MISSOURI S&T

University of Science & Technology

Electrical & Computer Engineering
Graduate Handbook

July 2019

I. Message from the Chairman

On behalf of the Electrical and Computer Engineering (ECE) faculty and staff, I would like to welcome you to our department. While we continue to update this Graduate Handbook to reflect the most recent policies and procedures in our department, it is inevitable that you may have some questions or concerns that are not addressed in this document. I would encourage you to discuss these with the graduate secretary and/or the Associate Chair for Graduate Studies (Graduate Coordinator) in the ECE department.

As our department has evolved over the past several years, we have developed research programs in new and exciting areas and we hope to continue in this direction. If you have questions regarding currently active research areas in the department you can obtain some general information by consulting the department's website (http://ece.mst.edu/). For more specific questions you may wish to contact the individual faculty members associated with these research areas.

Finally, welcome to Missouri S&T. I hope that your stay with us will be productive as you further your education in your chosen field.

Sincerely,

Daryl G Beetner, PhD
Chair, Electrical and Computer Engineering Department
Missouri University of Science and Technology

II. General Information

The ECE department at Missouri S&T offers undergraduate and graduate education in two separate degree programs—Electrical Engineering (EE) and Computer Engineering (CpE). General regulations and procedures for all graduate programs are governed by the University. The individual departments and degree programs may also impose additional requirements. Information contained in this document describes <u>the requirements and procedures specifically applicable to students in the Electrical and Computer Engineering (ECE) degree programs</u>. Different sets of rules and regulations may apply to students in other degree programs.

III. Admissions

III.A. Required Documentation

All of the documentation requested below should be sent to the Director of Admissions, Office of Admissions (admissions@mst.edu; http://futurestudents.mst.edu/admissions/; 1-800-522-0938). When all of the required documentation has been received by the Admissions office it will be forwarded to the department. A recommendation will be made by the department. The recommendation will be forwarded to the Office of Graduate Studies for approval. Official notification of the outcome will be sent to the applicant from the Admissions office.

III.A.1. Application Form and Application Fee

All graduate applicants must submit a completed application form and a $50 non-refundable application fee. Graduate online application forms and instructions can be obtained at
http://futurestudents.mst.edu/admissions/

III.A.2. Graduate Record Exam (GRE) Scores

All graduate applicants must submit a complete set of GRE scores (GRE-V, GRE-Q, and GRE-AW). These reports should be sent directly from ETS to the Director of Admissions. The GRE requirement may be waived for exceptional applicants. See section III.B.3 for details of this waiver.

III.A.3. Language scores

International applicants must submit TOEFL scores to the Director of Admissions. TOEFL scores are not required from domestic applicants. The language score is required for all non-native English speakers, even international students with an undergraduate degree from S&T and other US institutions. The ECE department has no particular preference for either the Internet-based, the computer-based or the paper-based TOEFL. Recently the IELTS (International English Language Testing System) and Pearson Test (PTE) have become widely available and is recognized by the department as an acceptable substitute for the TOEFL test.

III.A.4. Letters of Recommendation

All applicants are strongly encouraged to submit at least three letters of recommendation. For all applicants for doctoral degrees, a minimum of three letters of recommendation is required. Letters of recommendation should be directly sent to the Director of Admissions.

III.A.5. Transcripts

All applicants must submit official transcripts from all colleges and universities attended. The transcripts should be sent directly from the colleges and universities to the Director of Admissions. Where the colleges and/or universities use a system differing significantly from the 4 point GPA system used at S&T, it is helpful to include a statement of the grading scheme, class rank and any other information that can be provided by the college or university.

III.A.6. Financial Statement

All international students must submit a financial statement showing sufficient resources to cover living and educational expenses for one year. This requirement does not apply to domestic applicants.

III.A.7. Statement of Purpose

All applicants are strongly encouraged (required for doctoral applicants) to submit a Statement of Purpose indicating their specific area(s) of interest in electrical and/or computer engineering, and outlining how the pursuit of an advanced degree will complement their overall career plan.

III.A.8. Curriculum Vitae (CV) or Resume

Applicants are strongly encouraged to include CV or resume as part of their application package. This material may be useful in documenting significant industrial experience, post graduate training, publications, and other significant professional accomplishments.

III.A.9. Summary

Table 1. A Summary of Customarily Required Application Documents

	Master's Degrees (MS)		Doctoral Degrees (PhD or DE)	
	International	Domestic	International	Domestic
Application Form	Required	Required	Required	Required
Application Fee	Required	Required	Required	Required
GRE Scores *	Required	Required	Required	Required
Language Fluency **	Required	Not Required	Required	Not Required
Recommendation Letters	Encouraged	Encouraged	Required	Required
Transcripts	Required	Required	Required	Required
Financial Statement	Required	Not Required	Required	Not Required
Statement of Purpose	Encouraged	Encouraged	Required	Required
CV or Resume	Encouraged	Encouraged	Encouraged	Encouraged

* See section III.B.3 for the waiver condition.
** See section III.B.4 for possible options.

