COMPUTER ENGINEERING, BS

Banner Code: EC-BS-CPE

Academic Advising

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The field of computer engineering can be described as an amalgam of hardware and software design. Computer engineers are involved in research, design, development, production, and operation of a wide variety of digital systems, from integrated circuits through microcontrollers, multi-core processors, FPGA-based accelerators, to big-data and cloud computing platforms. Reflecting the industry trend to integrate hardware and software development, the computer engineering program is built around computer-aided design tools that can simulate and assist in the design of new digital systems, such as those found in smartphones, tablets, robots, autonomous vehicles, drones, spacecraft, computer networks, smart factories, defense systems, and the internet-of-things. Advanced languages, such as VHDL and Python, and software tools, such as those used for FPGA- and ASIC-design and simulation, can be used to model hardware and software functionality from the system and architecture level down to the gate and transistor levels. Design, optimization, verification, and testing methodology involving these tools are taught in the program. Hands-on design experiences and simulation are emphasized throughout the curriculum through labs and projects integrated into various courses. The program culminates in a year-long senior design project effort which provides each student with the opportunity to apply concepts to designing, innovating and building a functional hardware system in a team environment.

The Department of Electrical and Computer Engineering is staffed by 33 full-time professors and several part-time professors.

The bachelor's program in Computer Engineering is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.

Career Opportunities

Career opportunities exist in engineering design and development such as hardware/software co-design and integration, embedded system programming, mobile system and application development, robot and drone design, and cloud and big data computing. Other opportunities include engineering management, consultancy, technical sales, and patent law. The program provides a strong preparation for graduate study.

Specializations

The curriculum provides a strong background in the fundamentals of computer engineering. A number of technical elective specializations are offered, ranging from primarily hardware-oriented to those that are more software-oriented. These include robotics, embedded systems, computer networks, internet of things, power and energy systems, hardware and system security, and space-based systems. The curriculum includes 9 credits of senior technical electives, which may be used for specialization in one of these technical areas.

Additional Information

The requirements for the degree may be satisfied on a full-time or part-time basis. Cooperative education provides students the opportunity to integrate paid career-related work experience with classroom learning. Academic credit towards the completion of major requirements cannot be given for co-op experience. In addition to the usual financial aid available through the Office of Student Financial Aid, computer 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 (http://catalog.gmu.edu/policies/academic/undergraduate-policies/).

Writing-Intensive Requirement

Mason's writing-intensive requirement is satisfied through ECE 333 Linear Electronics I 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 (http://catalog.gmu.edu/colleges-schools/engineering-computing/#requirementspoliciestext) for more information.

Double Major and Minor Programs for Computer Engineering and Electrical Engineering

Computer Engineering majors and Electrical Engineering majors can earn degrees with double majors in a number of disciplines. Computer Engineering and Computer Science may be combined. Electrical Engineering has been combined with Computer Engineering, Mechanical Engineering, Computer Science, Physics, or Math. Details are available in the department brochures or at the College of Engineering and Computing website (https://cec.gmu.edu). There are several minors available for students in the ECE Department including the Mechanical Engineering minor (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/mechanical/mechanical-engineering-minor/), Bioengineering minor (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/bioengineering/bioengineering-minor/) and others as listed in the catalog.

Grade Requirements

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

Students must complete each ECE, ENGR, BENG, CS, MATH, PHYS and STAT course presented as part of the required 126 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 College of Engineering and Computing 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 College of Engineering and Computing who do not successfully complete a course required for a College of Engineering and Computing major within three attempts will also be terminated.

In addition, students in the College of Education and Computing with evidence of continued failure to make adequate progress toward declaring or completing a Volgenau School major will be terminated from the school. Adequate progress is determined by the major program. For more information, see AP.5.2.4 Termination from the Major (https://catalog.gmu.edu/policies/academic/undergraduate-policies/#ap-5-2-4).

