

# ELECTRICAL ENGINEERING, BS

Banner Code: VS-BS-ELEN

## Academic Advising

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Electrical engineering is a major field of modern technology. Electrical engineers are involved in research, development, design, production, and operation of a wide variety of devices and systems, including integrated circuits and microwave and laser devices, communication systems, control systems, radar, robots, large telecommunication networks, and power networks. The electrical engineering program is staffed by ECE faculty composed of 33 full-time professors, including fellows of IEEE or other professional societies, and several part-time professors.

The bachelor's program in electrical engineering is accredited by the Engineering Accreditation Commission of ABET (<http://www.abet.org>).

## Career Opportunities

Career opportunities exist in engineering research and development, system design, system integration, engineering management, engineering consultancy, technical sales, and patent law, among others. The program provides a strong preparation for graduate study.

## Specializations

The curriculum provides a strong background in the fundamentals of electrical engineering and senior-level courses in the important areas of electronics, networks, communications and signal processing, computer engineering, and controls and robotics. Further, the curriculum includes 9 credits of senior technical electives, 2 credits of advanced engineering labs, and 3 credits of senior advanced design project, which may be used for further specialization in one of these areas.

## Additional Information

Degree requirements may be satisfied on a full-time or part-time basis. Cooperative education provides students with the opportunity to integrate paid career-related work experience with classroom learning. Academic credit towards the completion of major requirements is not given for co-op experience. In addition to the usual financial aid available to all students through the Office of Student Financial Aid, electrical engineering majors are eligible to apply at the ECE Department for scholarships provided by professional societies and industrial organizations, including the Armed Forces Communications and Electronics Association and the Institute of Electrical and Electronics Engineers.

## Admissions & Policies

### Policies

For policies governing all undergraduate degrees, see AP.5 Undergraduate Policies.

### Writing-Intensive Requirement

Mason's writing-intensive requirement is satisfied by the following group of three courses: ECE 333 Linear Electronics I, ECE 445 Computer Organization, and ECE 491 Engineering Seminar in which faculty provide feedback on student writing assignments. Drafts and revisions are required.

### Change of Major

See Change of Major for more information.

### Termination from the Major

No math, science, or Volgenau School of Engineering course that is required for the major may be attempted more than three times. Those students who do not successfully complete such a course within three attempts will be terminated from the major. Undeclared students in the Volgenau School who do not successfully complete a course required for a Volgenau School major within three attempts will also be terminated. For more information, see AP.5.2.4 Termination from the Major.

Once a student has attempted one of these courses twice unsuccessfully, the third attempt must be no later than the next semester of enrollment, excluding summers. Failure to take the course at that time will result in termination from the major. If the student is unable to take the course when required, the student may request an extension to a future semester; extensions require approval of the student's advisor, their department, and the Associate Dean for Undergraduate Programs. The deadline for extension requests is the add deadline for the semester in which the course is required.

Students who have been terminated from a Volgenau School of Engineering major may not register for a Volgenau School course without permission of the department offering the course. This applies to all undergraduate courses offered by the Volgenau School except IT 104 Introduction to Computing (Mason Core) and STAT 250 Introductory Statistics I (Mason Core).

A student may not declare any major in the Volgenau School of Engineering if the student has previously met the termination criteria for that major at any time, regardless of what the student's major was at the time the courses were taken.

### Double Major and Minor Programs for Electrical Engineering and Computer Engineering

Electrical Engineering majors and Computer Engineering majors can earn degrees with double majors in a number of disciplines. Computer Engineering and Computer Science are frequently combined. Electrical Engineering has been combined with Computer Engineering, Computer Science, Mechanical Engineering, Physics or Math. Details are available in the department brochures or at the Volgenau School web site [volgenau.gmu.edu](http://volgenau.gmu.edu) (<http://volgenau.gmu.edu>). There are several minors

available for students in the ECE Department including the Mechanical Engineering minor.

## Grade Requirements

All electrical engineering students are strongly encouraged to see their major faculty advisor before course registration each semester.

Students must complete each ECE, ENGR, BENG, CS, MATH, PHYS, and STAT course presented as part of the required 121 credits for the degree with a grade of C or better.

Students must also complete any course required by the program that is a prerequisite to another course applicable to the degree with a grade of C or better.