III.B. Admission Guidelines

The admission guidelines listed below provide a rough indication of the department's expectations for incoming graduate students. The recommendations are not absolute. They are not necessarily intended to preclude the acceptance of students who may have specialized skills, training, or other accomplishments providing solid evidence of outstanding potential to contribute to the research mission of the department.

III.B.1. Undergraduate Grades

The nominal GPA recommendation for admission to the MS degree program is an undergraduate GPA of 3.3 on a 4.0 GPA system. In evaluating academic performance from universities that may use other grading systems, the department may rely upon statistical data gathered in analyzing academic outcomes for recent graduate students and/or academic qualifications of recently accepted students from comparable institutions to the extent that such statistical data is available. The department will not offer graduate admissions to students who do not have the equivalent of a four-year undergraduate degree in engineering or a closely related field. As an example, we cannot accept students who have only a diploma or an engineering technology degree.

III.B.2 Graduate Grades

For doctoral applicants who hold an MS degree, the nominal requirement is a graduate GPA of 3.5/4.0 or higher in their MS degree. An undergraduate GPA of 3.5/4.0 or higher is recommended for the doctoral applicants without an MS degree (directly from undergraduate to doctorate). In addition, applicants seeking admission to the doctoral program should meet or exceed all of the guidelines for those seeking admission to the MS program.

III.B.3. GRE Scores

The ECE department recommends a GRE-Q score of 155, sum of GRE-V and GRE-Q scores of 305, and GRE-AW score of 3.5. This GRE requirement may be waived for otherwise exceptional applicants. Examples include applicants with an undergraduate GPA of 3.5 obtained from the all courses offered by the electrical engineering or computer engineering program at Missouri S&T (must be minimum 18 credit hours).

III.B.4. Language Fluency

Only international students are required to provide TOEFL scores. The recommended TOEFL score set by the ECE department is 88 on the IBT (Internet-based testing) version, 230 on the computer-based, or 570 on the paper-based test version. The required minimum IELTS and PTE scores are 6.5 and 59, respectively.

Those applicants who are academically qualified but do not have the recommended language proficiency score (lower than the recommended TOEFL-IBT 88, the minimum required IELTS 6.5 or PTE 59) may be admitted with the following conditions:
1. Applicants with a score of TOEFL between 60-87, IELTS 5.5-6.0 or PTE 50-58 may be admitted to the ECE Department and allowed to take academic courses while improving their language proficiency through the on-campus Intensive English Program (IEP) in the Applied Language Institute (ALI: https://ali.mst.edu/) during the first semester. They should submit the satisfactory score (TOEFL 88, IELTS 6.5 or PTE 59) to waive the IEP courses as soon as possible before beginning in the program.
2. Applicants with a scores lower than TOEFL 60, IELTS 5.5 or PTE 50 and even without a score at the time of application may be admitted as a full-time student to the on-campus Intensive English Program (IEP) in the Applied Language Institute (ALI) to meet the language requirement before being admitted to the ECE Department. They may submit the satisfactory score (TOEFL 88, IELTS 6.5 or PTE 59) to change their admission status from an IEP student to a full-time ECE student as soon as possible before beginning in the program.

III.B.5. Transferring into ECE from Other Fields

Students applying for graduate studies with degrees in closely related fields may have additional conditions placed on their admission. These conditions are generally imposed to make sure that students who do not hold a traditional electrical or computer engineering degree will have sufficient background to have a good chance for academic success in the department's graduate programs. Specifically, students who wish to pursue a graduate degree in electrical engineering but hold only degrees in related subjects (e.g., physics, computer science, etc.) may be required to take courses as listed in the following table:

Table 2. Essential Background Courses for Electrical Engineering (EE)

All subjects below (or equivalent) are required	Two of the five subjects below (or equivalent) are required
• Circuits (EE 2100/2120 or 2800) • Introductory Electronics (EE 2200) • Digital Logic (CpE 2210)	• Control Systems (EE 3320) • Electronics (EE 3100) • Digital Communications (EE 3430) • Electromagnetics or Devices (EE 3600 or 3250) • Power Systems or Machines (EE 3500 or 3540)

The corresponding table for students who wish to pursue a graduate degree in computer engineering but hold degrees in related subjects (e.g., computer science, mathematics, etc.) is:

Table 3. Suggested Background Courses for Computer Engineering (CpE)

All subjects below (or equivalent) are required	Two of the four subjects below (or equivalent) are required
• Digital Logic (CpE 2210) • Data Structures (CS 1575) • Discrete Mathematics (CS 1200)	• Computer Organization (CpE 3110) • Microcontrollers/Embedded Systems (CpE 3150) • Operating Systems (CS 3800) • Digital Signal Processing (EE 3410)

When students are required to take some combination of these background courses as a condition for their admission, they should realize that of the required background courses are undergraduate courses. As such, they will not count towards fulfilling the requirements for the MS or doctoral degrees.

