Graduate Student Handbook

Revision Date: 27 January 2020
Foreword

The Department of Electrical Engineering and Computer Science (EECS) at the University of Toledo offers graduate programs leading to the Master of Science in Electrical Engineering (MSEE), the Master of Science in Engineering with concentration in Computer Science and Engineering (MSE), and the Doctor of Philosophy (Ph.D.) in Engineering Science degrees with concentrations in Electrical Engineering or Computer Science and Engineering. The research focus of the Department faculty is in the areas of:

- High Performance Computing Systems (HPCS)
- Software and Intelligent Systems (SIS)
- Communication and Signal Processing (CSP)
- Power Electronics and Energy Systems (PEES)
- Solid-State and RF Devices and Systems (SRDS)

This handbook describes the graduate programs of the Department. It also outlines a number of procedures for graduate students and states various departmental rules and regulations.

The information provided in this handbook is intended as a supplement to, and not a substitute for, the College of Graduate Studies (COGS) Catalog and other document of the University of Toledo. The COGS Catalog contains general rules and regulations governing the University’s graduate programs. The department web site is [https://www.utoledo.edu/engineering/electrical-engineering-computer-science/](https://www.utoledo.edu/engineering/electrical-engineering-computer-science/), and the COGS home page is at [https://www.utoledo.edu/graduate/](https://www.utoledo.edu/graduate/).

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1 The policies and guidelines contained in this handbook are provided for general guidance and are subject to change by the department. Students are encouraged to consult their academic advisors and the Graduate Program Director for clarification of any issues. (Revised: 27 January 2020)
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1. ACADEMIC AND RESEARCH PROGRAMS

The faculty of the EECS Department participate in five academic and research focus groups. Research activities of faculty often overlap across multiple focus groups, and therefore several faculty members participate in more than one focus group. Each focus group may offer a set of core courses (which every student in that focus group is expected to take) and another set of recommended courses. Recommended courses are to be selected by the student in consultation with their advisor to complete the course requirements for the degree. The graduate curriculum, to the degree possible, provides depth as well as breadth in the plan of study for all graduate students.

For a more information, please see the sections addressing M.S. and Ph.D. academic requirements later in this handbook.

Students majoring in Computer Science & Engineering (CSE) may choose from the following focus groups:

- High Performance Computing Systems (HPCS)
- Software and Intelligent Systems (SIS)

Students majoring in Electrical Engineering (EE) may choose from the following focus groups:

- Communication, Controls and Signal Processing (CCSP)
- Power Electronics and Energy Systems (PEES)
- Solid State and RF Devices and Systems (SRDS)

*Please note that students pursuing EE areas will receive an M.S. degree in Electrical Engineering; those pursuing CSE areas will receive an M.S. degree in Engineering Science (with concentration in Computer Science and Engineering).

Changing focus groups is not recommended; however, those students wishing to change their focus group to another within their major must complete a "Request for Change of Focus Group" form, available from the Academic Program Coordinators.

Students wishing to change their focus group to one within another major must re-apply for that major with through COGS.
1.1 HIGH PERFORMANCE COMPUTING SYSTEMS (HPCS)

Members: Mohammed Niamat (Group Leader), Devinder Kaur, and Ahmad Y. Javaid

Research concentration areas for the members of this focus group entail high performance computing, Information visualization, cybersecurity, cyber physical systems and security, information systems and services, system software for parallel computing, scalable system architecture, reliable computing, FPGAs, VLSI Design, and Fault Tolerance.

Further research in the HPCS group focuses on computing from both the programming language and the computer architecture viewpoints; computational complexity; quantum computing; design of both software and hardware; distributed systems; databases; fault tolerance and reliability; performance modeling of computer and communication networks; adaptive scheduling, resource reservation protocols, and routing protocols; cybersecurity; algorithms; information systems; cellular and high-performance computing; theoretical foundations and advanced analysis for real-time, hybrid and embedded systems.

Students specializing in the HPCS area are advised to select core and recommended courses from the following list in consultation with their advisors.

Suggested List of Core and Recommended Courses:

- EECS 6/8110: Advanced Computer Architecture
- EECS 6/8550: Software Specification and Design
- EECS 5330: Image Analysis and Computer Vision
- EECS 6/8320 Data Compression for Multimedia Communication
- EECS 6/8660: Field Programmable Gate Arrays
- EECS 6/8980: Hardware Oriented Security and Trust
- EECS 6/8980: Testing of Digital Circuits (Reliable Computing)
- EECS 5720: Fundamentals of Cybersecurity
- EECS 5760: Computer Security

Students may also choose other EECS courses not listed above as recommended courses in consultation with their advisors. In exceptional cases, recommended courses may be taken from other departments such as Mathematics and Physics. The faculty advisor must approve such courses in advance.

Faculty Research Interests:

Dr. Mohammed Niamat’s research is in the area of hardware-oriented security and trust; reconfigurable processors including field programmable gate arrays; reliable computing including testing of digital, reconfigurable, system on chip (SOC) and VLSI circuits; built in self-test (BIST); fault modeling; parallel processing; hardware implementation of algorithms; and applications of blockchain and machine learning.
Dr. Devinder Kaur’s research is in the areas of computer architecture, parallel and distributed processing, intelligent systems based on fuzzy logic, neural networks and bio-inspired algorithms.

Dr. Ahmad Y. Javaid’s research is in the areas of cybersecurity of drone networks, smartphones, wireless sensor networks, and other cyber-physical systems. He is also conducting extensive research on human-machine teams and applications of AI and machine learning to areas including but not limited to attack detection and mitigation.

