

**EXECUTIVE COMMITTEE
COLLEGE OF MARLAN & ROSEMARY BOURNS COLLEGE OF ENGINEERING
REPORT TO THE RIVERSIDE DIVISION
MAY 21, 2019**

To be adopted:

Proposed Changes to Electrical and Computer Engineering

PRESENT:

Graduate Program

The Department of Electrical and Computer Engineering offers programs leading to M.S. and Ph.D. degrees.

University requirements for the M.S. and Ph.D. degrees in Electrical Engineering are given in the Graduate Studies section of this catalog.

1. Research focus areas currently include communications, computer vision, control, detection and estimation, distributed systems, electronic materials, error-correcting codes, image processing, information theory, intelligent sensors, intelligent systems, machine learning, modeling and simulation, multimedia, nanostructures and nanodevices, navigation, neural networks, pattern recognition, robotics and automation, signal processing, solid-state devices and circuits, system identification, and transportation systems.

Combined B.S. + M.S. Five-Year Program The college offers a combined B.S. + M.S. program in Electrical Engineering designed to lead to a Bachelor of Science degree as well as a Master of Science degree in five years. Applicants for this program must have a high school GPA above 3.6, a combined SAT Reasoning score above 1950 (or ACT plus Writing equivalent), complete the Entry Level Writing Requirement before matriculation, and have sufficient mathematics preparation to enroll in calculus in their first quarter as freshmen.

2. Students in the B.S. + M.S. program are allowed to count up to 12 units of undergraduate technical electives taken as UCR undergraduates towards the 48-unit requirements of the M.S. degree.

PROPOSED:

Graduate Program

[no change]

[no change]

1. Research focus areas currently include communications, computer vision, control, detection and estimation, distributed systems, electronic materials, error-correcting codes, image processing, information theory, intelligent sensors, intelligent systems, machine learning, modeling and simulation, multimedia, advanced materials, nanostructures and nanodevices, navigation, neural networks, pattern recognition, robotics and automation, signal processing, solid-state devices and circuits, system identification, and transportation systems.

[no change]

2. Students in the B.S. + M.S. program are allowed to count up to 12 units of undergraduate technical electives taken as UCR undergraduates towards the 36-unit requirements of the M.S. degree.

Interested students who are entering their junior year should check with their academic advisor for information on eligibility and other details.

[no change]

Admission All applicants for the M.S. and Ph.D. programs must submit official scores for the GRE General Test. All applicants whose native language is not English and who do not have a degree from an institution where English is the exclusive language of instruction must complete the Test of English as a Foreign Language (TOEFL) with a minimum score of 550 (paper-based), 220 (computer-based), or 90 (Internet-based).

[no change]

3. Applicants must meet the general admission requirements of the Riverside Division of the Academic Senate and the UCR Graduate Council as set forth in the UC Riverside Graduate Student Application. In addition, **Master's Degree** Applicants should have completed a program equivalent to UCR's B.S. in Electrical Engineering or demonstrate the required knowledge and proficiency in the following subjects:

1. Mathematics, including calculus, differential equations, and complex variables
2. Circuits and electronics (equivalent of EE 100)
3. Signals and systems (equivalent of EE 110)
4. ~~Communication and signal processing (equivalent of EE 115, EE 141)~~
5. ~~Logic design, digital systems, and microcomputers (equivalent of EE 120)~~
6. ~~Control systems (equivalent of EE 132)~~
7. ~~At least one major high-level programming language and associated programming techniques (equivalent of CS 010)~~

4. Students with background in other scientific fields are encouraged to apply. Applicants lacking minimum undergraduate preparation in the above areas may be admitted but must take the appropriate undergraduate courses. ~~Under special circumstances, students who have not completed all undergraduate requirements may be admitted provided that the deficiencies are corrected~~ within the first year of graduate study. Courses taken for this purpose do not count towards an advanced

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1. Mathematics, including calculus, differential equations, and complex variables
2. Circuits and electronics (equivalent of EE 100A and EE 100B)
3. Signals and systems (equivalent of EE 111, or both EE 110A and 110B)
4. Logic design, digital systems, and microcomputers (equivalent of EE 120A and 120B)
5. Control systems (equivalent of EE 132)
6. At least one major high-level programming language and associated programming techniques (equivalent of CS 010)

4. Students with background in other scientific fields are encouraged to apply. Applicants lacking minimum undergraduate preparation in the above areas may be admitted, but must take the appropriate undergraduate courses as approved by the Graduate Advisor. If admitted, these students must correct all deficiencies within the first year of graduate study. Courses taken for this purpose do not count towards an advanced degree.

degree.

