

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 reliable, secure, and high-speed communication networks, autonomous vehicles, robots, multi-agent systems, nanoscale integrated circuits as well as sensors that are essential to the internet-of-things. Other technologies in electrical engineering include smartphones, tablets and other modern computing platforms, as well as wearable technology such as health-monitoring wristbands, biomedical systems such as prosthetic devices, and brain-machine interfaces.

The Department of Electrical and Computer Engineering is staffed by 33 full-time professors 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 areas of electronics, networks, communications and signal processing, bioengineering, computer engineering, and controls and robotics. Further, the curriculum includes 12 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 through the Office of Student Financial Aid, electrical engineering majors are encouraged to apply for scholarships provided by various professional societies and industrial organizations in their field.

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 two courses: ECE 333 Linear Electronics I and ECE 491 Engineering Seminar in which faculty provide writing instruction and feedback on student technical writing assignments. Drafts and revisions are required.

Change of Major

See Change of Major for more information.

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>). There are several minors available for students in the ECE Department including the Mechanical Engineering minor, Bioengineering minor, and others as listed in the catalog.

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.

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.

Requirements

Degree Requirements

Total credits: minimum 121

Electrical and Computer Engineering

Code	Title	Credits
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	3
ECE 286	Electric Circuit Analysis II	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) ¹	1
ECE 493	RS: Senior Advanced Design Project II (Mason Core)	2
Total Credits		42

¹ 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 more than 3 credits of ECE 499 Special Topics in Electrical Engineering, 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.

Code	Title	Credits
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	Mobile Robots	
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

Code	Title	Credits
Select two advanced labs from the following:		2
ECE 429	Control Systems Lab	
ECE 434	Linear Electronics II Laboratory	
ECE 447	Single-Chip Microcomputers ¹	
ECE 448	FPGA and ASIC Design with VHDL ¹	
ECE 461	Communication Engineering Laboratory	
ECE 467	Network Implementation Laboratory	
Total Credits		2

¹ Fulfills 3 credits of technical electives and 1 credit of advanced lab.

Computer Science

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

Mathematics and Statistics

Code	Title	Credits
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

Code	Title	Credits
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

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

English, Communication, and Economics

Code	Title	Credits
ENGH 302	Advanced Composition (Mason Core) (Natural Sciences and Technology section)	3
COMM 100 or COMM 101	Public Speaking (Mason Core) Fundamentals of Communication (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.

Code	Title	Credits
Written Communication ¹		3
Literature		3
Arts		3
Western Civilization/World History		3
Global Understanding		3
Total Credits		15

¹ 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.

Available Concentrations

- Concentration in Bioengineering (BIOE)
- Concentration in Communications and Signal Processing (CSP)
- Concentration in Computer Engineering (CPE)
- Concentration in Control Systems (CON)
- Concentration in Electronics (ELE)

Concentration in Bioengineering (BIOE)

Code	Title	Credits
BENG 301	Bioengineering Measurements	3
BENG 302	Bioengineering Measurements Lab	1
ECE 434 or ECE 429	Linear Electronics II Laboratory Control Systems Lab	1
ECE 492	Senior Advanced Design Project I (Mason Core)	1
ECE 493	RS: Senior Advanced Design Project II (Mason Core) ¹	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 ^{2,3}	
BENG 538	Medical Imaging	
BENG 590	Selected Topics in Bioengineering	
ECE 499	Special Topics in Electrical Engineering ^{1,2,3}	
ECE 590	Selected Topics in Engineering ^{1,2}	
Total Credits		14

¹ Bioengineering topic only.

² Must be pre-approved by department.

³ For a minimum of 3 credits.

Concentration in Communications and Signal Processing (CSP)

Code	Title	Credits
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) ¹	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 ^{1,2,3}	

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 ^{1,2}	
PHYS 306	Wave Motion and Electromagnetic Radiation	
CYSE 476	Cryptography and Computer Network Security	
Total Credits		13

¹ Communications and signal processing topic only.

² Must be pre-approved by department.

³ For a minimum of 3 credits.

Concentration in Computer Engineering (CPE)

Code	Title	Credits
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) ¹	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	Mobile Robots	
ECE 499	Special Topics in Electrical Engineering ^{1,2,3}	
ECE 510	Real-Time Concepts	
ECE 548	Sequential Machine Theory	
ECE 590	Selected Topics in Engineering ^{1,2}	
CS 471	Operating Systems	
Total Credits		13-14

¹ Computer engineering topic only.

² Must be pre-approved by department.

³ For a minimum of 3 credits.