1.2 SOFTWARE AND INTELLIGENT SYSTEMS (SIS)

Members: Kevin Xu (Group Leader), Devinder Kaur, Gursel Serpen, Gerald Heuring, and Lawrence Thomas.

Intelligent systems embody inquiries into artificial and computational intelligence fields. The Intelligent Systems (IS) faculty conducts research in several areas. Faculty research interests span fields of artificial intelligence, machine learning, artificial neural networks, data mining, fuzzy logic and reasoning, and hybrid algorithms.

Research in Intelligent Systems focuses on design and development of software applications for optimization, biomedical informatics, computer security, image interpretation, intrusion detection and access control in computing systems, medical image interpretation and hybrid reasoning systems for diagnosis, development of novel neural network algorithms for optimization, data mining in databases for knowledge modeling and extraction, development of novel ensemble machine learning algorithms, evolutionary computation-based hybrid techniques for knowledge extraction, empirical process intelligent control and databases, logic reasoning with applications in cognitive wireless sensor networks, development of cognitive software for management and control of various aspects of wireless sensor networks, and mathematical aspects related to intelligent systems such as probabilistic modeling and statistical inference for large, high-dimensional, and structured data.

Students specializing in the SIS area are advised to select suggested relevant core and recommended elective courses from the following lists in consultation with their advisors.

Recommended Software Systems Core
- EECS 6/8110: Advanced Computer Architecture
- EECS 5530: Computer Graphics
- EECS 5560: Database Systems Management
- EECS 5760: Computer Security

Recommended Intelligent Systems Core
- EECS 5740: Artificial Intelligence
Recommended Elective Courses

- EECS 5980: Special Topics: Social and Information Networks
- EECS 6/8980: Special Topics: Probabilistic Methods in Data Science
- EECS 6/8980: Special Topics: Wireless Sensor Networks
- EECS 5330: Image Analysis and Computer Vision
- EECS 5390: Wireless and Mobile Networks
- EECS 6/8300: Random Signals and Optimal Filters

Students may also choose other EECS courses not listed above as recommended courses in consultation with their advisors. In exceptional cases, recommended courses may be taken from the MIME, BIOE, Physics and Mathematics departments. Such courses must be approved in advance by the faculty advisor.

Faculty Research Interests:

**Dr. Devinder Kaur**’s research is in the areas of computer architecture, parallel and distributed processing, intelligent systems based on fuzzy logic, neural networks and bio-inspired algorithms.

**Dr. Gerald Heuring**’s research is in the areas of computer graphics and operating systems.

**Dr. Gursel Serpen**’s research is in the areas of artificial intelligence and machine learning, and their applications in adaptation and automation, sensor networks, optimization, cyber security, bio-medical informatics, and legal reasoning.

**Dr. Lawrence Thomas**’s research is in the area of software engineering and computer security.

**Dr. Kevin Xu**’s research is in the areas of machine learning and statistical signal processing with applications to network science, human dynamics, and health.

The research in this research group has been funded by the NSF, NIH, NGA, AFOSR, the Ohio Federal Research Network, University of Toledo, and industry partners.
1.3 COMMUNICATION, CONTROL AND IMAGE PROCESSING (CCIP)

Members: Junghwan Kim (Group Leader), Richard Molyet, and Ezzatollah Salari

The research in the Communication, Control and Image Processing focus group involves a wide variety of topics such as mobile wireless sensor network, satellite communication, process control, real-time control, optimal control, pattern recognition, neural networks, machine learning, image processing and biomedical applications.

The research in communication systems involves modeling, simulation and performance analysis of communication systems, mobile/satellite system architecture, and network and payload design. Work also involves on tactical communication network, digital video/audio/multimedia broadcasting, advanced channel coding using FEC codes including turbo code and LDPC codes.

The research in control focuses on control of autonomous vehicles, smart grid systems, dc power systems, and biomedical processes.

The research in pattern recognition & neural networks, machine learning and image processing mainly focuses on exploring advanced pattern recognition and machine learning techniques for a variety of image processing applications. Current focus is on the use of convolutional neural network, deep learning, generative models, GANs, SVM and random forests mainly for biomedical images. Also, a variety of advanced techniques for Image fusion, tracking of objects in a video, and data compression have been developed.

Students specializing in the CCIP area are advised to select courses from the following list in consultation with their advisors.

Suggested List of Core and Recommended Courses:

- EECS 6/8300: Random Signals and Optimal Filters
- EECS 6/8340: Modern Communications I
- EECS 6/8350: Modern Communications II
- EECS 6/8390: Modeling and Performance of Communication Networks
- EECS 4/5370: Information Theory and coding
- EECS 4/5390: Wireless and Mobile Networks
- EECS 6200/8200: Digital Control Systems
- EECS 6220/8220: Nonlinear Control Systems
- EECS 6230/8230: Optimal Control Theory
EECS 4/5330: Image Analysis and Computer Vision
EECS 4/5380: Digital signal Processing
EECS 6/8370: Pattern Recognition & Neural Nets
EECS 6/8320: Data Compression for Multimedia Communication
EECS 4/5750: Machine learning

Students may also choose other EECS courses not listed above in consultation with their advisors. In exceptional cases, courses may be taken from the Physics and Mathematics departments. Such courses must be approved in advance by the Advisor.