Master of Science

The Department of Electrical and Computer Engineering offers the M.S. degree in Electrical Engineering.

General university requirements are listed in the Graduate Studies section of this catalog. Students may obtain an M.S. degree in Electrical Engineering through either Plan I (Thesis) or Plan II (Comprehensive Examination). The normative time for a student to complete the M.S. degree under both Plan I or Plan II is six quarters (two years). Students who are admitted with deficiencies may require up to three additional quarters.

5. Plan I (Thesis) Students must complete ~~48~~ units of approved graduate ~~or upper-division undergraduate~~ work in Electrical Engineering and related areas such as Computer Science, Materials Science and Engineering, ~~or other approved subject areas~~. At least ~~36~~ of these units must be ~~graduate-level~~ courses numbered between 200 and 279 ~~taken at a campus of the UC~~. ~~Colloquium units cannot be counted towards the unit requirements. No more than 12 units may be in graduate research (courses numbered 297 or 299). Upper-division undergraduate courses numbered 125 and above may be counted towards the unit requirements upon approval.~~

~~6. A thesis on a research topic must be submitted and approved by the faculty. The thesis must demonstrate the student's in-depth knowledge of the chosen research topic. Publishable results are encouraged. The thesis defense is a two-hour examination session open to the public and begins with a brief presentation of the thesis by the candidate, followed by a question and answer session.~~

7. Plan II (Comprehensive Examination) Students must complete 48 units of approved graduate or upper-division undergraduate work in Electrical Engineering and related areas such as

Master of Science

[no change]

[no change]

5. Plan I (Thesis) Students must complete 36 units of approved graduate work in Electrical Engineering and related areas such as Computer Science and Materials Science and Engineering. At least 24 of these units must be courses numbered between 200 and 279. At least 12 units must be in graduate research (courses numbered 297 or 299). Colloquium units (CS 287, EE 259, MSE 250, MSE 251) and courses numbered 291 are not counted towards the 36 unit requirement.

6. Students choosing Plan I must submit a master's thesis in accordance with the general requirements of the University. The thesis must be original research work, and demonstrate the student's ability to explore a research area, acquire in-depth knowledge of the chosen research topic, and make a research contribution. The thesis must be approved by a committee of at least three faculty members. The thesis must be defended in a two-hour examination open to the public, beginning with a brief presentation by the candidate, and followed by a question-and-answer session.

7. Plan II (Comprehensive Examination) Students must complete 36 units of approved graduate or upper-division undergraduate course work in Electrical Engineering and related areas

Computer Science, Materials Science and Engineering, or other approved subject areas. At least 36 of these units must be graduate-level courses numbered between 200 and 279 taken at a campus of the UC. Units from courses numbered 291 or higher and colloquium units may not be counted towards the unit requirements. A maximum of 6 units in Directed studies (290) may be counted. Upper-division undergraduate courses numbered 125 and above may be counted towards the unit requirements upon approval.

such as Computer Science and Materials Science and Engineering. At least 24 of these units must be graduate-level courses numbered between 200 and 279. To satisfy the remaining unit requirements, students may use up to 8 units in Directed studies (290) and upper-division undergraduate EE courses numbered 115 and above with the exception of EE 116, 120, and 132. Colloquium units (CS 287, EE 259, MSE 250, and MSE 251) and courses numbered 291 and higher are not counted towards the 36 unit requirement.

8. Students must pass the comprehensive examination. This written exam consists of problems from five courses in one of the three Exam Areas:

signals, systems, and machine intelligence
nano materials and devices, or
computer engineering

Students must pass the exam in no more than two attempts. In the second attempt, they will be required to solve problems only from courses they did not pass in their first attempt.

8. In addition to the course requirements of Plan II, students must pass a comprehensive examination administered by the program.

Normative Time to Degree Six quarters (two years)

[no change]

Doctoral Degree

[no change]

The Department of Electrical and Computer Engineering offers the Ph.D. degree in Electrical Engineering.