Concentration in Control Systems (CON)

Code	Title	Credits
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) ¹	2
Select three from the following:		9-10
ECE 370	Robot Design	
ECE 422	Digital Control Systems	
ECE 447	Single-Chip Microcomputers	
ECE 450	Mobile Robots	
ECE 470	Introduction to Humanoid Robotics	

ECE 499	Special Topics in Electrical Engineering ^{1,2,3}	
ECE 511	Microprocessors	
ECE 521	Linear Systems and Control	
ECE 528	Introduction to Random Processes in Electrical and Computer Engineering	
ECE 590	Selected Topics in Engineering ^{1,2}	
Total Credits		13-14

¹ Control systems topic only

² Must be pre-approved by department.

³ For a minimum of 3 credits.

Concentration in Electronics (ELE)

Code	Title	Credits
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) ¹	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 ^{1,2,3}	
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 ^{1,2}	
PHYS 306	Wave Motion and Electromagnetic Radiation	
PHYS 308	Modern Physics with Applications	
Total Credits		13-14

¹ Electronics topic only.

² Must be pre-approved by department.

³ For a minimum of 3 credits.

Accelerated Master's

BS (selected)/Operations Research, Accelerated MS

Overview

Highly-qualified students in selected BS programs (see below) have the option of obtaining an accelerated Operations Research, 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

Mason undergraduate students majoring in the following disciplines may apply to this option if they have earned 90 undergraduate credits with an overall GPA of at least 3.30 and completed all MATH and PHYS requirements. Criteria for admission are identical to criteria for admission to the Operations Research, MS program.

- Computer Engineering
- Computer Science
- Electrical Engineering

Accelerated Option Requirements

Up to two courses (6 credits) of approved master's level courses taken as part of the undergraduate degree may be applied to the graduate degree. These two courses may be chosen from the graduate courses in the following table.

For BS candidates, these graduate courses replace the corresponding undergraduate courses. The undergraduate version of these courses may not be applied to the MS degree.

Undergraduate	Graduate	
SYST 420	SYST 521	Credit may not be received for both courses.
SYST 473	SYST 573	Credit may not be received for both courses.
OR 441	OR 541	Credit may not be received for both courses.
OR 442	OR 542	Credit may not be received for both courses.

Any other 500-level course may be applied to both the undergraduate and graduate degrees with approval of the advisor and SEOR department chair.

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.

BS (selected)/Statistical Science, Accelerated MS

Overview

Highly-qualified students in selected BS programs (see below) have the option of obtaining an accelerated Statistical Science, MS. Students in an accelerated degree program must fulfill all university requirements for the master's degree.

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 enrolled in a BS degree in any one of the Volgenau School major areas, in the Mathematics, BS program from the College of Science, or in the Economics, BS program from the College of Humanities and Social Sciences may apply to this option if they have earned 90 undergraduate credits with an overall GPA of 3.00. Criteria for admission are identical to criteria for admission to the Statistical Science, MS program, which include successful completion of the following Mason courses each with a grade of C or better:

Code	Title	Credits
MATH 113	Analytic Geometry and Calculus I (Mason Core)	4
MATH 114	Analytic Geometry and Calculus II	4
MATH 213	Analytic Geometry and Calculus III	3
MATH 203 or MATH 321	Linear Algebra Abstract Algebra	3
STAT 250 or STAT 344	Introductory Statistics I (Mason Core) Probability and Statistics for Engineers and Scientists I	3
STAT 346 or MATH 351	Probability for Engineers Probability	3

Accelerated Option Requirements

Students must complete all credits that satisfy requirements for the BS and MS programs, with 6 credits overlapping with grades of B or better in two 500-level STAT courses selected from STAT 544 Applied Probability, STAT 554 Applied Statistics I, and STAT 574 Survey Sampling I.

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 Graduate Recruitment and Enrollment Services. At the completion of MS requirements, a master's degree is conferred.

BS (selected)/Systems Engineering, Accelerated MS

Overview

Highly-qualified students in selected BS programs (see below) have the option of obtaining an accelerated Systems 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

Mason undergraduate students majoring in computer engineering, computer science, or electrical engineering may apply to this option if they have earned 90 undergraduate credits with an overall GPA of at least 3.30 and completed all MATH and PHYS requirements. Criteria

for admission are identical to criteria for admission to the Systems Engineering, MS program.

Accelerated Option Requirements

Up to two courses (6 credits) of approved master's level courses taken as part of the undergraduate degree may be applied to the graduate degree. These two courses may be chosen from the graduate courses in the following table.

For BS candidates, these graduate courses replace the corresponding undergraduate courses listed. The undergraduate version of these courses may not be applied toward the MS degree.

Undergraduate	Graduate	
SYST 420	SYST 521	Credit may not be received for both courses.
SYST 473	SYST 573	Credit may not be received for both courses.
OR 441	OR 541	Credit may not be received for both courses.
OR 442	OR 542	Credit may not be received for both courses.

Any other 500-level course may be applied to both the undergraduate and graduate degrees with approval of the advisor and SEOR department chair.

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/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.