Faculty research interests:

Dr. Junghwan Kim’s research is in the areas of modeling and performance analysis of on-board processing satellite system and its architecture, anti-jamming techniques and spread spectrum system, cellular and mobile wireless network, advanced channel coding, multimedia broadcasting and physical layer (PHY)–based encryption.

Dr. Richard Molyet’s research is in the areas of modeling and control of autonomous vehicle collision avoidance, control and performance evaluation of smart grid systems using SMES storage, control of shipboard dc power systems, and modeling and control of biomedical processes such as human kidney function.

Dr. Ezzatollah Salari’s current research is in the areas of pattern recognition, neural networks, and machine learning involving convolutional neural network, deep learning, generative models, GANs, SVM and random forests in a variety of image processing applications.

1.4 POWER ELECTRONICS AND ENERGY SYSTEMS (PEES)

Members: Raghav Khanna (Group Leader), Daniel Georgiev, Ahmad Javaid, and Richard Molyet

Climate change effects and the resulting demand for clean energy have led to significant technological advancements in the areas of power systems, control, power electronics, and semiconductor devices. Integrated together, these disparate topics of varying levels of abstraction can lead to substantial improvements in the efficacy of renewable energy systems, the smart grid, transportation electrification systems, and electronic devices. Consequently, specific areas of interest for this focus group include power converter design and operation, semiconductor device modeling and characterization, utilization of energy storage devices for grid-related harmonic mitigation, stability analysis of the smart grid, cybersecurity of the smart grid, and advanced strategies for renewable energy integration.
Recent externally funded research projects have been sponsored by the US Department of Defense, US Department of Energy, and NASA Jet Propulsion Laboratory with objectives related to power electronic device modeling, converter design, and improved integration of solar technology. Even more recently, a research grant has been allocated from Lawrence Livermore National Laboratory related to analysis of cybersecurity threats to the smart grid.

Students specializing in the PEES area are advised to select core and recommended courses from the following list in consultation with their advisors.

Suggested List of Core and Recommended Courses:

- EECS 5240: Power Systems Operation
- EECS 5460: Power System Management (online only)
- EECS 5480: Power Electronics 1
- EECS 6540: Advanced Power Electronics
- EECS 5260: Control Systems Design
- EECS 6980: Feedback Control Systems
- EECS 5720: Fundamentals of Cybersecurity
- EECS 6980: Compound Semiconductor Devices

Students may also choose other EECS courses not listed above as recommended courses in consultation with their advisors. In exceptional cases, recommended courses may be taken from the Physics and Mathematics departments. Such courses must be approved in advance by the advisor.

Dr. Raghav Khanna’s research is in the areas of modeling and characterization of wide bandgap semiconductors for improved performance of next generation power electronic circuits, and in renewable energy integration.

Dr. Daniel Georgiev’s research is in the areas of materials for photovoltaics, compound semiconductor devices for power electronic applications, and vacuum microelectronics.

Dr. Ahmad Javaid’s research is in the area of cybersecurity of drone networks, smart grid networks, smartphones, wireless sensor networks, and other systems.

Dr. Richard Molyet’s research is in the area of optimal and feedback control, as well as the use of energy storage devices for grid-related harmonic mitigation.
1.5 SOLID-STATE AND RF DEVICES AND SYSTEMS (SRDS)

**Members:** Daniel Georgiev (Group Leader), Abbas Semnani, Raghav Khanna, and Anthony Johnson

The research of the SRDS group focuses on a blend of electrical engineering and applied/engineering physics topics that exploit electromagnetics, photonics, plasma and semiconductor basics, as well as atomic and molecular scale phenomena in developing next generation of solid-state materials and devices, plasma-based devices and systems, and microwave and RF electronics. The research targets the growing demand for renewable/alternative energy, electrical energy conversion and storage, reconfigurable devices and systems for emerging wireless applications and communications, photovoltaics, solid-state lighting, sensors, low-power electronics, and harsh environments capable electronics. The SRDS group aims to foster research leading to the development of commercially viable products, patents, user-friendly CAD tools, significant publications in high-quality conferences and journals, and securing external research funding from various resources.

Current and past SRDS research projects have been funded by NSF, NASA, OFRN, DOD, DOE as well as industry sources.

Students specializing in the SRDS area are advised to select core and recommended courses from the following list in consultation with their advisors.

**Suggested List of Core and Recommended Courses:**

- EECS 5410: Electro-Optics
- EECS 6/8980-012: Compound Semiconductors and Devices
- EECS 6/8980-002: Low Temperature Plasma in Engineering and Science
- EECS 5480: Power Electronics 1
- EECS 5490: Electronics Energy Processing II
- EECS 5330: Image Analysis and Computer Vision
- EECS 6/8540: Advanced Power Electronics
- EECS 5420: Microwave electronics

With the approval with their advisor, students may also choose as recommended courses other EECS courses not listed above, or courses from other engineering departments as well as non-engineering departments such as Mathematics, Physics and Astronomy, Chemistry, or Medical Physics. Such courses must be approved in advance by the faculty advisor.
Faculty Research Interests:

Dr. Daniel Georgiev’s research interests are in the areas of electronic materials and device fabrication, laser processing of materials, glassy semiconductors, magnetic materials, and device modeling.

Dr. Abbas Semnani’s research interests are in the areas of low-temperature plasma and plasma metamaterials, tunable antenna arrays, reconfigurable RF electronics, applied and computational electromagnetics, high-power microwaves, inverse scattering, RF nanotechnology and plasma physics.

Dr. Raghav Khanna’s research interests are in the areas of modeling and characterization of wide bandgap semiconductors for improved performance of next generation power electronic circuits, and in renewable energy integration.