## Requirements

### Degree Requirements

Total credits: minimum 121

#### Electrical and Computer Engineering

ECE 101	Introduction to Electrical and Computer Engineering	3
ECE 201	Introduction to Signals and Systems	3
ECE 220	Continuous-Time Signals and Systems	3
ECE 285	Electric Circuit Analysis I <sup>1</sup>	3
ECE 286	Electric Circuit Analysis II <sup>1</sup>	3
ECE 305	Electromagnetic Theory	3
ECE 331	Digital System Design	3
ECE 332	Digital Electronics and Logic Design Lab	1
ECE 333	Linear Electronics I	3
ECE 334	Linear Electronics Lab I	1
ECE 421	Classical Systems and Control Theory	3
ECE 433	Linear Electronics II	3
ECE 445	Computer Organization	3
ECE 460	Communication and Information Theory	3
ECE 491	Engineering Seminar	1
ECE 492	Senior Advanced Design Project I (Mason Core) <sup>2</sup>	1
ECE 493	RS: Senior Advanced Design Project II (Mason Core)	2
Total Credits		42

<sup>1</sup> Note that ECE 285 Electric Circuit Analysis I/ECE 286 Electric Circuit Analysis II courses taken at Mason prior to fall 2013 or transferred to Mason prior to fall 2014 do NOT meet the circuits analysis requirement. Students who fit in either category need to contact the department as soon as possible to discuss their options.

<sup>2</sup> Students who would like to complete a more challenging senior design project have the option of enrolling in ECE 392 Engineering Design Studio to gain a semester head start in the design process.

#### Technical Electives

Four technical elective courses totaling 12 credit hours must be selected from the list below. Up to 3 credits of ECE 499 Special Topics in Electrical Engineering courses may be taken as technical electives. ECE 447 Single-Chip Microcomputers and ECE 448 FPGA and ASIC Design with VHDL,

which are 4-credit courses with built-in labs, can be used to fulfill one technical elective and one advanced lab requirement. Some graduate courses and courses outside the ECE department may be taken to fulfill the technical elective requirement with the permission of the department. The decision to approve non-ECE courses as well as graduate courses as technical electives is at the discretion of the department based on a review of the course content and the student's academic record.

Select 12 credit hours from the following: 12

ECE 350	Embedded Systems and Hardware Interfaces
ECE 370	Robot Design
ECE 410	Applications of Discrete-Time Signal Processing
ECE 422	Digital Control Systems
ECE 430	Principles of Semiconductor Devices
ECE 431	Digital Circuit Design
ECE 446	Device Driver Development
ECE 447	Single-Chip Microcomputers
ECE 448	FPGA and ASIC Design with VHDL
ECE 450	Introduction to Robotics
ECE 462	Data and Computer Communications
ECE 463	Digital Communications Systems
ECE 465	Computer Networking Protocols
ECE 470	Introduction to Humanoid Robotics
ECE 499	Special Topics in Electrical Engineering

Total Credits 12

#### Advanced Engineering Labs

Select two advanced labs from the following: 2

ECE 429	Control Systems Lab
ECE 434	Linear Electronics II Laboratory
ECE 447	Single-Chip Microcomputers <sup>1</sup>
ECE 448	FPGA and ASIC Design with VHDL <sup>1</sup>
ECE 461	Communication Engineering Laboratory
ECE 467	Network Implementation Laboratory

Total Credits 2

<sup>1</sup> Fulfills 3 credits of technical electives and 1 credit of advanced lab.

#### Computer Science

CS 112	Introduction to Computer Programming (Mason Core)	4
CS 222	Computer Programming for Engineers	3
Total Credits		7

#### Mathematics and Statistics

MATH 113	Analytic Geometry and Calculus I (Mason Core)	4
MATH 114	Analytic Geometry and Calculus II	4
MATH 203	Linear Algebra	3
MATH 213	Analytic Geometry and Calculus III	3
MATH 214	Elementary Differential Equations	3

STAT 346	Probability for Engineers	3
Total Credits		20

## Physics

PHYS 160	University Physics I (Mason Core)	3
PHYS 161	University Physics I Laboratory (Mason Core)	1
PHYS 260	University Physics II (Mason Core)	3
PHYS 261	University Physics II Laboratory (Mason Core)	1
PHYS 262	University Physics III (Mason Core)	3
PHYS 263	University Physics III Laboratory (Mason Core)	1
Total Credits		12

