Electrical and Computer Engineering

Henry Samueli School of Engineering and Applied Science

Graduate Degrees

The Department of Electrical and Computer Engineering offers the Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees in Electrical and Computer Engineering.

Admissions Requirements

Master's Degree

Advising

Each department in the Henry Samuel School of Engineering and Applied Science has a graduate adviser. A current list of graduate advisers can be obtained from the Office of the Associate Dean for Academic and Student Affairs, 6426 Boelter Hall, Henry Samueli School of Engineering and Applied Science.

Students are assigned a faculty adviser upon admission to the School. Advisers may be changed upon written request from the student. All HSSEAS faculty serve as advisers.

New students should arrange an appointment as early as possible with the faculty adviser to plan the proposed program of study toward the M.S. degree. Continuing students are required to confer with the adviser during the time of enrollment each quarter to keep track of progress towards the degree and, when necessary, to modify/refine the study list.

Based on the quarterly transcripts, the departmental graduate adviser and Associate Dean for Academic and Student Affairs review student records at the end of each quarter. Special attention is given to students who were admitted provisionally or are on probation. If their progress is unsatisfactory, students are informed in writing by the Associate Dean for Academic and Student Affairs.

Students are strongly urged to consult with the departmental student office staff and/or the Office of Academic and Student Affairs regarding procedures, requirements and the implementation of policies. In particular, advice should be sought on advancement to candidacy for the M.S. degree, and on the use of the Filing Fee.

Areas of Study

Student can pursue specialization across three major areas of study: circuits and embedded systems, physical and wave electronics, and signals and systems. Student must select a number of formal graduate courses to serve as

their major and minor fields of study according to requirements listed under Course Requirements for the master's comprehensive plan (eight courses) and thesis plan (seven courses). A formal graduate course is defined as any 200-level course, excluding seminar or tutorial courses. The selection of the major and minor course sequences must be from different established tracks, or according to *ad hoc* tracks, or combinations of the two. The selected courses must be approved by the student's faculty adviser.

A track is a coherent set of courses in some general field of study. The department suggests lists of established tracks as a means to assist students in selecting their courses. Suggested tracks are described under Course Requirements. Students are not required to adhere to the suggested courses in any specific track. Students can select graduate courses from across established tracks, from across areas, and from outside Electrical and Computer Engineering and tailor these selections to their professional objectives. In consultation with their faculty advisers and subject to the approval of the Vice-Chair of Graduate Affairs, students also can propose an *ad hoc* track.

Foreign Language Requirement
None.

Course Requirements
The selection of courses for the master's degree program is tailored to the student's professional objectives and must meet the requirements outlined below. The courses should be selected and approved in consultation with the student's faculty adviser. Changes from the stated requirements are considered only in exceptional cases and must be approved by the Vice-Chair of Graduate Affairs.

The minimum standards and course requirements for the master's degree program are:

Prerequisite. B.S. degree in engineering or a related field.
Time-to degree. All master's degree course requirements must be completed within two academic years from admission into the program.

Academic standards. Students must maintain a minimum cumulative grade-point average of 3.00 each quarter ~~and a grade of B or better in all graduate courses~~.

Capstone Plan:
Six formal graduate courses to fulfill the student's major field of study
Two formal courses to fulfill the student's minor field of study
Five of the formal graduate courses must be in Electrical and Computer Engineering

One graduate seminar series course (Electrical and Computer Engineering 297)
One individual study course (Electrical and Computer Engineering 299) to cover the comprehensive examination or one additional formal graduate course
Electrical and Computer Engineering 296, 375, and 500-series courses may not be applied to course requirements.

Thesis Plan:
Five formal graduate courses to fulfill the student's major field of study
Two formal graduate courses to fulfill the student's minor field of study
Four of the formal graduate courses must be in Electrical and Computer Engineering
One graduate seminar series course (Electrical and Computer Engineering 297)
Two (8 units) Electrical and Computer Engineering 598 courses to cover thesis work

Both plans:

Student must select a number of formal graduate courses to serve as their major and minor fields of study according to requirements for the master's capstone plan (eight courses) and thesis plan (seven courses). The selection of the major and minor course sequences must be from different established tracks, or according to *ad hoc* tracks, or combinations of the two. The selected courses must be approved by the student's faculty adviser.

A formal graduate course is defined as any 200-level course, excluding seminar or tutorial courses.

A maximum of one upper division courses may replace one of the formal graduate courses covering the student's major and minor fields of study provided that (1) the undergraduate course is not required of undergraduate students in the department, and (2) the undergraduate course is approved by the student's faculty adviser.

A track is a coherent set of courses in some general field of study. The department suggests list of established tracks as a means to assist students in selecting their courses. Students are not required to adhere to the suggested courses in any specific track. Students can select graduate courses from across established tracks, from across areas, and from outside Electrical and Computer Engineering and tailor these selections to their professional objectives. In consultation with their faculty advisers and subject to the approval of the Vice-Chair of Graduate Affairs, students also can propose an *ad hoc* track.

Established Tracks

Circuits and Embedded Systems Area Tracks

Embedded Computing. Courses in this track deal with the engineering of computer systems, as may be applied to embedded devices used for communications, multimedia, or other such restricted purposes. Courses related to this track are: Electrical and Computer Engineering 201A, 201C, M202A, M202B, 204A, 213A, 216A, Computer Science 251A.
Integrated Circuits. Courses in this track deal with the analysis and design of analog and digital integrated circuits; architecture and IC implementations of large-scale digital processors for communications and signal processing; hardware-software co-design; and computer-aided design methodologies. Courses related to this track are: Electrical and Computer Engineering 213A, 215A, 215C, 215D, 215E, M216A, 221A, 221B, Computer Science 251A, 252A.