Dr. Anthony Johnson’s research interests are in the areas of VLSI and ASIC system design.
2. REGISTRATION

Course registration can be done online through the student’s UT account. It is strongly recommended that course registration is done as early as possible, much before the semester begins. The Graduate Program Director (or the focus group representative) can serve as the faculty advisor of new students until a permanent advisor is chosen. A Plan of Study (PoS) should be prepared and submitted as soon as possible but no later than the end of the first regular semester of the student’s studies.

Changes in the student’s PoS may be requested by submitting a Plan of Study Course Substitution Form or an amended PoS form. It is the responsibility of the student to ensure that required courses in the program are taken.

2.1 FINANCIAL SUPPORT

Students with Research Assistantships (RA) or Graduate/Teaching Assistantships (GA/TA) are expected to meet certain research objectives. RAs are supported by faculty research grants and are expected to work with the respective faculty and to help meet their research goals and expectations. GAs/TAs are supported by the department and they are assigned twenty hours of teaching/grading duties every semester. GAs/TAs are expected to meet the goals set by the department and faculty advisor(s) in terms of research output.

2.2 FULL-TIME STATUS

Full-time graduate students supported by the Department must register for a minimum of 9 graduate credit hours each semester including projects, independent study, research and thesis. Self-supporting full-time international students must complete a minimum of 9 hours each term. Courses taken on an audit basis are excluded from this number.

Students with Research Assistantships (RA), Graduate Assistantships (GA), University Fellowships (UF), Tuition Scholarships (TS) and any other financial assistance from general funds must maintain full-time status, exclusive of audit hours. If a supported student falls below the required minimum (9 credits) registration through course withdrawals during any term, he or she will be liable for the tuition for that term. Registering for credit hours in excess of the limit for a given type of financial support (e.g., 9 cr.h.) may need to be covered by the student or may result in financial penalties.

First-year students receiving financial support from the Department must register for three regular courses (a minimum of 9 hours total) per semester during each semester of the first year plus research or other hours to meet full-time registration requirements. The three course/9-credit load requirement is exclusive of independent study, research, thesis, etc.
2.3 PART-TIME STATUS

To maintain an active degree program status, students are required to register for at least one credit each term. Part-time students are expected to take at least one course per term or register for thesis or dissertation work in order to complete the degree program within a reasonable time. Exceptions may be granted for such reasons as illness, maternity leave or travel requirements imposed by employers.

2.4 EXCESSIVE CREDIT HOURS

According to State of Ohio and University rules, there is a maximum number of credit hours that graduate students can earn while still being eligible for financial support from general funds. Graduate students who remain in their program for longer time than the average (or longer than their expected graduation date), and earn more credit hours that the minimum required towards their degree, should be aware of the above limit and should check with COGS.

2.5 COURSE REGISTRATION REGULATIONS

Changes in the registration can be made online through the student’s account. Some courses (such as thesis/dissertation research, independent research, independent study), as well as registration/adding after the first week of the semester, require registration override/permission by the instructor for the course. Such overrides must be requested from the instructor in advance. Courses cannot be added after the 15th calendar day of the semester.

Permission to audit a course is at the discretion of the instructor of the course, who is not obligated to accept a student for audit. Audit course credits do not count towards degree requirements. Audit hours also do not count toward the maximum number of allowed credit hours (see section 2.4) for university funded financial assistance and they do not count toward full-time status. Audit credit hours do, however, require payment of tuition. No more than three courses can be taken on an audit basis.

2.6 RESEARCH COURSES

EECS 6900(M.S)/8900(Ph.D): Independent Research
Both Masters (6900) and Doctoral (8900) students may register for research hours up to the maximum allowable for each semester. Such research hours may be used to explore research topics for a thesis or dissertation. An example for a master’s degree student would be EECS 6900:0XY - 3 hours, where 0XY is the identification number (or section) of the advisor. For a doctoral student an example is EECS 8900:0XY - 2 hours. Type of grade: S or U.
EECS 6960: Master’s Graduate Research and Thesis
A total of 9 hours of the 30 required for a master’s degree (thesis option) may be used for the thesis. An example for a master’s degree student would be EECS 6960:0XY - 3 hours, where OXY is the identification number (or section) of the advisor. Type of grade: S or U.

EECS 8960 (Ph.D): Dissertation
An example dissertation registration for a Ph.D. candidate would be EECS 8960:0XY - 3 hours, where OXY is the identification number of the advisor. Type of grade: S or U.

EECS 6990(M.S)/8990 (Ph.D): Independent Study
Independent study is defined as individualized study under the direction of an EECS faculty member, and is distinct from thesis or dissertation research. A maximum of 3 credits of independent study may be counted toward the M.S. degree course work requirements; an additional 6 credits may be counted toward the doctoral degree course work requirement. This course number is not to be used for thesis/dissertation research. Type of grade: letter grade.

EECS 5920: M.S Projects
6 hours of the 30 required for a master’s degree (project option) may be used for the project. Type of grade: S or U.

A self-supported student working only on thesis or dissertation and using University resources must register for a minimum of 1 credit hour each term in order to have an active status in the program.
3. GENERAL INFORMATION

3.1 RESPONSIBILITIES OF GRADUATE STUDENTS

- Maintain a cumulative GPA of at least 3.0 with no less than C grade for any course in the Plan of Study
- Comply with University, College, and Departmental regulations.
- Complete and submit the appropriate forms.
- Keep the EECS department office updated regarding current address, phone number, and e-mail addresses.