In exceptional cases, evidence of professional experience in a field directly related to the applicant's chosen graduate program may be accepted in lieu of remedial courses. Such applicants may be asked to take the S&T advancement exam in electrical or computer engineering to further demonstrate their proficiency in prerequisite knowledge.

III.B.6. Other Considerations for Admission

When applicants meet all of the guidelines listed above and provide all of the information requested, the department will usually recommend admission. When applicants do not meet these guidelines, the department may consider other factors such as:
1. Specific skills, training, and/or experience relevant to departmental research projects.
2. Publications and/or presentations at conferences.
3. Recommendations from S&T ECE faculty, particularly when accompanied by offers of a graduate research assistantship (GRA) or other forms of financial support as appropriate.

IV. Graduate Assistantships

There are three major mechanisms of funding for graduate students in the ECE department: Graduate Research Assistantship (GRA), Graduate Teaching Assistantship (GRA), and Fellowship. There are also Grader positions compensated on an hourly basis. Students can be appointed as GRA or GTA at any rate of up to 50% FTE (Full-Time Equivalent), which is the maximum part-time employment rate for students (100% represents the full-time job). The monthly stipend for 50% FTE is approximately $2,000. The stipend is proportionally adjusted for lower % FTE (e.g. $400 for 10% FTE). A student's out-of-state tuition is waived if the student is funded as a GRA or GTA (or a combination of the two) at a rate of 25% FTE or higher.

IV.A. Graduate Research Assistantship (GRA)

This assistantship is to support students who contribute to faculty members' research. If a GRA is offered, the out-of-state tuition is waived (if higher than 25% FTE) and the monthly stipend is provided according to % FTE. Students may contact individual faculty members with materials (CVs, publication,

etc.) preferably before application to demonstrate their qualification and competency in the interested research areas. The faculty member may offer a GRA position with admission if the student is qualified and funding is available. Or it may be offered anytime with continued interactions with faculty members during study in the ECE program.

IV.B. Graduate Teaching Assistantship (GTA)

GTAs are normally required to teach undergraduate-level laboratory courses. If a GTA is offered, the out-of-state tuition is waived (if higher than 25% FTE) and the monthly stipend is provided according to % FTE. The department appoints GTAs every semester. Students apply for the GTA positions several months before the start of the semester they are to teach, pass the communication test (non-native speakers only), and are selected by the department. Therefore, new incoming students are typically not eligible for a GTA position during the first semester.

IV.C. Fellowship

The mechanism of Department Fellowship waives the student's out-of-state tuition only (no stipend). The student may assist an individual faculty member's departmental work on teaching, research and service activities. Students may contact individual faculty members with materials (CV, publication, portfolio, etc.) before applying to demonstrate their qualification. The faculty member may offer a Fellowship anytime, similar to GRA positions. The Chancellor's Fellowship is available only for the PhD applicants with US citizenship or permanent residency. This Fellowship waives the tuition and provide stipends.

IV.D. Grader

This mechanism provides students with biweekly stipends based on hourly rates (no tuition waived). Graders are normally required to grade assignments from undergraduate-level courses. Students may contact individual faculty members who teach the course to be appointed as Grader several months before the start of the semester when they are to grade. Typically new incoming international students are not eligible for the Grader position (US citizens or permanent residents are eligible) during the first semester.

V. Graduate Degrees

The ECE department offers master's (MS; thesis and non-thesis options) and doctoral degrees (Doctor of Philosophy, PhD, and Doctor of Engineering, DE) in electrical and computer engineering, respectively. Students who meet the normal graduate admissions criteria, but only wish to take an advanced 6xxx-level course can be admitted as non-degree graduate students. In order to earn a degree, a cumulative GPA of 3.0 or higher (in all graduate-level courses taken at S&T and listed on Form I or Form V) must be maintained. A graduate student who accumulates ten or more credit hours of C or F grades shall no longer be a candidate for a degree from S&T. This requirement is cumulative over all degree programs (MS plus doctorate, MS plus a second MS, etc.) and is not per degree program.

The university requires that all of the graduate credit for an MS and a doctoral degrees must be obtained within a continuous 6 and 8 year period, respectively, preceding the degree's conferral. Otherwise it is necessary for the advisor to submit a formal written request for an extension and the request must be approved by the Graduate Coordinator and the Office of Graduate Studies. In the case of doctoral

candidates who already hold a MS degree or have passed the Qualifying Exam, the time limit is reduced from eight to six years.