Physical and Wave Electronics Area Tracks

Electromagnetics. Courses in this track deal with electromagnetic theory; propagation and scattering; antenna theory and design; microwave and millimeter wave circuits; printed circuit antennas; integrated and fiber optics; microwave-optical interaction; antenna measurement and diagnostics; numerical and asymptotic techniques; satellite and personal communication antennas; periodic structures; genetic algorithms; and optimization techniques. Courses related to this track are: Electrical and Computer Engineering 221C, 260A, 260B, 261, 262, 263, 266, 270.
Photonics and Plasma Electronics. Courses in this track deal with laser physics; optical amplification; electro-optics; acousto-optics; magneto-optics; nonlinear optics; photonic switching and modulation; ultrafast phenomena, optical fibers, integrated waveguides; photodetection; optoelectronic integrated circuits; optical MEMS; analog and digital signal transmission; photonics sensors; lasers in biomedicine; fundamental plasma waves and instability; interaction of microwaves and laser radiation with plasmas; plasma diagnostics; and controlled nuclear fusion. Courses related to this track are Electrical and Computer Engineering 270, 271, 272, 273, 274, 285A, 285B, M287.

Solid-State and MEMS Devices. Courses in this track deal with solid-state physical electronics; semiconductor device physics and design; and microelectromechanical systems design and fabrication. Courses related to this track are: Electrical and Computer Engineering 221A, 221B, 221C, 222, 223, 224, 225, CM250A, M250B, Mechanical and Aerospace Engineering 281, 284, C287L

Signals and Systems Area Tracks

Communications Systems.. Courses in this track deal with communication and telecommunication principles and engineering applications; channel and source

coding; spread spectrum communication; cryptography; estimation and detection; algorithms and processing in communication and radar; satellite communication systems; stochastic modeling in telecommunication engineering; mobile radio engineering; telecommunication switching; queuing system; communication networks; and local-area, metropolitan-area, and wide-area computer communication networks. Courses related to this track are: Electrical and Computer Engineering 205A, 210A, 230A 230B, 230C, 230D, 231A, 231E, 232A, 232B, 232C, 232D, 232E, 233A, 233B, 238, 241A.
Control Systems and Optimization. Courses in this track deal with state-space theory of linear system; optimal control of deterministic linear and nonlinear systems; stochastic control; Kalman filtering; stability theory of linear and nonlinear feedback control systems; computer-aided design of control systems; optimization theory, including linear and nonlinear programming; convex optimization and engineering application; numerical methods; nonconvex programming; associated network flow and graph problems; renewal theory; Markov chains; stochastic dynamic programming; and queuing theory. Courses related to this track are: Electrical and Computer Engineering 205A, 208A, M208B, M208C, 210B, 236A, 236B, 236C, M237, M240A, 240B, M240C, 241A, 241B, 241C, M242A, 243.

Signal Processing. Courses in this track deal with digital signal processing theory; statistical signal processing; analysis and design of digital filters; digital speech processing; digital image processing; multirate digital signal processing; adaptive filtering; estimation theory; neural networks; and communications signal processing. Courses related to this track are: Electrical and Computer Engineering 205A, 210A, 210B, 211A, 211B, 212A, 212B, 213A, M214A, 214B, M217, 238.

Ad Hoc Track

In consultation with their faculty advisers, students can petition for an *ad hoc* track tailored to their professional objectives. This track may comprise graduate courses from across established tracks, from across areas, and even from outside Electrical and Computer Engineering. The petition must justify how the selection of courses forms a coherent set of courses, and how the proposed track serves the student's professional objectives. The petition must be approved by the student's faculty adviser and the Vice-Chair of Graduate Affairs.

Teaching Experience
Not required.

Field Experience
Not required.

Capstone Plan
The M.S. capstone requirement is satisfied by one of the following two options:

1. Through completion of an individual study (Electrical and Computer Engineering 299) under the direction of a faculty member. The student is assigned a topic of individual study by the faculty member and the study culminates with a written report and an oral presentation. The master's individual study program is administered for each student by the faculty member directing the course, the director of the area to which the student belongs, and the Vice-Chair of Graduate Affairs. Students who fail the examination may be re-examined once with the consent of the Vice-Chair of Graduate Affairs.

2. By solving a comprehensive examination problem in the final, project, or equivalent, of every formal graduate course in Electrical and Computer Engineering taken by the student. An average of at least 3.0 in the comprehensive examination problems is required for graduation. The master's individual study program is administered for each student by the student's academic adviser, the director of the area to which the student belongs, and the Vice Chair of Graduate Affairs.

Thesis Plan
Every master's degree thesis plan requires the completion of an approved thesis that demonstrates the student's ability to perform original, independent research.

The master's thesis requirement is satisfied through completion of a thesis that is under the direction of the student's faculty adviser and meets the approval of a thesis committee comprised of the adviser and two other faculty members. Thesis research must be conducted concurrently with the required course work.

Time-to-Degree
The average (normative) length of time for students in the master's degree program is five academic quarters (and one summer term). The maximum time allowed for completion of the degree is six academic quarters (and two summer terms) from the time of admission to the master's degree program.

DEGREE	NORMATIVE TIME TO ATC (Quarters)	NORMATIVE TTD	MAXIMUM TTD
M.S.	**5**	**6**	**8**