3.2 COMPLETION OF STUDENT RESEARCH

It is expected that the research and the resulting thesis or dissertation will be completed while the student is in full-time residence. This is especially to be expected of those students who have received support (GA, TA, RA, or TS). Departure before final acceptance of the thesis or dissertation generally results in long delays before completion, in some cases so long that the work has been superseded by the work of others and may no longer be considered acceptable and meeting the requirements. International students must maintain full-time status and remain in residence until all requirements for the degree are met.

In those instances where unusual circumstances exist and the student wishes to complete his or her degree while no longer in residence, the student must provide adequate justification and secure written concurrence in advance by both the advisor and the Graduate Program Director. The student and the advisor must also agree on a schedule for completing the degree. Failure to do so can result in resignation of the advisor and/or the student being considered as withdrawn from the program.

3.3 GRADE REQUIREMENTS FOR GRADUATION

All regular (i.e., non-research) course work which is to be counted towards the M.S. or Ph.D. degree, must be taken for a letter grade (A, A-, B+, etc.), and cannot be taken on Pass/Fail, S/U, or audit basis. A letter grade of C- or below is not acceptable for graduate credit, although such grades are included in the computation of the grade point average. All research courses (see section 2.6) must be taken with a grade S (using only S or U type of grades) in order to be counted towards the degree. Independent study is graded with a letter grade (A, A-, B+, etc.).
In order to be awarded the master’s or the doctoral degree, the student must have a grade point average (GPA) of at least 3.00/4.00 (B average) for all credits (course work and thesis research) in his or her program of study. Grades earned in courses which are repeated are included in the computation of the GPA.

If a grade of incomplete (IN) or progress (PR) is received, the student must remove the IN or the PR grade from the record as soon as possible. After one semester, the IN grade automatically changes to an F (failure). No student may graduate with an IN or PR on their record.

3.4 CONTINUATION AND DISMISSAL

A student may continue their studies in the EECS Department as long as reasonable progress is being made toward the degree. From an academic viewpoint, this means that the student’s record in graduate course work, exclusive of thesis or dissertation research, continues to exhibit an average of B or better with an appropriate distribution of A, B, and C grades, and that IN and PR grades appear only infrequently and for a good cause.

Academic dishonesty and misconduct will be dealt with according to the current University policies. The process involves the course instructor and may require the department and the college intervention; the consequences may be as severe as expulsion of the student from the graduate program and the university.

3.5 FACILITIES AND STUDENT SERVICES

Graduate students can use their university account for academic use of computers, computer networks and access to the Internet, as well as servers or mainframe computers operated by the University Computer Center or Engineering College Computing office. In some cases, an approval by the department chair may be required. The University has an excellent central library facility (Carlson Library). Graduate students may reserve a carrel in the library, if available, for study purposes.

Keys or cards for access to departmental areas are assigned on a discretionary, as-needed basis. All keys must be returned to the Key Control Office at the end of each academic year and prior to leaving the University. A cash deposit is required by the university for each key authorized. Deposits are returned when the Key Control Office confirms that a key has been returned. In addition, grades, transcripts, and final paychecks will be withheld from individuals who have not returned keys.

Computer accessories and supplies, laser printing, copying, and similar items are the students’ responsibility and will not be furnished by the department.
The Graduate Student Association (GSA) is available to assist and serve graduate students in many ways. Their offices are located in the Student Union. For a list of the services or assistance GSA has available, please contact the GSA office.
4. MASTER OF SCIENCE DEGREE REQUIREMENTS

4.1 BASIC REQUIREMENTS

The Master of Science Degree is offered with the following options.

1. **Master of Science Degree with Thesis Option**: A minimum of 30 credit hours of approved graduate study including 9 credit hours of Master of Science Thesis under the supervision of an EECS faculty member is required. Students are required to successfully complete the oral defense of the thesis work, submit typed copies of their thesis to the Graduate School and the department (see Section 4.6).

2. **Master of Science Degree with Non-Thesis Options**: The degree requirements for Master of Science with Non-Thesis option are available with the approval of the Department Chair or the Department Graduate Program Director:

   a. **Master of Science Degree with Project Option**: Students are required to complete 30 credit hours of an approved graduate study including 6 hours of Master of Science Project as specified by individual department guidelines and requirements. Students are required to submit a bound, typed Project Report to the department approved by a committee consisting by the student’s advisor and another faculty member.

   b. **Master of Science Degree with Coursework-only Option**: Students are required to complete a minimum of 30 credit hours of approved graduate-level course work.

All students must complete the following additional requirements:

- Take core and recommended courses in the focus group in consultation with their advisor.
- Courses taken from other focus groups must have advanced approval of their advisor.
- Submit a Plan of Study and obtain its approval.
- Take a minimum of 18 hours of EECS courses (including thesis/project and independent study).
- Take at least 6 hours of EECS courses at the 6000 level excluding thesis, independent study, and (independent) research courses.
- Take the EECS 5930 Graduate Seminar course (which counts towards the required 30 hours for the program).
- Be enrolled in a minimum of one credit hour in the semester of graduation.
- Submit at least one peer-reviewed journal manuscript (if pursuing thesis option) or one conference paper (if pursuing project option).
Note: All M.S. students in the EECS Department are encouraged to pursue a thesis option; however, students with Graduate/Teaching/Research Assistantships are required to choose the thesis option.