V.A. Advisor and Advisory Committee

Every student will have an academic advisor. In addition, thesis option MS and doctoral students must have their advisory committee chaired by the student's advisor. Typically, the advisor is a member of tenure-track/non-tenure track faculty of the ECE Department. For thesis MS or doctoral students, the advisor may be from other departments at S&T if a co-advisor from ECE is a member of the student's advisory committee. The advisor and at least half of the remaining committee must be members (or associate members) of the S&T Graduate Faculty. The remaining members have to hold the highest degree awarded in their fields, which is typically a doctoral degree. They will have to provide a CV/resume when the student submits the form (see section VI.A) that will be forwarded to the Office of Graduate Studies. As long as the above requirements are met, there is nothing to preclude the advisory committee from including members who are affiliated with other universities, corporations, or governmental organizations particularly when these additional members can provide expertise in the area of the student's research. A faculty member can remain as the advisor should he or she choose to leave Missouri S&T. However, the student will need to add an on-campus co-advisor to the advisory committee.

V.B. Master's (MS) Degrees (thesis and non-thesis)

The thesis option MS degree is based on a combination of coursework and research. This option requires the student to find a faculty member willing to serve as advisor. This should be done as soon as possible so that the student and advisor will be able to formulate both a plan of coursework and a research project. The minimum number of advisory committee members (including the advisor) is three.

The non-thesis option MS degree is based entirely on coursework. Non-thesis students are assigned an initial advisor by the department, typically the Associate Chair for Graduate Studies (Graduate Coordinator). In this case the advisor's role is to assist the students in selecting courses consistent with their interests and abilities. The advisor is also responsible for ensuring the student's program of study meets the department's degree requirements and allows the student the opportunity to complete all degree requirements within a reasonable and customary time limit.

MS degree students, both thesis and non-thesis option, may change this degree option and/or their advisor at any time with the consent of their current advisor, their new advisor (in cases of advisor change), and in the case of thesis option students with the consent of their advisory committee.

V.C. Doctoral Degrees (PhD and DE)

The two types of doctoral degrees are the Doctor of Philosophy (PhD) and the Doctor of Engineering (DE), both of which place a strong emphasis on research with an advisor. The research portion of the PhD degree is generally conducted on campus. It is strongly recommended for PhD students to have at least 3 IEEE-journal-class articles accepted or under review at the time of the Defense from their PhD work as major contributor. The primary difference of the research portion of the DE degree from that of the PhD is that DE research is conducted as an internship with an industrial concern or government laboratory and is jointly supervised by an internship advisor employed by the cooperating organization and a faculty advisor employed by S&T. All ECE doctoral programs require the completion of a

dissertation. Oversight for the dissertation is the responsibility of the student's advisor together with an advisory committee. The advisory committee for a doctoral student should include at least five members. At least one member from outside the ECE department is required.

VI. Graduate Degree Procedures

A description of the common specific steps required to complete the requirements for a graduate degree in all departments can be found in the Graduate Catalog. The following describes how these procedures are followed in the ECE department.

VI.A. Program of Study (Form I and Form V)

Graduate degrees are often highly individualized to accommodate each student's research and academic interests. Therefore graduate degree seekers are required to submit a formal written Program of Study showing the courses they plan to take and when they plan to take the courses (see section VII for requirements). This is met by completing a Program of Study, Form I for MS students and Form V for doctoral students, respectively (see chapter VII for details of the degree requirements to complete the forms). A failed course should not be listed on the form.

For MS students, an acceptable Program of Study (Form I) must be submitted and approved within the first six weeks of the semester in which the student completes their fifteenth credit hour. For doctoral students, an acceptable Program of Study (Form V) must be submitted and approved immediately after passing the Qualifying Exam. Students should bring their forms (draft version) along with a degree audit to the graduate secretary for a review before they obtain the approval from advisors and/or committee members. There is no advisory committee required for the non-thesis MS option. After obtaining all signatures, the form should then be sent back to the graduate secretary to obtain department approval. Email verification of approval is an acceptable substitute, only if the committee members are not physically available to sign the form in person (e.g., on travel, has left the university, etc.).

After receiving department approval, the forms will be forwarded to the Office of Graduate Studies for final approval. The Program of Study requirement will be considered to be fulfilled after the required form receives approval from the Office of Graduate Studies. Failure to comply with this requirement may cause the Office of Graduate Studies to place a hold (encumbrance) on the student's registration. Once a hold has been placed, the student will not be allowed to register for courses until a Program of Study has been submitted. In addition to Form I and Form V, thesis option MS and doctoral students are required to pass major exams (including Defense, Qualifying Exam and Comprehensive Exam) to fulfill the degree requirements (see chapter VIII for details of the major exams).