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. A third attempt of a College of Engineering and Computing course requires support by the student's major department as well as permission by the department offering the course. This permission is not guaranteed. 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 College of Engineering and Computing major may not register for a College of Engineering and Computing course without permission of the department offering the course. This applies to all undergraduate courses offered by the College of Engineering and Computing except IT 104 Introduction to Computing (Mason Core) (http://catalog.gmu.edu/mason-core/) and STAT 250 Introductory Statistics I (Mason Core) (http://catalog.gmu.edu/mason-core/).

A student may not declare any major in the College of Engineering and Computing 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: 126

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 231	Digital System Design	3
ECE 232	Digital System Design Lab	1
ECE 240	C Programming for Engineers	3
ECE 285	Electric Circuit Analysis I	3
ECE 286	Electric Circuit Analysis II	3
ECE 321	Continuous-Time Signals and Systems	3
ECE 333	Linear Electronics I	3
ECE 334	Linear Electronics Lab I	1
ECE 340	Data Structures and Embedded Systems Programming in C/C++	3
ECE 350	Embedded Systems and Hardware Interfaces	3
ECE 445	Computer Organization	3
ECE 447	Microcontrollers	4
ECE 448	FPGA Design with VHDL	4
ECE 465	Computer Networking Protocols	3
ECE 491	Engineering Seminar	1
ECE 492	Senior Advanced Design Project I (Mason Core) (http://catalog.gmu.edu/mason-core/)	1
ECE 493	RS: Senior Advanced Design Project II (Mason Core) (http://catalog.gmu.edu/mason-core/)	2
Total Credits		50

Technical Electives

Three technical electives totaling 9 credit hours must be selected from the list below. Some graduate courses listed below 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.

Code	Title	Credits
Select 9 credits from the following: [1]		9
ECE 370	Robot Design	
ECE 410	Applications of Discrete-Time Signal Processing	
ECE 411	Electricity Sector Engineering, Economics, and Regulation	
ECE 414	Grid Digitization and Automation	
or ECE 514	Grid Digitization and Automation	
ECE 415	Power System Analysis	
ECE 416	Electric Machinery and Modern Applications	
ECE 417	Smart Grid and Cyber Security	
or ECE 517	Cyber Infrastructure of the Smart Grid	
ECE 418	Power System Protection and Control	
or ECE 518	Power System Protection and Control	
ECE 419	Power Electronics for Modern Power Systems	
or ECE 519	Power Electronics for Modern Power Systems	
ECE 421	Classical Systems and Control Theory	
ECE 424	Modern Control Systems Design	
ECE 425	Secure RF Communications	
ECE 431	Digital Circuit Design	
ECE 433	Linear Electronics II	
ECE 446	Device Driver Development	
ECE 450	Mobile Robots	
ECE 455	GPU Architecture and Programming	
or ECE 555	GPU Architecture and Programming	
ECE 460	Communication and Information Theory	

ECE 462	Data and Computer Communications	
ECE 463	Digital Communications Systems	
ECE 470	Introduction to Humanoid Robotics	
ECE 476	Cryptography Fundamentals	
ECE 480	Small Spacecraft Engineering	
or ECE 580	Small Spacecraft Engineering	
ECE 499	Special Topics in Electrical and Computer Engineering	
CYSE 462	Mobile Devices and Network Security	
The following 500-level courses may also be taken: [1]		
ECE 505	Hardware Security	
ECE 508	Internet of Things	
ECE 511	Computer Architecture	
ECE 512	Computer Architecture Security	
ECE 516	Mobile Systems and Applications	
ECE 521	Linear Systems and Control	
ECE 527	Learning From Data	
ECE 528	Introduction to Random Processes in Electrical and Computer Engineering	
ECE 530	Sensor Engineering	
ECE 531	Introduction to Wireless Communications and Networks	
ECE 532	Secure Wireless Communications and Networks	
ECE 535	Digital Signal Processing	
ECE 542	Computer Network Architectures and Protocols	
ECE 552	Big Data Technologies	
ECE 554	Machine Learning for Embedded Systems	
ECE 556	Neuromorphic Computing	
ECE 567	Optical Fiber Communications	
ECE 580	Small Spacecraft Engineering	
ECE 590	Selected Topics in Engineering	
Total Credits		9