## Engineering

ENGR 107	Introduction to Engineering (Mason Core)	2
Total Credits		2

## English, Communication, and Economics

ENGH 302	Advanced Composition (Mason Core) (Natural Sciences and Technology section)	3
COMM 100 or COMM 101	Public Speaking (Mason Core) Interpersonal and Group Interaction (Mason Core)	3
ECON 103	Contemporary Microeconomic Principles (Mason Core)	3
Total Credits		9

## Additional Mason Core

Students must complete all Mason Core requirements not fulfilled by major requirements. Mason Core courses should be selected from the department's list of approved courses. The Synthesis Mason Core requirement is satisfied by ECE 492 Senior Advanced Design Project I (Mason Core) and ECE 493 RS: Senior Advanced Design Project II (Mason Core). All students must submit at least 24 credits of social science and humanities coursework, which is normally satisfied by the 24 credits of Mason Core social science and humanities courses listed here and in previous sections.

Written Communication <sup>1</sup>	Literature	Arts	Western Civilization/World History	Global Understanding	Total Credits
3	3	3	3	3	15

<sup>1</sup> Lower-level requirement.

## Concentrations

Concentrations are available in the electrical engineering baccalaureate program. Completion of specific science courses and senior-level courses leads to one of these designations on the student's transcript on graduation. Concentration requirements may also meet some or all of the Advanced Engineering Lab and Technical Elective requirements.

### Concentration in Bioengineering (BIOE)

BENG 301	Bioengineering Measurements	3
BENG 302	Bioengineering Measurements Lab	1
ECE 434	Linear Electronics II Laboratory	1
or ECE 429	Control Systems Lab	
ECE 492	Senior Advanced Design Project I (Mason Core)	1
ECE 493	RS: Senior Advanced Design Project II (Mason Core) <sup>1</sup>	2
Select two from the following:		6
BENG 304	Modeling and Control of Physiological Systems	
BENG 313	Physiology for Engineers	
BENG 406	Introduction to Biomechanics	
BENG 420	Bioinformatics for Engineers	
BENG 525	Neural Engineering	
BENG 499	Special Topics in Bioengineering <sup>2</sup>	
BENG 538	Medical Imaging	
BENG 590	Selected Topics in Bioengineering	
ECE 499	Special Topics in Electrical Engineering <sup>1,2,3</sup>	
ECE 590	Selected Topics in Engineering <sup>1,2</sup>	
Total Credits		14

<sup>1</sup> Bioengineering topic only.

<sup>2</sup> Must be pre-approved by advisor.

<sup>3</sup> For a minimum of 3 credits.

### Concentration in Communications and Signal Processing (CSP)

ECE 461	Communication Engineering Laboratory	1
ECE 492	Senior Advanced Design Project I (Mason Core)	1
ECE 493	RS: Senior Advanced Design Project II (Mason Core) <sup>1</sup>	2
Select three from the following:		9
ECE 410	Applications of Discrete-Time Signal Processing	
ECE 462	Data and Computer Communications	
ECE 463	Digital Communications Systems	
ECE 465	Computer Networking Protocols	
ECE 499	Special Topics in Electrical Engineering <sup>1,2,3</sup>	
ECE 528	Introduction to Random Processes in Electrical and Computer Engineering	
ECE 535	Digital Signal Processing	
ECE 567	Optical Fiber Communications	
ECE 590	Selected Topics in Engineering <sup>1,2</sup>	
PHYS 306	Wave Motion and Electromagnetic Radiation	
Total Credits		13

<sup>1</sup> Communications and signal processing topic only.

<sup>2</sup> Must be pre-approved by advisor.

<sup>3</sup> For a minimum of 3 credits.

**Concentration in Computer Engineering (CPE)**

ECE 447	Single-Chip Microcomputers	4
ECE 492	Senior Advanced Design Project I (Mason Core)	1
ECE 493	RS: Senior Advanced Design Project II (Mason Core) <sup>1</sup>	2
Select two from the following:		6-7
ECE 350	Embedded Systems and Hardware Interfaces	
ECE 431	Digital Circuit Design	
ECE 446	Device Driver Development	
ECE 448	FPGA and ASIC Design with VHDL	
ECE 450	Introduction to Robotics	
ECE 499	Special Topics in Electrical Engineering <sup>1,2,3</sup>	
ECE 510	Real-Time Concepts	
ECE 548	Sequential Machine Theory	
ECE 590	Selected Topics in Engineering <sup>1,2</sup>	
CS 471	Operating Systems	
Total Credits		13-14

<sup>1</sup> Computer engineering topic only.