VI.B. Modifications to Program of Study (Form I-A and Form V-A)

Once the Form I or V has been approved, students can modify their program of study by submitting a revised Form I (Form I-A) and Form V (Form V-A). It is strongly recommended that these forms be updated as soon as any changes (i.e., course change, program end date, etc.) have been made. However, the program of study will only be reviewed by the Office of Graduate Studies and needs to be current before the final Defense (for thesis MS students), before graduation (for non-thesis MS), and before the Comprehensive Exam and final Defense (for doctorate). Any changes to the advisory committee must be immediately documented with a Form I-A or V-A.

Students should use Form I-A or V-A to change their advisor and/or to replace members of their advisory committee. Changing advisors requires the approval of both the old and new advisors. Replacing committee members requires the approval of current advisor and both former and proposed committee members. A student who changes advisors should realize that their new advisor has the right to request the addition or deletion of specific courses from the previously approved form.

Any course that has received a grade of 'C' or lower cannot be removed. If a student receives an 'F' grade and has not removed the course from their program before the grade has been issued, they'll be required to retake the course until a passing grade has been earned. However, if a MS student has extra hours with grade 'A' or 'B' listed on their Form I and decides to continue to a PhD program at S&T, before they graduate, a form I-A may be submitted with those extra courses removed. These extra hours with grade 'A' or 'B' can count towards PhD credit.

Responsibility for assuring that the program of study, as modified, still meets all of the requirements enumerated above rests with the student and the advisor. MS degree students, both thesis and non-thesis option, may change this degree option and/or their advisor at any time with the consent of their current advisor, their new advisor, and in the case of thesis option students the consent of their advisory committee. Only the signature of the advisor is required if the Form I-A or Form V-A includes only revision of the course list, without change of advisor and/or committee members.

VI.C. Transition from MS to Doctorate

An MS student may change their degree program from MS to doctorate before completing the MS study. The student is then subject to the case of the doctoral student without MS (directly from BS to Doctorate) and must meet all requirements accordingly (see section VII.C for BS to Doctorate). All courses and research credits obtained during MS study may be then counted toward the doctoral study.

All doctoral students with a completed MS degree by the beginning of doctoral study are subject to the requirements of a doctoral student with MS (see section VII.D for MS to Doctorate). For those doctoral students with a completed MS degree from Missouri S&T, any extra credit hours during MS (earned beyond the minimum requirement and listed on the Form I) may not be used to fulfill course requirements for any other degree. The basic premise for counting courses is that one course can count towards only one degree. Accordingly, all of the courses shown on the Form I (or I-A) are considered to be the requirements for MS. However, if the MS study has not been finished, the student may want to consider submitting a Form I-A to remove extra courses from the Form I. These courses then may no longer be considered to be part of the MS degree and may be counted towards fulfilling the doctorate. However, it is important to note that this process requires the approval of the advisor, Graduate Coordinator, and the Office of Graduate Studies.

International students who wish to remove courses from one degree to apply towards another degree should discuss the implications of this change with the International Affairs Office (https://international.mst.edu/). This change could conceivably affect the I-20 status of an international student. Therefore, the International Affairs Office has two additional requirements for international students who wish to remove courses from their program of study. The policy of the International Affairs Office is:

1. An international student may remove courses from their program of study only when they are in the last semester of the MS program. For unavoidable circumstances, for instance family/medical emergency, the student will have to provide documentation to the International Affairs Office to remove the course during the program of study.

2. The courses being removed from the program of study can include only courses being taken during the current semester. Courses cannot be removed retroactively.

VI.D. Transfer of Lecture Course Credits

To transfer lecture course credits from a student's previous institution, a document describing the course (including title, credit hours, summary of contents, academic level) is required to prove the equivalency of the course to be transferred to a course at Missouri S&T. Examples include: course catalog description in the previous institution's homepage, course syllabus used, or letter from the instructor who taught the course. Also, the student's transcript listing the course title and its score must be provided. The student must also provide documentation showing the proposed transfer courses were not used toward a previously earned degree. The Graduate Coordinator may approve the transfer based on the information provided after consulting with the instructors of equivalent courses at Missouri S&T and/or ECE Graduate Studies Committee members.

A maximum of nine hours of lecture course credits for an MS degree may be transferred from a student's previous institution. For doctoral credits, a student who does not hold an MS degree may transfer a maximum of 18 hours, while a student with an MS degree may transfer a maximum of nine hours. Students must have earned at least a B grade for any course to be transferred to our programs.

VI.E. Application for Graduation

Within the first four weeks of the final semester, the student should ensure that all degree requirements will be fulfilled by the end of the semester. At this time the student should fill out an application for graduation through Joe'SS. Complying with this requirement will allow adequate time for the faculty to approve the granting of the degree and will also enable the student to participate in the next graduation ceremony. Failure to comply with this requirement may delay granting the degree. Graduation ceremonies are held at the end of the Fall and Spring semesters. Students who complete their degrees during the summer session and meet these requirements will be invited to participate in the graduation ceremony held at the end of the next Fall semester.