Students are encouraged to include higher-level math courses in their program, subject to approval of their advisors. Courses taken on an audit basis do not count toward the degree. Courses outside the College of Engineering require prior approval by the faculty advisor, and the EECS Graduate Program Director or the EECS Department Chair.

In order to be awarded the Master of Science degree, the student must have at least a B average (GPA of 3.0/4.0) for all graduate course credits in his or her program of study as well as for his or her entire graduate transcript.

4.2 PLAN OF STUDY

The student must, in conjunction with his/her faculty advisor, prepare a coherent Plan of Study that includes a majority of courses from the focus area with which the student is associated. The Plan of Study must be approved by the faculty advisor, EECS Graduate Program Director, the Associate Dean of Graduate Studies, and the College of Graduate Studies (COGS).

Any changes in the student’s Plan of Study must be submitted in as an amendment of the Plan of Study Form and approved by the EECS Graduate Program Director, the Associate Dean of Graduate Studies, and COGS.

4.3 TIME LIMIT

The M.S. degree may be pursued on a full or part-time basis. However, each student must complete all requirements for the M.S. degree no later than 6 years from the date of first graduate registration in the EECS Department, unless a petition for extension has been approved by the faculty advisor, EECS Graduate Director, and COGS.

4.4 FORMATION OF THESIS COMMITTEE

After the student has chosen his or her permanent advisor, a thesis committee is formed (for those students pursuing thesis option) and approved by the EECS Graduate Program Director in consultation with the thesis advisor and the student. The M.S. thesis committee shall be composed of a minimum of three members (having a majority of EECS faculty), one of whom should be from the student’s focus area. The thesis advisor and any co-advisor must be full-time members of the EECS faculty as well as a full member of the UT Graduate Faculty.
4.5 THESIS SUBMISSION, DEFENSE, AND ACCEPTANCE

A final draft of the M.S. thesis is prepared by the student when research is completed to the satisfaction of the faculty advisor. The student must follow the thesis preparation requirements by UT’s COGS. The draft thesis should be submitted to the advisor for critical review and evaluation. This should be done in a timely manner, giving the advisor sufficient time to review the final draft. After the thesis advisor has reviewed the thesis draft, recommended changes, and approved the final text and form of the document, the student should submit copies to the thesis committee for evaluation. The thesis committee members should have at least one week for review of the document before the defense. All members of the thesis committee are expected to be present at the thesis defense.

The student, in consultation with the thesis advisor and the committee, schedules the thesis defense. The thesis advisor will counsel the student regarding specific topics to be addressed at the defense. The defense is public, presented in an open (announced at least a week in advance of the scheduled date) presided over by the thesis advisor. The student is allowed approximately 40 minutes for a formal oral presentation. Following the oral presentation, the thesis committee, other faculty, students, and guests are allowed to ask questions concerning the student’s thesis work. After the question and discussion period is concluded, all those present, other than the faculty members constituting the committee, will be excused.

The thesis committee holds a private discussion of the student’s thesis and makes a final decision by a majority vote whether the student’s defense has been successful. If the student does not pass the thesis defense, then the thesis committee, in consultation with the Graduate Program Director, will decide a course of action to correct deficiencies, weaknesses, or other problems.

Changes of the thesis draft that are recommended by the committee are made by the student in consultation with the faculty advisor and any concerned committee members. The student should also be aware that COGS requires final corrected copies to be submitted by a specified date, if a student is to graduate in that term.

After a successful defense and completion of any corrections, the committee signs a thesis approval page and forwards it to the Graduate Program Director.

The thesis must be uploaded to the Ohio Library and Information Network (OhioLINK) following a review and approval by COGS.
4.6 GRADUATION

Students must formally apply for graduation in the semester they will complete their degree requirements online within the deadlines as stated on the COGS website.

There is no formal ceremony for Summer graduates. Students who will be completing their degrees in the Summer will be recognized if they apply for the Spring commencement. Otherwise, they will be recognized in the Fall commencement ceremony.

4.7 PART-TIME GRADUATE STUDIES

Admission to the program and requirements for the M.S. degree are identical to that for admission to the regular full-time program.
5. DOCTOR OF PHILOSOPHY DEGREE REQUIREMENTS

The Doctor of Philosophy degree is conferred on the basis of extended study and high scholarly attainment in the field of electrical engineering, computer engineering or computer science. The requirements for the Ph.D. degree are as follows:

- Complete a minimum of 60 semester credits beyond the M.S. degree or a minimum of 90 semester credits beyond the B.S. degree.
- Complete at least 45 semester credits of graduate-level course work beyond the B.S. degree of which the credit allowance for the master’s degree will not exceed 30 semester credit hours.
- Take courses associated with the focus group in consultation with their advisor.
- Obtain an approval in advance if taking courses outside the list of courses associated with the student’s focus group.
- Take no more than 3 semester credits of Independent Study for students with M.S. degree and no more than 6 semester credits of Independent Study for direct-route Ph.D. students (i.e., with a bachelor’s degree only) to be counted toward the Ph.D. course requirement.
- Pursue, complete and publish a research study (a dissertation) which is demonstrated to be an original contribution to the student’s field of study.
- Successfully defend the dissertation research in a public defense.
- Submit a minimum of 2 peer-reviewed journal paper manuscripts or equivalent publications, which are based on the dissertation research, and have at least one of these publications accepted before the dissertation defense. Equivalent publications can be conference publications from high-quality, highly selective conferences (evidence for this must be submitted to the Graduate Program Director) or accepted patent applications. Copies of the official letters of acknowledgments for the submitted/accepted papers should be submitted to the department as part of the required paperwork.
- Complete the seminar course EECS 5930.

