Computer Engineering involves knowledge of hardware and software development. The students learn how to design new generations of computers, as well as embedded computing systems, such as those found in smartphones, cars, appliances, computer networks, smart factories, and the internet-of-things. The program covers the entire digital integrated circuit design process targeting Field Programmable Gate Arrays (FPGAs) and Application Specific Integrated Circuits (ASICs), using various optimization criteria, such as speed, cost, power, energy, reliability, and security. It also encompasses the complete software development process targeting microcontrollers, microprocessors, multi-cores, and Graphics Processing Units (GPUs). It teaches students how to efficiently partition the system into software and hardware components, and develop high-performance interfaces between these two parts. Project-oriented courses and labs expose students to modern computer-aided design tools for hardware and software design. The students master the art of writing comprehensive technical reports and giving successful oral presentations. The computer engineering program offers the following specialization areas: digital systems design, microprocessor and embedded systems, internet of things, digital signal processing, computer networks, and network and system security.

Admission is very competitive. The department’s policy is to admit only those students who have demonstrated a potential for outstanding performance in their graduate work.

Admissions & Policies

Admissions

Categories of Admission

Each student may be admitted into one of the following categories: degree, provisional, or nondegree. Provisional admission is for anyone whose past performance provides reasonable, but not strong, evidence of ability to pursue graduate work. To advance to degree status, a provisional student must achieve a 3.00 GPA after 12 credits, remove all undergraduate deficiencies by completing the corresponding courses with grades of B or better, and receive a B or better in two core courses specific to the student’s selected program and specialization. The nondegree category is used primarily by students who want to take courses but not necessarily pursue a degree. Nondegree students seeking to enter degree programs must formally apply for admission.

Requirements

To be considered for admission to the master’s program, applicants should have a baccalaureate degree in electrical engineering, computer engineering, or a closely-related discipline from an accredited program with a reputation for high academic standards, and have earned a GPA of B or better during the last 60 credits. Other requirements are as follows:

- Two letters of recommendation, preferably from academic references or references in industry or government who hold advanced degrees and are familiar with the applicant’s professional accomplishments
- Resume and detailed statement of career goals and aspirations
- For students who have not earned a bachelor’s degree from a U.S. university, satisfactory performance on the GRE
- For students whose native language is not English, a minimum TOEFL score of 575 for the paper-based exam or 230 for the computer-based exam. A minimum score of 600 for the paper-based exam or 250 for the computer-based exam is required for applicants who wish to be considered for a graduate teaching assistantship.

Non-ECE Students

Students with BS or MS degrees in ECE-related disciplines (for example, computer science, mathematics, mechanical engineering, physics, or electrical engineering technology) are encouraged to apply for admission. They may initially be admitted into the provisional category and advance to degree status by satisfying requirements described in the Admissions Categories section. Such students may also be advised to take some courses from the undergraduate electrical or computer engineering curriculum, according to their intended specialization and specific backgrounds.

Policies

Student Advising

Newly-admitted graduate students must consult with the ECE graduate coordinator before they register for classes. Students should make an appointment by calling the ECE office. Students are expected to select a specialization from those available in each MS degree program. Students then are assigned an academic advisor from that specialization.

GPA Requirements

A maximum of 6 credits of courses with grades of C or B- may be applied toward the degree. The student must present a GPA of at least 3.00 for all courses submitted for the degree.

Program Requirements

Students must complete a minimum of 30 graduate credits beyond the bachelor’s degree. This work must represent a cohesive set of courses leading to comprehensive knowledge in one specialized area of computer engineering; it cannot be a set of disjointed courses.

Plan of Study

Before the end of the second semester, each student must submit to the graduate coordinator’s office a plan of study that has been approved by the academic advisor. This plan should be kept up to date by regular consultation with the academic advisor. A final, signed version of the plan must be turned in when the student submits a graduation application.

Requirements

Degree Requirements

Total credits: 30
Seminar

In their final semester, students must continue to register for the requirement. Students who have not met the seminar requirement in previous semesters must meet and submit a grade of S (satisfactory) upon completion of the requirement. The department office will verify that the seminar requirement has been met.

To demonstrate completion of the seminar requirement, students must register for ECE 795 Engineering Seminar in their final semester. The department office will verify that the seminar requirement has been met and submit a grade of S (satisfactory) upon completion of the requirement. Students who have not met the seminar requirement in their final semester must continue to register for ECE 795 Engineering Seminar in subsequent semesters until the requirement is met.

Core Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Select two courses from the following: 1</td>
<td></td>
</tr>
<tr>
<td>CS 571</td>
<td>Operating Systems</td>
<td>6</td>
</tr>
<tr>
<td>ECE 511</td>
<td>Microprocessors</td>
<td></td>
</tr>
<tr>
<td>ECE 542</td>
<td>Computer Network Architectures and Protocols</td>
<td></td>
</tr>
<tr>
<td>ECE 545</td>
<td>Digital System Design with VHDL</td>
<td></td>
</tr>
<tr>
<td>ECE 548</td>
<td>Sequential Machine Theory</td>
<td></td>
</tr>
</tbody>
</table>

Total Credits: 6

1 Requires B or better in each course.

ECE or CS Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Select a minimum of 3 ECE or CS courses, at the 600 level and above, including doctoral courses (800 and 900 levels) 1,2</td>
<td>9</td>
</tr>
</tbody>
</table>

Total Credits: 9

1 Not including ECE 798 Research Project or ECE 799 Master's Thesis
2 Requires a grade of B or better in each.

Electives

Electives should be chosen either from the list of pre-approved electives strongly suggested for a given specialization area or from the list of elective courses common for all specialization areas. Elective courses from the latter list must be approved by the student's advisor prior to the registration for a given course.