Occasionally students fill out their application for graduation and, due to unforeseen circumstances, are unable to complete their degree requirements by the end of the semester. In these cases the student will need to notify their advisor and fill out a new application for graduation for the subsequent semester. International students who determine that they will not be able to fulfill their degree requirements after applying for graduation should contact the International Affairs Office as soon as possible to avoid any adverse consequences regarding their immigration status.

If a student is planning on finishing program requirements during intercession, he or she will have to submit all final forms and documentation by the Friday before the next semester begins and apply for graduation the following semester. If needing to defend during intercession, a student will have to enroll for the defense by filling out an Oral Defense Registration form.

VII. Graduate Degree Requirements

Requirements for graduate degrees may originate at different levels. Requirements applying to all graduate degrees granted by S&T are set by the graduate faculty. Requirements applying to all graduate degrees granted in the ECE department are determined by the faculty of the department. It is important

to realize that a candidate for a graduate degree from this department <u>must meet both requirements set at the campus (S&T) level and the department (ECE) level</u>.

VII.A. Master's (MS) Degree

On the Form I, there must be at least one single <u>subset</u> of courses that satisfies <u>all</u> of the following requirements <u>simultaneously</u>:

1. The total number of credit hours in the subset for thesis/non-thesis option students must be greater than or equal to 30.
2. There must be at least 6 credit hours of 6xxx-level lecture courses for a thesis option student and at least 9 credit hours of 6xxx-level lecture courses for a non-thesis option student.
3. At least half of the 6xxx-level lecture courses, at least half of the thesis research (5099) and at least half of the special problems/seminars courses (5000) should be in the student's degree program. This requirement is based on the number of credit hours rather than on the number of courses.
4. All lecture courses must be courses in engineering, math, or science, specifically excluding humanities/social sciences with the exception of a course taken to fulfill the graduate communications requirement (see section VII.E for more details on how to satisfy the communications requirement).
5. If a student wishes to pursue courses in an area where they lack background, they may be required to take suitable remedial courses at the undergraduate and/or graduate levels prior to enrolling in graduate courses in that area. These remedial courses are likely to be prerequisites to the graduate courses in which the student wishes to enroll.
6. Thesis option: There must be at least 21 hours of lecture credit (specifically excluding 5099) and at least 6 hours of thesis research credit (5099). The remaining 3 hours (out of total 30 hours) may be either lecture or research credit hours.
7. Non-thesis option: The maximum number of research credit hours (5099) accepted towards a non-thesis MS degree is zero. Under rare circumstances, with approval from the Graduate Coordinator, up to 4 credit hours of special problems (5000) and/or seminar courses may be accepted.
8. Non-thesis option: Students are required to declare their primary/secondary emphasis areas from the list of emphasis areas in the ECE graduate program after consulting with the Graduate Coordinator. A student should take a minimum of 12 lecture credit hours from their primary area and up to 9 lecture credit hours from their secondary area. The remaining lecture credit hours (out of a total of 30 hours) can be taken from the other areas of the program or outside their program/department. In the event that an emphasis area does not offer a sufficient number of courses, then courses from other emphasis areas within the student's program may be permitted with the approval of the Graduate Coordinator.
9. Non-thesis option: A student can change the emphasis area after approval from the Graduate Coordinator. However, the aforementioned requirement for the course selection (minimum 12 hours from primary, maximum 9 hours from secondary and maximum 9 hours from outside) must be satisfied with respect to the new emphasis area.

VII.B. Second Master's (MS) Degree in ECE

The second MS degree in ECE is intended for students who already hold an MS degree in a field closely related to ECE. The minimum number of credit hours required for a second MS degree is 24. As in the case of a first MS degree, the second MS degree can include research and coursework (thesis option) or coursework only (non-thesis option). Students who wish to obtain a second MS degree based on having a MS degree in a closely related field must apply specifically for admission as a second MS degree

student. The following requirements apply once the student has been accepted as a second MS degree student:

On Form I there must be at least one single <u>subset</u> of courses that satisfies <u>all</u> of the following requirements <u>simultaneously</u>:
1. The total number of credit hours in the subset must be greater than or equal to 24 (6 hours less than the first MS degree).
2. Thesis option: There must be at least 15 hours of lecture credit (specifically excluding 5099) and at least 6 hours of thesis research credit (5099). The remaining 3 hours (out of total 24 hours) may be either lecture or research credit hours.
3. Non-thesis option: A student should take a minimum of 12 lecture credit hours from their primary area. The remaining lecture credit hours (out of total 24 hours) can be taken from the other areas of the ECE program.
4. All other requirements as listed for the first MS degree in ECE must be met.