It is the responsibility of both the student and the faculty advisor to formulate a program of study to meet the objectives and needs of the student and to satisfy the requirements for the Ph.D. degree. The student’s program of study should contain both breadth of knowledge and depth of specialization in at least one of the focus areas outlined earlier. The program of study must be approved by the faculty advisor, advisory committee, the Graduate Program Director, and COGS.
Note: The doctoral program is normally a full-time program throughout both course work and the dissertation. The department does not encourage part-time students in the Ph.D. program.

5.1 FORMATION OF THE ADVISORY COMMITTEE

After a student has selected their advisor, a Ph.D. advisory committee will need to be formed by the advisor in consultation with the Graduate Program Director and the student. The Ph.D. committee is composed of a minimum of five graduate faculty members, at least one of whom must be outside the focus area and at least one must be from outside the EECS Department. It is strongly recommended that the rest of the committee members be from the student’s focus group.

The advisor chairs the committee. The chairperson or co-chairperson must be a full-time faculty member with appointment in the EECS Department and a full member of the UT Graduate Faculty (or must have a graduate faculty status that permits serving as an advisory committee chair). The responsibilities of the committee include:

- Assist the student in developing a Doctoral Program Proposal.
- Review and approve the student’s qualifying examination parts as well as evaluate the student’s examination performance.
- Evaluate the student’s dissertation research proposal, its presentation and defense.
- Advise and assist the student in the dissertation research.
- Evaluate the Ph.D. written dissertation.
- Participate in the decision on the approval of the final defense of the dissertation.

5.2 DOCTORAL QUALIFYING EXAMINATION

Objective: The objective of the Ph.D. Qualifying Examination (QE) is to assess the student’s potential for successfully completing doctoral level studies and research in the program.

Qualifying Examination Format:

The student will be tested on four courses, chosen by the student advisor: two based on the core courses of the focus group; and two based on the recommended list in the student’s focus group. The courses will all be at the graduate level (5000 or higher level), with at least 3 courses at the 6000/8000 level. The examination will be of the open-book closed-notes format. If other materials (excluding student’s notes) are allowed, those need to be explicitly stated on the exam sheets and approved by the EECS Graduate Committee as part of the examination approval process.

The examination will be given in two written parts. The first part will be in the morning and will be based on the core courses with a duration of 3 hours (90 min per course). The
second part of the examination will be in the afternoon of the same day, it will be based on the two recommended courses, and will also last 3 hours (90 min per course).

The student’s advisor will work with the corresponding course instructors to prepare the examination parts. The examination parts will then have to be approved by the advisory committee and the Graduate Committee.

The Graduate Program Director, with the help of the Graduate Committee, will coordinate and administer the examination.

**Timing**

Direct route Ph.D. students (i.e., students who do not have a master’s degree and are admitted “directly” to the Ph.D. program with bachelor’s degrees) must take the QE *after they complete three or four regular semesters of PhD studies, but no later than the end of their fifth regular semester*. Regular semesters are the Spring and the Fall semesters but not the Summer semester. Ph.D. students with a master’s degree must take the QE *after they complete their second, or third semester, but no later than the end of their fourth semester*.

The Graduate Program Director will announce the date for the QE in advance and the examinations will be scheduled early in each regular semester (either in the second or in the third week of the semester).

A student in the Ph.D. program can take the examination up to two times and must pass it within the first 3 years after entering the Ph.D. Program. If a student fails the QE in their first attempt, a second opportunity to take it is not automatic and can be granted upon consideration and approval by the advisory committee and the Graduate Committee. If a second opportunity to take the exam is granted, the student must re-take the QE in the next offering and in the next regular semester.

**Evaluation**

The student’s advisory committee will review the results of the QE and, based on the student’s performance, will make one of the following recommendations to the Graduate Committee:

1. The student passes the QE unconditionally and proceeds onto the dissertation.
2. The student fails the examination and is found lacking the potential for a doctoral study. The student will not be allowed to continue in the Ph. D. program.
3. The student fails the examination but is deemed to have the potential for doctoral work. The student is directed to retake the entire exam for a second time. This is only an option on the first attempt at the qualifying examination.
4. The student passes the examination with some deficiencies (conditional pass). The student is directed to complete additional work (this would typically be course work) prescribed by the advisory committee with a clear scope, deadline, and deliverables.
This decision and the parameters of the additional work must be clearly communicated to the Graduate Committee. The additional work is evaluated by the advisory committee and a final recommendation of type 1, 2, or 3 above is submitted to the Graduate Committee.

Based on the recommendation of the student’s advisory committee and the result of the examination, the Graduate Committee will make the final decision and the Graduate Program Director will inform the student about the outcome of their examination.

**Appeals**

A student may request a review of the graded Ph. D. Qualifying Examination in writing to the Graduate Program Director. The student should specify the reasons for the appeal. The student’s advisory committee will then review the grading and provide a recommendation to the Graduate Committee for a final decision.

**5.3 ADMISSION TO DOCTORAL CANDIDACY**

Doctoral students are admitted to doctoral candidacy upon passing the Ph.D. Qualifying Examination and applying for doctoral candidacy by filing the “Application for Candidacy” form available through COGS. COGS reviews the application and formally notifies the student of admission to candidacy.

**5.4 DISSERTATION PROPOSAL DEFENSE**

**Objective:** The Ph.D. proposal defense is a review and evaluation of the student’s Ph.D. research project in terms of scientific and technical merits, scope, feasibility and any other relevant criteria. The content and the style of the dissertation proposal presentation and the student’s ability to communicate clearly their current work, the plan for future work, and the satisfaction of any expectations/deliverables are considered as well.