The plan of study usually has no fewer than 15 credits of courses designated ECE.

Lists of courses appropriate for specialization areas, such as digital systems design, microprocessor and embedded systems, digital signal processing, computer networks, and network and system security, are available on the ECE website. A self-defined specialization may be created when appropriate, with the approval of the computer engineering graduate program coordinator. This specialization must include components of hardware and software development and the corresponding plan of study should comprise courses from ECE and the Computer Science Departments.

Seminar Requirement

Graduate students are expected to participate actively in the exchange of knowledge and ideas in their discipline. Towards this objective, all degree candidates must attend a minimum of 6 graduate seminars approved for the degree program. Approved seminars are publicized on the departmental webpage.

To demonstrate completion of the seminar requirement, students must register for ECE 795 Engineering Seminar in their final semester. The department office will verify that the seminar requirement has been met and submit a grade of S (satisfactory) upon completion of the requirement. Students who have not met the seminar requirement in their final semester must continue to register for ECE 795 Engineering Seminar in subsequent semesters until the requirement is met.

Thesis/Scholarly Paper Option

To complete the program, students may select one of the following options:

Thesis Option

Students who select this option must complete:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 799</td>
<td>Master's Thesis</td>
<td>6</td>
</tr>
<tr>
<td>Coursework</td>
<td></td>
<td>24</td>
</tr>
</tbody>
</table>

Total Credits: 30

The thesis is particularly recommended for those students who wish to develop and document their research skills or contemplate subsequent enrollment in a PhD program. The thesis involves a research effort, which is conducted under the guidance of a faculty advisor. In some cases, permission may be granted to complete a portion of the work at the student’s place of employment. The final written thesis and oral defense are approved by the student’s advisory committee.

For the Electrical Engineering program, this committee consists of at least three full-time faculty members, including two from the student’s major specialization, and one from outside the specialization. For the Computer Engineering Program, this committee consists of at least three full-time faculty members, including two affiliated with the MS in Computer Engineering Program, one of whom must be from the ECE Department. Thesis students may not register for ECE 798 Research Project. Students must register for at least 3 credits of thesis for their first thesis semester. Following their first thesis semester, they must register for at least 1 credit of thesis each fall and spring semester until graduation.

Scholarly Paper Option

Students who select to complete their degree program with a scholarly paper must:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Complete 30 credits of coursework</td>
<td>30</td>
</tr>
<tr>
<td>ECE 797</td>
<td>Scholarly Paper</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Enroll in a 600-level or above course requiring a research project</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Write a Scholarly Paper project report and present findings as part of the course requirements</td>
<td></td>
</tr>
</tbody>
</table>

Total Credits: 30

An acceptable scholarly paper must be technically sound, adhere to accepted formatting standards for technical reports, and contain a significant literature review evidenced by a comprehensive list of cited references.

A list of courses requiring projects that can be used to satisfy the scholarly paper requirement will be published on the department website. Scholarly papers must be individual written project reports – not group projects. To qualify as a scholarly paper an oral presentation of the project is required. A passing grade for the project, reflecting both the written report and the oral presentation, satisfies the scholarly paper requirement.

A successful scholarly paper will be recorded by awarding a satisfactory (S) grade for ECE 797 Scholarly Paper. Students are eligible to attempt the scholarly paper and register for ECE 797 Scholarly Paper after completion of 18 hours of coursework. Students choosing the scholarly
paper option are not eligible for graduation until they have received a final, passing grade for ECE 797 Scholarly Paper.

**Accelerated Master's**

**Computer Engineering, BS/Computer Engineering, Accelerated MS**

**Overview**
The university offers highly-qualified students in the Computer Engineering, BS the option of obtaining an accelerated Computer Engineering, MS.

For more detailed information, see AP6.7 Bachelor's/Accelerated Master's Degrees. For policies governing all graduate degrees, see AP6 Graduate Policies.

**Admission Requirements**
Students in the Computer Engineering, BS program may apply to this option if they have earned 90 undergraduate credits with an overall GPA of 3.25. Criteria for admission are identical to criteria for admission to the Computer Engineering, MS program.

**Accelerated Option Requirements**
Students must complete all credits that satisfy the requirements for the BS and MS programs, with 6 credits overlap.

Students take 6 credits of 500-level courses as part of their technical electives or substitutes for required courses as part of their 126-credit undergraduate program. The specific courses that may be taken and applied to the accelerated program will be specified by the ECE Department.

Students admitted to the accelerated program must maintain an overall GPA of at least 3.25 during the entire BS/MS program and present a GPA of at least 3.25 for the 24 credits of graduate work submitted for the MS degree.

Students may take additional graduate-level courses as part of their BS technical electives with advisor approval. These additional graduate-level courses will not count toward the MS degree.

**Degree Conferral**
Students must apply the semester before they expect to complete the BS requirements to have the BS degree conferred. In addition, at the beginning of the student's final undergraduate semester, students must complete a Bachelor's/Accelerated Master's Transition form that is submitted to the Office of the University Registrar and the VSE Graduate Admissions Office. At the completion of MS requirements, a master's degree is conferred.