VII.C. Doctoral Programs (BS → Doctorate)

The majority of graduate students accepted into the doctoral program already hold a relevant MS degree, either from S&T or elsewhere. Typically this MS degree will be in electrical engineering, computer engineering, or a closely related field. Occasionally students who are exceptionally well qualified by virtue of outstanding academic accomplishments, research potential, and/or relevant experience will request and be granted direct admission to the doctoral program with only a BS degree. Programs of study for doctoral students without a relevant MS degree are subject to the following requirements:

On Form V there must be at least one single <u>subset</u> of courses taken for graduate credit that satisfies <u>all</u> of the following requirements <u>simultaneously</u>:
1. The total number of credit hours in the subset must be greater than or equal to 90.
2. Excluding all credit hours attributable to dissertation research (6099), the number of remaining credit hours of graduate coursework must equal or exceed 48 and at least 30 of these credit hours should be taken in the ECE program.
3. Students are required to take at least 18 credit hours of 6xxx-level coursework.
4. All lecture courses must be courses in engineering, math, or science, specifically excluding humanities/social sciences, with the exception of a course taken to fulfill the graduate communications requirement (see section VII.E. for more details on how to satisfy the communications requirement).
5. The total number of credit hours taken as doctoral dissertation research (6099) must equal or exceed 42, and at least half of these credit hours should be taken in the student's degree program (i.e. EE 6099 for electrical engineering students and CpE 6099 for computer engineering students).

VII.D. Doctoral Programs (MS → Doctorate)

Subject to approval by a doctoral candidate's advisory committee, it is possible to receive some credit for a MS degree in a relevant field.

On Form V there must be at least one single <u>subset</u> of courses taken for graduate credit that satisfies <u>all</u> of the following requirements <u>simultaneously</u>:
1. The total number of credit hours in the subset must be greater than or equal to 60.

2. Excluding all credit hours attributable to dissertation research (6099), the number of remaining credit hours of graduate coursework must equal or exceed 24 and at least 15 of these credit hours should be taken in the ECE program.
3. Students are required to take at least 12 credit hours of 6xxx-level coursework.
4. All lecture courses must be courses in engineering, math, or science, specifically excluding humanities/social sciences with the exception of a course taken to fulfill the graduate communications requirement (see section VII.E for more details on how to satisfy the communications requirement).
5. The total number of credit hours taken as doctoral dissertation research (6099) must equal or exceed 36, and at least half of these credit hours should be taken in the student's degree program (i.e. EE 6099 for electrical engineering students and CpE 6099 for computer engineering students).

VII.E Technical Communications Requirement

An ECE graduate student is required to fulfill a zero-credit hour communications requirement to demonstrate that they possess sufficient technical communications capabilities to be successful in their profession. Fulfillment of this requirement is determined by the student's graduate advisor in consultation with the Graduate Coordinator. A Communications Requirement Form, approved by the advisor, should be submitted with the first submission of the Graduate Form I or Form V. Resubmission of this form is required if the activity elected for fulfillment changes. This form will be referenced by the graduate secretary each time a student submits a revised Form I or Form V and is tracked on the graduate degree audit before graduation.

Typical examples of experiences that might demonstrate completion of this requirement include:
1. Major contribution to authoring a conference or journal paper
2. Completing a communications-intensive graduate-level course (see Communications Requirement Form for approved courses)
3. Substantial communications-related experience in industry
4. Substantial communications coursework at the undergraduate level.

VIII. Major Exams

In addition to the exams given as part of the formal coursework required for graduate degrees, there are several major exams required for students pursuing advanced degrees in the ECE department. The required exams depend on the degree being sought and, in the case of MS degree students, whether the degree is thesis or non-thesis option.

VIII.A. Master (MS) Thesis Defense

All thesis option MS degree candidates must defend their thesis in an oral thesis Defense examination conducted by their advisory committee. The student will be responsible for arranging a time and place for the oral thesis Defense. Students should contact the graduate secretary to arrange for an official department announcement to be made at least one week in advance of the exam. Thesis option students must also fill out a Defense notification form announcing the date, location, abstract, etc., for their thesis Defense at least one week in advance. This form will then be distributed electronically to all department faculty and graduate students. Committee members should be provided with a written copy of the thesis and oral presentation material (typically PowerPoint slides) at least ten days in advance of the exam.

The chair of the advisory committee will submit Form II and the evaluation rubric (obtained from graduate secretary) for approval to the graduate secretary.

VIII.B. Doctoral Qualifying Exam

The Qualifying Exam is administered in two parts: a written exam and an oral exam. The objective of the written exam is to determine the students' understanding of the fundamentals of EE/CpE subjects and to ensure solid theoretical background to start research. The objective of the oral exam is to evaluate the students' ability for critical thinking, problem solving and communication required to independently conduct research. The oral exam will be administered only for students who have passed the written exam.