[1] Registration in 500-level courses requires departmental approval

Computer Science

Code	Title	Credits
CS 112	Introduction to Computer Programming (Mason Core) (http://catalog.gmu.edu/mason-core/)	4
CS 211	Object-Oriented Programming	3
CS 471	Operating Systems	3
Total Credits		10

Mathematics and Statistics

Code	Title	Credits
MATH 113	Analytic Geometry and Calculus I (Mason Core) (http://catalog.gmu.edu/mason-core/)	4
MATH 114	Analytic Geometry and Calculus II	4
MATH 125	Discrete Mathematics I (Mason Core) (http://catalog.gmu.edu/mason-core/)	3
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		23

Physics

Code	Title	Credits
PHYS 160	University Physics I (Mason Core) (http://catalog.gmu.edu/mason-core/)	3
PHYS 161	University Physics I Laboratory (Mason Core) (http://catalog.gmu.edu/mason-core/)	1
PHYS 260	University Physics II (Mason Core) (http://catalog.gmu.edu/mason-core/)	3
PHYS 261	University Physics II Laboratory (Mason Core) (http://catalog.gmu.edu/mason-core/)	1
Total Credits		8

Engineering

Code	Title	Credits
ENGR 107	Introduction to Engineering (Mason Core) (http://catalog.gmu.edu/mason-core/)	2
Total Credits		2

Concentrations

Concentrations are available in the computer engineering baccalaureate program. Completion of specific courses leads to one of these designations on the student's transcript on graduation. Concentration requirements may also meet some or all of the Technical Elective requirements.

Available Concentrations:

- Computer Networks (CNWK)
- Embedded Systems (EMSY)
- Hardware and System Security (HSYS)
- Internet of Things (INOT)
- Robotics (ROB)
- Power and Energy Systems (PES)
- Space-Based Systems (SBSY)

Computer Networks (CNWK)

Code	Title	Credits
Required Course:		
ECE 465	Computer Networking Protocols	3
Select three from the following:		9
ECE 414	Grid Digitization and Automation	
or ECE 514	Grid Digitization and Automation	
ECE 460	Communication and Information Theory	
ECE 462	Data and Computer Communications	
ECE 463	Digital Communications Systems	
ECE 476	Cryptography Fundamentals	
ECE 531	Introduction to Wireless Communications and Networks	

ECE 532	Secure Wireless Communications and Networks	
ECE 542	Computer Network Architectures and Protocols	
ECE 567	Optical Fiber Communications	
Total Credits		12

Embedded Systems (EMSY)

Code	Title	Credits
Required Course:		
ECE 447	Microcontrollers	4
Select three from the following:		9
ECE 421	Classical Systems and Control Theory	
ECE 446	Device Driver Development	
ECE 455	GPU Architecture and Programming	
or ECE 555	GPU Architecture and Programming	
ECE 480	Small Spacecraft Engineering	
or ECE 580	Small Spacecraft Engineering	
ECE 516	Mobile Systems and Applications	
ECE 530	Sensor Engineering	
ECE 554	Machine Learning for Embedded Systems	
Total Credits		13

Hardware and System Security (HSYS)

Code	Title	Credits
Required Courses:		
ECE 465	Computer Networking Protocols	3
ECE 505	Hardware Security	3
Select two from the following:		6
ECE 417	Smart Grid and Cyber Security	
or ECE 517	Cyber Infrastructure of the Smart Grid	
ECE 425	Secure RF Communications	
ECE 455	GPU Architecture and Programming	
or ECE 555	GPU Architecture and Programming	
ECE 462	Data and Computer Communications	
ECE 476	Cryptography Fundamentals	
ECE 512	Computer Architecture Security	
ECE 532	Secure Wireless Communications and Networks	
Total Credits		12

