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.

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.

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

Admission All applicants 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), 213 (computer-based), or 80 (Internet-based).

Students in the B.S. + M.S. program are allowed to count up to 12 units of technical-elective or graduate coursework they take as UCR undergraduates towards the 48-unit requirements of the M.S. degree.

Admission

All applicants 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), 213 (computer-based), or 80 (Internet-based).

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)

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 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.

Plan I (Thesis)

Students must complete 36 units of graduate or upper-division undergraduate work in Electrical Engineering and other approved subject areas. At least 24 of these units must be in graduate-level courses taken at a campus of the UC, including at least 12 units of required graduate courses. The required and approved courses in each area are determined by the graduate program committee. No more than 12 units may be in graduate research (courses numbered 297 or 299). Upper-division undergraduate courses numbered 125 and above can be counted towards the degree requirements.

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.

Plan II (Comprehensive Examination)

The same requirements as in Plan I apply, except that students must complete at least 18 quarter units of graduate-level courses taken at a UC campus, and none of these credits can be in courses numbered 297 or 299. A maximum of 6 units can be taken in Directed Studies (290).

Students must complete 48 units of graduate or upper-division undergraduate work in Electrical Engineering, related areas such as Computer Science or Materials Science and Engineering, and 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. The required and approved courses in each area are determined by the graduate program committee. Colloquium units cannot be counted towards the unit requirements.
Students must take the comprehensive examination. The examination is conducted jointly with the Ph.D. preliminary examination. The examination emphasizes the fundamental knowledge of the study area rather than the specifics covered in individual courses. Candidates must solve at least five problems in at least three different major areas. No more than three problems may be chosen from the student’s major area of specialization (i.e., communications and signal processing; control and robotics; intelligent systems; nano materials, devices, and circuits; integrated circuits and VLSI system design.)

**Normative Time to Degree** Six quarters (two years)

**Doctoral Degree**

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

**Admission** An M.S. or equivalent degree in Electrical Engineering or a related field is normally required. Exceptional applicants may be admitted directly without an M.S. degree. Students with backgrounds in other scientific fields are encouraged to apply. Applicants lacking 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 degree.

**Course Work** There is no strict course or unit requirement for the Ph.D. degree. The faculty recommends that the student take a minimum of 36 units of 100- or 200-level course work (excluding EE 297 or EE 299) while in graduate standing as evidence of preparation for the doctoral qualifying examination. The courses may include graduate course work used for the M.S. degree. 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 pass the comprehensive examination. This written exam consists of problems from five courses in one major subject area (Systems theory and applications, 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.

An M.S. degree is not required for admission to the Ph.D. program. Students with backgrounds in Electrical Engineering or other related areas are encouraged to apply. 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.

Students must complete at least 36 units of graduate coursework in Electrical Engineering, related areas such as Computer Science or Materials Science and Engineering, and other approved subject areas. Only 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 PhD. 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 MS study to count towards the requirement. All 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 major subject area (i.e., communications and signal processing; control and robotics; intelligent systems; nano materials, devices, and circuits; integrated circuits and VLSI system design.) A coherent program of approximately 24 units of graduate course work in the major area is recommended. Students may need to take considerably more than the 24 units to prepare for the Ph.D. research. The balance of the courses should lend support to the major field of study while adding breadth to the student’s overall program. These courses may consist of Electrical Engineering courses in an area distinguishedly different from the major area and/or courses from other campus departments.
Advancement to Candidacy  A student advances to candidacy after he/she has passed the preliminary examination and the oral qualifying examination, as described below.

Preliminary Examination  The purpose of the preliminary examination is to screen candidates for continuation in the doctoral program. The examination is administered by the graduate program committee and is combined with the M.S. comprehensive examination. Students must solve five problems in their major area. Three of these problems must be from the “basic” courses and two must be from the “advanced” courses designated for each subject area. Students will be exempt from problems on basic courses for which they received “A” or higher, and problems on advanced courses for which they received “A-” or higher. Students who did not pass all five problems at the Ph.D. level in their first trial will be given a second chance within one month of their first attempt. In the second attempt, they will be required to solve problems only from the courses they did not pass at the Ph.D. level in their first attempt. The normative time for taking the preliminary exam is by the end of the student’s third quarter.