Every doctoral student is required to pass the Qualifying Exam, both written and oral portions, by the end of the second semester after completion of the MS degree or by the end of the fifth semester after completion of the BS degree. These exams are offered only once in the fall semester and once in the spring semester. Students should contact the graduate secretary to register at least seven weeks before the exam. More details including the exam procedures, written exam study guides, and the oral exam evaluation rubric are available in a separate document (see General Information for EE/CpE Qualifying Exam). After the oral exam, the chair of the tentative advisory committee will submit the Oral Report Form to the graduate secretary for department approval. After the successful completion of the Qualifying Exam, both written and oral, the graduate secretary will process a Form 4 and submit to the Office of Graduate Studies.

Students who fail the Qualifying Exam on their first attempt will be given a second opportunity to pass the exam when it is given in the following semester. Students who fail the exam once and do not take the exam in the subsequent semester will no longer be considered doctoral degree candidates in the ECE department. A student who fails the Qualifying Exam on two consecutive semesters may file a written petition with the ECE Graduate Studies Committee for a third attempt. The petition must include at least three faculty recommendations, documentation of academic and research progress, and documentation of extenuating circumstances. The committee will vote, by simple majority, to approve or deny the petition. If the petition is approved, it will be forwarded to the Office of Graduate Studies as a request to administer the last attempt.

Upon request of the advisor, the Qualifying Exam may be waived for those who transferred to our doctoral programs after they had passed the Qualifying Exam, or equivalent, in the same program (e.g., electrical or computer engineering) at other institutions. The advisor should provide the Graduate Coordinator with the necessary information related to the exam taken, including the subjects list and the method of administration. The Graduate Coordinator may then waive the exam based on the information provided and input from the Graduate Studies Committee.

VIII.C. Doctoral Comprehensive Exam

The purpose of the Comprehensive Exam is to evaluate a student's overall research progress and plan for completion of the doctoral dissertation. It should be taken after preliminary work has been carried out to demonstrate the promise of the proposed topic and preparation of the student to conduct research. The exam serves as an opportunity for the advisory committee to recommend revisions to the topic or approach, and as such, the exam should be taken well before the final Defense. In the course of this exam, the student is expected to demonstrate their ability to formulate research questions, identify objectives, conduct a literature survey, design research methods, illustrate the approach with preliminary

data, and articulate plans for completion of the dissertation in a timely fashion. All doctoral students are required to pass a Comprehensive Exam, which can be taken any time after completion of at least half of their required doctoral lecture credit hours. This corresponds to completion of at least 12 lecture credit hours (for MS to doctoral students) and 36 lecture credit hours (for BS to doctoral students). A period of at least six months must elapse between the Comprehensive Exam and the dissertation Defense.

The exam will be an oral session (approximately 45 minutes) to present the research questions, objectives, literature survey, proposed methods, preliminary work and plans for completion of the dissertation, followed by questions from the advisory committee. The committee may request a separate written dissertation proposal with contents and format that they specify. The oral presentation material (typically PowerPoint slides) and a written dissertation proposal (if requested) should be distributed to the committee members no later than two weeks prior to the date of the exam.

The student is responsible for arranging a time and place for the exam. Form VI-A (Request for Authorization of Comprehensive Exam), which requires approval by the student's advisory committee, the department, and the Office of Graduate Studies, should be submitted at least five weeks before the exam. Form V (Program of Study) must be up-to-date before the exam can be authorized. If requirements are met, the student will be sent an email informing them of authorization. After the exam, the chair of the advisory committee will submit Form VI-B (Report on Comprehensive Examination) and the evaluation rubric (obtained from the graduate secretary) to the graduate secretary for department approval.

VIII.D. Doctoral Dissertation Defense

All doctoral degree candidates must defend their dissertation in an oral dissertation Defense examination conducted by their advisory committee. It is strongly recommended for doctoral students to have at least three IEEE-journal-class articles from doctoral work as major contributor accepted or under review at the time of the Defense. The student will be responsible for arranging a time and place for the oral dissertation Defense. Students should contact the graduate secretary and the Office of Graduate Studies to arrange for an official department announcement to be made at least two weeks in advance of the exam. Doctoral students must also fill out a Defense notification form announcing the date, location, abstract, etc., for their Defense at least one week in advance. This form will then be distributed electronically to all department faculty and graduate students. The oral presentation material (typically PowerPoint slides) and the written dissertation should be distributed to the committee members no later than two weeks prior to the date of the exam. After the Defense, the chair of the advisory committee will submit the Graduate Form VII and the evaluation rubric (obtained from graduate secretary) to the graduate secretary for department approval.

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C-S.K., S.S., M.F.