<sup>2</sup> Must be pre-approved by advisor.

<sup>3</sup> For a minimum of 3 credits.

**Concentration in Control Systems (CON)**

ECE 429	Control Systems Lab	1
ECE 492	Senior Advanced Design Project I (Mason Core)	1
ECE 493	RS: Senior Advanced Design Project II (Mason Core) <sup>1</sup>	2
Select three from the following:		9-10
ECE 370	Robot Design	
ECE 422	Digital Control Systems	
ECE 447	Single-Chip Microcomputers	
ECE 450	Introduction to Robotics	
ECE 470	Introduction to Humanoid Robotics	
ECE 499	Special Topics in Electrical Engineering <sup>1,2,3</sup>	
ECE 511	Microprocessors	
ECE 521	Modern Systems Theory	
ECE 528	Introduction to Random Processes in Electrical and Computer Engineering	
ECE 590	Selected Topics in Engineering <sup>1,2</sup>	
Total Credits		13-14

<sup>1</sup> Control systems topic only

<sup>2</sup> Must be pre-approved by advisor.

<sup>3</sup> For a minimum of 3 credits.

**Concentration in Electronics (ELE)**

ECE 434	Linear Electronics II Laboratory	1
or ECE 435	Digital Circuit Design Laboratory	
ECE 492	Senior Advanced Design Project I (Mason Core)	1

ECE 493	RS: Senior Advanced Design Project II (Mason Core) <sup>1</sup>	2
Select three from the following:		9-10
ECE 430	Principles of Semiconductor Devices	
ECE 431	Digital Circuit Design	
ECE 447	Single-Chip Microcomputers	
ECE 448	FPGA and ASIC Design with VHDL	
ECE 499	Special Topics in Electrical Engineering <sup>1,2,3</sup>	
ECE 513	Applied Electromagnetic Theory	
ECE 565	Introduction to Optical Electronics	
ECE 567	Optical Fiber Communications	
ECE 584	Semiconductor Device Fundamentals	
ECE 586	Digital Integrated Circuits	
ECE 587	Design of Analog Integrated Circuits	
ECE 590	Selected Topics in Engineering <sup>1,2</sup>	
PHYS 306	Wave Motion and Electromagnetic Radiation	
PHYS 308	Modern Physics with Applications	
Total Credits		13-14

<sup>1</sup> Electronics topic only.

<sup>2</sup> Must be pre-approved by advisor.

<sup>3</sup> For a minimum of 3 credits.

**Accelerated Master's****Electrical Engineering, BS/Electrical Engineering, Accelerated MS****Overview**

Highly-qualified students in the Electrical Engineering, BS have the option of obtaining an accelerated Electrical Engineering, MS.

For more detailed information, see AP.6.7 Bachelor's/Accelerated Master's Degrees. For policies governing all graduate degrees, see AP.6 Graduate Policies.

**Admission Requirements**

Students in the Electrical 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 Electrical 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 121-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.

## Electrical Engineering, BS/ Telecommunications, Accelerated MS

### Overview

Highly-qualified students in the Electrical Engineering, BS have the option of obtaining an accelerated Telecommunications, MS.

For more detailed information, see AP.6.7 Bachelor's/Accelerated Master's Degrees. For policies governing all graduate degrees, see AP.6 Graduate Policies.

### Admission Requirements

Students can apply for the program during the semester in which they expect to complete 90 undergraduate credits applicable toward the BS degree. An overall GPA of at least 3.10 at the time of application is required. Criteria for admission are identical to criteria for admission to the MS in Telecommunications Program. Application is made using the accelerated graduate program application forms, and all usual requirements must be met. The accelerated program application form specifies the overlapping courses and details the 3.10 undergraduate GPA.

### Accelerated Option Requirements

Students must complete 145 credits that satisfy all the requirements for the BS and MS degrees, 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 121-credit undergraduate program. 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. Students admitted to the accelerated program must maintain an overall GPA of at least 3.00 during the MS program and present a GPA of at least 3.00 for the 24 credits of graduate work submitted for the MS degree.

Code	Title	Credits
Select 6 credits from the following:		6
TCOM 535	The TCP/IP Suite of Internet Protocols	
TCOM 551	Digital Communication Systems	
Or approved substitutions		
Total Credits		6

### Degree Conferral

Students must apply to have the BS conferred the semester before they expect to complete the BS requirements. At the completion of the MS requirements, the MS degree will be awarded.