Admission Students with backgrounds in Electrical Engineering or other related areas are encouraged to apply. An M.S. degree is not required for admission to the Ph.D. program. Under special circumstances, applicants lacking undergraduate preparation in core Electrical Engineering areas related to their field of research may be admitted, but must take the appropriate undergraduate courses to correct the deficiencies within the first year of graduate study. Courses taken for this purpose do not count towards an advanced degree.

[no change]

9. **Course Work** Students must complete at least 36 units of approved graduate coursework in Electrical Engineering and related areas such as Computer Science, Materials Science and Engineering, or other approved subject areas. Only

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courses numbered between 200 and 279, excluding Colloquium courses, may be counted towards this requirement. Students who have already taken 36 units of graduate coursework at UCR as part of the M.S. program in Electrical Engineering are deemed to have met the minimum-unit requirement for the Ph.D. Students who are admitted with an M.S. degree from a different institution may use up to 16 units of equivalent courses taken during their M.S. study to count towards the requirement. Students must complete a minimum of six quarters (two years) in residence ~~in the UC~~ with a GPA of 3.00 or better. Students must establish a course plan in coordination with their research advisor or the program Graduate Advisor. The course plan should lend support to the students' research area, while adding breadth to their overall program. Students may need to take considerably more than 36 units to establish breadth and depth of knowledge in their area of research.

courses numbered between 200 and 279, excluding Colloquium courses (CS 287, EE 259, MSE 250, and MSE 251), may be counted towards this requirement. Students who have already taken 36 units of graduate coursework at UCR as part of the M.S. program in Electrical Engineering or Computer Engineering are deemed to have met the minimum-unit requirement for the Ph.D. Students who are admitted with an M.S. degree from a different institution may use up to 16 units of equivalent courses taken during their M.S. study to count towards the requirement. Students must complete a minimum of six quarters (two years) in residence at UCR with a GPA of 3.00 or better. Students must establish a course plan in coordination with their research advisor or the program Graduate Advisor. The course plan should lend support to the students' research area, while adding breadth to their overall program. Students may need to take considerably more than 36 units to establish breadth and depth of knowledge in their area of research.

Justification:

The EE MS program had a unit requirement of 36 units since its inception. In 2016, the faculty in ECE voted to increase the requirement to 48 units with the hope that it will provide students a broad exposure to various areas within ECE. However, this has created multiple problems that hamper the growth of our EE MS program, a critical component of a successful ECE department.

Our EE MS program is very small when compared to our peers, within the UC system and otherwise. This affects our rankings negatively, as well as faculty having access to MS students to work with in the labs. Students have complained that the amount of time needed to complete an MS is one of the negatives of our MS program.

48 units places us at the very high end of the number of units needed to graduate from the MS program, higher than UCLA, UCSB and UCD. Moreover, most of the programs at the high end, within UC and outside, have a set of courses that are specialized for MS students, while all our graduate courses are tailored towards PhDs. Currently, we do not have resources to create such MS-style courses; growing the MS program can provide such resources in the near future and help strengthen the overall graduate program.

Because of the above, the faculty voted unanimously to reduce the total number of units in the MS program to either 36 or 40 units (20 in favor, 0 opposed, 0 abstain, 9 absent). Every faculty present at the meeting agreed that raising the units to 48 was an experiment that did not work out. Between 36 and 40 units, 36 units was favored by 12 and opposed by 8, while the opposite was true for 40 units. Hence the decision to move back to 36 units.

Within the 36 units, the decision to allow 12 units of undergraduate courses was decided for the following reasons. As most of the MS students are international, they come from a wide variety of academic backgrounds. By allowing them to take upper-division undergraduate courses numbered 115 and above, we are allowing them to make up for any deficiencies in a certain area before taking graduate courses. Also, this allows MS Plan II students to move to focus areas that may not have been available to them in their undergraduate studies.

We are also allowing MS Plan II students to take up to 8 units of independent research credit. Many students have expressed interest in working on a problem to gain some research experience, but not to the full extent of an MS thesis. This option allows them that opportunity.

While CEN is an M.S. program jointly administered by ECE and CSE departments, there is no equivalent Ph.D. program; thus, M.S. students in CEN have to continue in either the EE or CS program to obtain a terminal degree. This change allows students to continue to the Ph.D. program in EE.

Approvals:

By the faculty of the Department of Electrical and Computer Engineering: **April 11, 2018**

By the Executive Committee of the College of Engineering: **November 13, 2018**

By the Committee on Educational Policy: **February 7, 2019**

By the Graduate Council: **March 21, 2019**