**Schedule:** The PhD student must present their dissertation proposal as soon as possible after passing the Ph.D. Qualifying Examination and typically within one year of it. The Ph.D. dissertation defense can be scheduled no earlier than 6 months after a successful defense of the Ph.D. proposal.

**Format:** A doctoral student’s proposal defense consists of the following components:
- A written dissertation proposal that is prepared by the student and presented to the Advisory Committee for review and evaluation.
- An oral presentation of the dissertation proposal, which occurs at least two weeks after the written proposal is submitted to the Advisory Committee.
Passing the proposal defense shall require:
- A satisfactory written dissertation proposal, a copy of which will be placed in the student's file.
- Satisfactory performance on the oral dissertation proposal presentation.

Evaluation Criteria: The Advisory Committee will consider all of the information available to it, including an interview with the student to clarify unresolved issues, and render one of the following decisions:
1. The student passes the proposal defense and he/she is encouraged to finish all remaining requirements at the earliest possible time.
2. The student passes the defense and, except for identified deficiencies for which the Committee will prescribe a remedy, the student is encouraged to finish all remaining requirements at the earliest possible time.
3. The student fails the defense but is given permission to repeat it after certain conditions are met.
4. The student fails the defense and is asked to withdraw from the program at the end of the term.

Passing the proposal defense requires approval of at least 2/3 of the student’s advisory committee.

Appeals: A student may appeal the Advisory Committee's decision. Such an appeal must be made in writing to the Graduate Program Director. The written appeal must contain explicit reasons for requesting that the review be conducted. The appeal must be filed within two weeks from the date the student is notified in writing by the Graduate Director of the Advisory Committee's decision. The Graduate Program Director will then present his case to the Graduate Committee for a final decision.

5.5 TIME LIMIT

Candidacy for the doctorate automatically terminates seven years after beginning of study for the degree.

5.6 DISSERTATION SUBMISSION, FINAL DEFENSE, AND ACCEPTANCE

Dissertation research is to be done while the student is in full-time residence. The PhD dissertation defense can be scheduled no earlier than 6 months after a successful defense of the Ph.D. proposal. The research must be completed and the dissertation must be written and successfully defended before the Ph.D. is conferred. The primary requirement for a dissertation is that it shows evidence of high scholarly attainment through original and independent research work and creation of new knowledge. The acceptability of a
dissertation depends upon its quality rather than the time and credit hours spent on the research work.

When the dissertation research is completed to the satisfaction of the dissertation advisor, the student will prepare a final draft of the Ph.D. dissertation. This draft is submitted to the dissertation advisor for critical review and evaluation before scheduling a final defense of the dissertation. After receiving advisor approval, the student prepares the dissertation in final form and submits a copy of the completed dissertation to each committee member for critical evaluation at least two weeks before the defense. Information concerning the required dissertation format, reproduction, and other regulations for preparing a dissertation is available from COGS.

Final public defense of the dissertation is required of every doctoral candidate after he or she has fulfilled all other requirements of the doctoral program. This examination is administered by the student’s dissertation committee and is restricted to the content of the dissertation and closely related subject matter. The dissertation advisor is the chairperson of the committee. All members of the dissertation committee are expected to be present at the dissertation defense. The defense is presided over by the student’s faculty advisor and must be publicized and posted at least two weeks before the defense date.

The dissertation defense includes an oral presentation of approximately 45 minutes. This is followed by questions and comments from members of the dissertation committee and others. At the conclusion of the question and discussion period, all attendees present other than the dissertation committee members shall be excused. The dissertation committee may ask additional questions and will make a decision regarding acceptability of the dissertation and its defense and report these findings to the candidate. At least a 3/4 majority of the committee must concur in the final decision.

Major or minor changes and additions or deletions to the dissertation may be recommended by the dissertation committee. These must be made by the student and approved by the dissertation advisor before the student can be certified as having completed requirements for the dissertation.

After successful defense and corrections have been completed, the committee will complete and sign a dissertation approval page and forward it to the Graduate Program Director. Should the student not pass the final dissertation defense, the committee, in consultation with the Graduate Program Director, will decide upon a future course of action.

The doctoral candidate must submit a minimum of two peer-reviewed journal paper manuscripts based on the dissertation research and have at least one of them accepted for publication (see the requirements at the beginning of section 5).
The dissertation must be uploaded to the Ohio Library and Information Network (OhioLINK) following a review and approval by COGS.

5.7 GRADUATION

Students must formally apply online for graduation in the semester they will complete their degree requirements within the deadlines as stated on the COGS website.

There is no formal ceremony for Summer graduates. Students who will be completing their degrees in the Summer will be recognized if they apply for the Spring commencement. Otherwise, they will be recognized in the Fall commencement ceremony.
6. PRACTICAL TRAINING

International Ph.D. students can apply for optional (post-completion of study) practical training with the Office of International Student and Scholar Services (OISSS). To request a letter from the department, students must:

- Have a minimum GPA of 3.0.
- Have all PR and IN grades removed from their transcripts, excluding project, thesis, dissertation, and independent study.
- Have an approved and current Plan of Study on file.
- Be completing their degree requirements by the end of the semester (as confirmed by their advisor).

If the above requirements are met, students should fill out a "Request for Practical Training" form, available through OISSS, obtain the signature of their advisor and submit it to the department for further processing.