal forms.** **

Note: The PHD prelim exam is similar to what is called the proposal exam in some universities.

Reference the steps listed on the OGAPS website for [Prelim Exam Requirements](#) and [Doctoral Degree Requirements](#). Also, please refer to the ECEN Graduate Students ecampus page.

Graduate Courses by Area

Course #	Title	Area of Specialization	Notes
681	Seminar	All Areas	
684	Professional Internship	All Areas	
685	Directed Studies	All Areas	
689	Special Topics	All Areas	
691	Research	All Areas	
607	Advanced Analog Circuit Design Techniques	Analog and Mixed Signals	
610	Mixed-Signal Interfaces	Analog and Mixed Signals	
620	Network Theory	Analog and Mixed Signals	
622	Active Network Synthesis	Analog and Mixed Signals	
625	Millimeter-Wave Integrated Circuits	Analog and Mixed Signals	
650	High Frequency GaAs/SiGe Analog IC Design	Analog and Mixed Signals	
665	Integrated CMOS RF Circuits and Systems	Analog and Mixed Signals	
698	Analog To Digital Converters	Analog and Mixed Signals	
704	VLSI Circuit Design	Analog and Mixed Signals	stacked with 474
720	High-Speed Links Circuits and Systems	Analog and Mixed Signals	
617	Advanced Signal Processing for Medical Imaging	Biomedical Imaging & Genomic Signal Proc	
634	Morphological Methods in Image and Signal Processing	Biomedical Imaging & Genomic Signal Proc	
648	Principles of Magnetic Resonance Imaging	Biomedical Imaging & Genomic Signal Proc	
660	BioMems and Lab-on-a-Chip	Biomedical Imaging & Genomic Signal Proc	
669	Engineering Applications in Genomics	Biomedical Imaging & Genomic Signal Proc	
760	Introduction to Probabilistic Graphical Models	Biomedical Imaging & Genomic Signal Proc	
761	Biosensors Lab	Biomedical Imaging & Genomic Signal Proc	
762	Advanced Ultrasound Imaging Techniques	Biomedical Imaging & Genomic Signal Proc	
763	Magnetic Resonance Engineering	Biomedical Imaging & Genomic Signal Proc	
764	Medical Imaging	Biomedical Imaging & Genomic Signal Proc	
765	Machine Learning with Networks	Biomedical Imaging & Genomic Signal Proc	
766	Algorithms in Structural Bioinformatics	Biomedical Imaging & Genomic Signal Proc	
752	Advances in VLSI Circuit Design	Computer Engineering and Systems	
602	Computer Communication and Networking	Computer Engineering and Systems	
619	Internet Protocols and Modeling	Computer Engineering and Systems	
621	Mobile Wireless Networks	Computer Engineering and Systems	
623	Parallel Geometric Computing	Computer Engineering and Systems	
624	IC Design Tools	Computer Engineering and Systems	
627	Multimedia Systems and Networks	Computer Engineering and Systems	
651	Microprogrammed Controls of Digital Systems	Computer Engineering and Systems	
652	Switching Theory	Computer Engineering and Systems	
653	Compute Arithmetic Unit Design	Computer Engineering and Systems	
654	Very Large Scale Integrated Systems Design	Computer Engineering and Systems	
659	Parallel/Distributed Numerical Algorithms	Computer Engineering and Systems	
670	Fiber Optic Networks	Computer Engineering and Systems	
676	Advanced Computer Architecture	Computer Engineering and Systems	
680	Testing and Diagnosis of Digital Systems	Computer Engineering and Systems	
687	Introduction to VLSI Design Automation	Computer Engineering and Systems	
699	Advances in VLSI Logic Synthesis	Computer Engineering and Systems	
714	Digital Integrated Circuit Design	Computer Engineering and Systems	stacked with 454