Plan II M.S. candidates who took the combined M.S. comprehensive and Ph.D. preliminary examination and successfully passed at the Ph.D. level are given credit for having passed the Ph.D. preliminary examination.

Oral Qualifying Examination  After passing the preliminary examination, the students are expected to demonstrate that they have a thorough understanding of their research field, and have potential for doing cutting-edge research. For that purpose, students must choose a research topic under the guidance of their faculty major professor and orally present to a Qualifying Committee, which is appointed by the Graduate Division based on nominations from the department, the state-of-the-art in that topic as well as the new research directions they intend to take. This presentation must be accompanied by a written report, which is written in proper technical English and in the style of a typical Electrical Engineering conference or journal publication. The student must complete this requirement in no more than two attempts. The normative time for taking the Oral Qualifying Exam is by the end of the first year.

Students will be exempt from problems on courses for which they received “A” or “A+”. Students who did not pass at the Ph.D. level in their first trial will be given a second chance. In the second attempt, they will be required to solve problems only from courses they did not pass at the Ph.D. level in their first attempt.

The presentation must be accompanied by a written report, written in proper technical English and in the style of a typical Electrical Engineering conference or journal publication. This report should clearly describe the proposed problem under study, demonstrate substantial knowledge of the topic and related issues, present the research results the student has obtained, and indicate the plans for future work. Students must demonstrate ability to carry out a program of independent advanced research and to report the results in accordance with standards observed in recognized technical journals.

The Oral Qualifying examination is closed to the public.
**Dissertation Proposal Evaluation** After advancement to candidacy, the student must form a Doctoral Dissertation Committee chaired by his or her major professor. The committee will consist of at least three senate faculty members with at least two members from the Electrical and Computer Engineering department.

The student must then prepare a written dissertation proposal that clearly indicates the proposed problem under study, demonstrate substantial knowledge of the topic and related issues, state the progress made towards a solution, and indicate the work remaining to be done. The new approaches and methods to be used in the research should be discussed. An extensive bibliography for the problem under study should also be attached to the proposal. The proposal should promise an original and substantial contribution to knowledge in the student’s major field. The student must demonstrate his/her ability to carry out a program of independent advanced research and to report the results in accordance with standards observed in recognized scientific journals.

The Dissertation Proposal Evaluation will be administered by the Doctoral Dissertation Committee, and will consist of an oral presentation of the dissertation proposal by the student, followed by an evaluation of the appropriateness of the research topic and the feasibility of the research plan. A realistic timeline for the completion of the dissertation will also be established. The normative time for the Dissertation Proposal Evaluation is by the end of the third year. It must be taken at least six months prior to the Dissertation Examination.

**Dissertation Examination and Defense** When the Doctoral Dissertation Committee determines that a suitable draft of the dissertation has been presented, a dissertation examination and defense for the student is scheduled. The defense consists of a public seminar followed by questions from the committee members and the audience.

**Language Requirement** To meet the degree requirements of the Electrical Engineering program, all admitted Ph.D. students whose native language is not English must take ESL classes until they get a “clear pass” on the TAST or SPEAK test.

**Normative Time to Degree** 12 quarters (15 quarters for students without an M.S. in Electrical Engineering)
Preparation for Careers in Teaching

All doctoral students are recommended to be employed as teaching assistants for at least three quarters during their graduate career. The department is developing special courses to aid in the learning of effective teaching methods, such as handling discussion/lab sessions and preparing and grading examinations.

Contact the Graduate Student Affairs Officer at the Department of Electrical and Computer Engineering, (951) 827-2484, or visit ee.ucr.edu for information on graduate courses.

Professional Development Requirement

All incoming M.S. and Ph.D. students must enroll in the Fall, Winter, and Spring offerings of EE 259, Colloquium in Electrical Engineering.

To facilitate in the development of technical presentation skills, all incoming M.S. and Ph.D. students must enroll in the Fall, Winter, and Spring offerings of EE 259, Colloquium in Electrical Engineering.

Additionally, students in the Ph.D. program must submit a Professional Development Report that details the students’ efforts in developing their technical writing and presentation skills. This report should be submitted to and approved by the Graduate Committee, as a prerequisite for filing the Oral Qualifying Committee nomination form. Specific requirements for the Professional Development Report are determined by the graduate program committee.