749	Microprocessor Systems Design	Computer Engineering and Systems	stacked with 449
750	Design and Analysis of Communication Networks	Computer Engineering and Systems	
751	Computational Methods for Integrated Systems Design	Computer Engineering and Systems	
753	Theory and Applications of Network Coding	Computer Engineering and Systems	
754	Optimization for Electrical and Computer Engineering Applications	Computer Engineering and Systems	
755	Stochasitc Systems	Computer Engineering and Systems	
756	Game Theory	Computer Engineering and Systems	
757	Distributed Systems and Cloud Computing	Computer Engineering and Systems	Cross listed CSCE 678
758	Data Mining and Analysis	Computer Engineering and Systems	Cross listed CSCE 676, STAT 639
759	Hardware Security	Computer Engineering and Systems	Cross listed CYBR 630
600	Experimental Optics	Device Science and Nanotechnology	
631	Fiber Optic Devices	Device Science and Nanotechnology	
640	Thin Film Science and Technology	Device Science and Nanotechnology	
656	Physical Electronics	Device Science and Nanotechnology	
657	Quantum Electronics	Device Science and Nanotechnology	
658	Low-Noise Electronic Design	Device Science and Nanotechnology	
664	Nanotechnology Fabrication	Device Science and Nanotechnology	
671	Solid State Devices	Device Science and Nanotechnology	
672	Semiconductor Lasers and Photodetectors	Device Science and Nanotechnology	
673	Fundamentals of Microelectronics	Device Science and Nanotechnology	
674	Introduction to Quantum Computing	Device Science and Nanotechnology	
675	Integrated Optoelectronics	Device Science and Nanotechnology	
678	Statistical Optics	Device Science and Nanotechnology	
688	IC MEMS and Sensor Fabrication	Device Science and Nanotechnology	
694	Nanobiotechnology	Device Science and Nanotechnology	
696	Erbium-Dipped Amplifier: Technology and Applications	Device Science and Nanotechnology	
767	Harnessing Solar Energy: Optics, Photovoltaics and Thermal Systems	Device Science and Nanotechnology	stacked with 467
770	Organic Semiconductor	Device Science and Nanotechnology	
771	Fluctuations & Noise Electronics	Device Science and Nanotechnology	
772	Introduction to Microelectromechanical Devices and Systems	Device Science and Nanotechnology	
773	Introduction to Nanophotonics	Device Science and Nanotechnology	
777	Photonics: Fiber and Integrated Optics	Device Science and Nanotechnology	stacked with 477
611	General Theory of Electromechanical Motion Devices	Energy and Power	
612	Computer Aided Design of Electromechanical Motion Devices	Energy and Power	
613	Rectifier and Inverter Circuits	Energy and Power	
614	Power Systems State Estimation	Energy and Power	
615	Methods of Electric Power Systems Analysis	Energy and Power	
616	Power System Electromagnetic Transients	Energy and Power	
630	Analysis of Power Electronic Systems	Energy and Power	
632	Motor Drive Dynamics	Energy and Power	

643	Electric Power System Reliability	Energy and Power	
666	Power System Faults and Protective Relaying	Energy and Power	
667	Power System Stability	Energy and Power	
668	High Voltage Direct Current (HVDC) Transmission	Energy and Power	
677	Control of Electric Power Systems	Energy and Power	
679	Computer Relays for Electric Power Systems	Energy and Power	
686	Electric and Hybrid Vehicles	Energy and Power	
710	Switching Power Supplies	Energy and Power	
710	Switching Power Supplies	Energy and Power	
711	Sustainable Energy & Vehicle Engineering	Energy and Power	
712	Power Electronics for Photovoltaic Energy Systems	Energy and Power	
715	Physical and Economical Operations of Sustainable Energy Systems	Energy and Power	
738	Power Electronics for Photovoltaic Energy Systems	Energy and Power	stacked with 438
741	Electronic Motor Drives	Energy and Power	stacked with 441
742	DSP Based Electromechanical Motion Control	Energy and Power	stacked with 442
626	Antenna Theory and Technique	Electromagnetics and Microwaves	
635	Electromagnetic Theory	Electromagnetics and Microwaves	
636	Phase Arrays	Electromagnetics and Microwaves	
637	Numerical Methods in Electromagnetics	Electromagnetics and Microwaves	
638	Antennas and Propagation	Electromagnetics and Microwaves	
639	Microwave Circuits	Electromagnetics and Microwaves	
641	Microwave Solid State Integrated Circuits	Electromagnetics and Microwaves	
730	CMOS RFIC Engineering	Electromagnetics and Microwaves	
735	Electromagnetic Field Theory	Electromagnetics and Microwaves	
601	Mathematical Methods in Signal Processing	Information Science and Systems	name change
603	Time Frequency Analysis and Multirate Signal Processing	Information Science and Systems	
604	Channel Coding for Communications Systems	Information Science and Systems	
605	Linear Multivariable Systems	Information Science and Systems	name change
606	Nonlinear Control Systems	Information Science and Systems	
608	Modern Control	Information Science and Systems	
609	Adaptive Control	Information Science and Systems	
628	Robust and Optimal Control	Information Science and Systems	name change
629	Applied Convex Optimization	Information Science and Systems	name change
633	Optimum Control Systems	Information Science and Systems	
642	Digital Image Processing	Information Science and Systems	
644	Discrete-Time Systems	Information Science and Systems	
645	Pattern Recognition by Neural Networks	Information Science and Systems	
646	Statistical Communication Theory (Probability and Random Processes for Information Science)	Information Science and Systems	name change
647	Information Theory	Information Science and Systems	
649	Pattern Recognition	Information Science and Systems	
655	Advanced Topic in Channel Coding	Information Science and Systems	
661	Modulation Theory (Advanced Digital Communications)	Information Science and Systems	name change
662	Estimation and Detection Theory	Information Science and Systems	

663	Data Compression with Applications to Speech and Video	Information Science and Systems	
682	Spread Spectrum and CDMA	Information Science and Systems	
683	Wireless Communication Systems	Information Science and Systems	

Graduate Course Descriptions

For current graduate course listings, please visit
http://catalog.tamu.edu/graduate/course-descriptions/ecen/

Undergraduate Course Descriptions

For current undergraduate course listings, please visit
http://catalog.tamu.edu/undergraduate/course-descriptions/ecen/