Internet of Things (INOT)

Code	Title	Credits
Required Courses:		
ECE 465	Computer Networking Protocols	3
ECE 508	Internet of Things	3
Select two from the following:		6
ECE 414	Grid Digitization and Automation	
or ECE 514	Grid Digitization and Automation	
ECE 455	GPU Architecture and Programming	
or ECE 555	GPU Architecture and Programming	
ECE 462	Data and Computer Communications	
ECE 476	Cryptography Fundamentals	
ECE 512	Computer Architecture Security	
ECE 530	Sensor Engineering	
ECE 532	Secure Wireless Communications and Networks	
ECE 554	Machine Learning for Embedded Systems	
Total Credits		12

Robotics (ROB)

Code	Title	Credits
Required Courses:		
ECE 370	Robot Design	3
ECE 447	Microcontrollers	4
Select two from the following:		6
ECE 421	Classical Systems and Control Theory	
ECE 424	Modern Control Systems Design	
ECE 450	Mobile Robots	
ECE 470	Introduction to Humanoid Robotics	
ECE 521	Linear Systems and Control	
ECE 530	Sensor Engineering	
Total Credits		13

Power and Energy Systems (PES)

Code	Title	Credits
Required Courses:		
ECE 305	Electromagnetic Theory	3
ECE 415	Power System Analysis	3
ECE 465	Computer Networking Protocols	3
Select one from the following:		3
ECE 411	Electricity Sector Engineering, Economics, and Regulation	
ECE 414	Grid Digitization and Automation	
or ECE 514	Grid Digitization and Automation	
ECE 416	Electric Machinery and Modern Applications	
ECE 417	Smart Grid and Cyber Security	
or ECE 517	Cyber Infrastructure of the Smart Grid	
ECE 418	Power System Protection and Control	
or ECE 518	Power System Protection and Control	
ECE 419	Power Electronics for Modern Power Systems	
or ECE 519	Power Electronics for Modern Power Systems	
Total Credits		12

Space-Based Systems (SBSY)

Code	Title	Credits
Required Courses:		6
ECE 350	Embedded Systems and Hardware Interfaces	
ECE 480	Small Spacecraft Engineering	
or ECE 580	Small Spacecraft Engineering	
Select two from the following:		6
ECE 421	Classical Systems and Control Theory	
ECE 424	Modern Control Systems Design	
ECE 425	Secure RF Communications	
ECE 433	Linear Electronics II	

ECE 460	Communication and Information Theory	
ECE 462	Data and Computer Communications	
ECE 463	Digital Communications Systems	
ME 472	Spacecraft Subsystems	
ECE 513	Applied Electromagnetic Theory	
ECE 530	Sensor Engineering	
ECE 550	System Engineering Design	
Total Credits		12

English, Communication, and Economics

Code	Title	Credits
ENGH 302	Advanced Composition (Mason Core) (http://catalog.gmu.edu/mason-core/) (Natural Sciences and Technology or Multidisciplinary section)	3
COMM 100	Public Speaking (Mason Core) (http://catalog.gmu.edu/mason-core/)	3
or COMM 101	Fundamentals of Communication (Mason Core) (http://catalog.gmu.edu/mason-core/)	
ECON 103	Contemporary Microeconomic Principles (Mason Core) (http://catalog.gmu.edu/mason-core/)	3
Total Credits		9

Additional Mason Core

Students must complete all Mason Core (http://catalog.gmu.edu/mason-core/) requirements not fulfilled by major requirements. Mason Core courses should be selected from the department's list of approved courses. Honors college students meet the written and oral communication requirements through completion of the honors college curriculum. The Synthesis Mason Core requirement is satisfied by ECE 492 Senior Advanced Design Project I (Mason Core) (http://catalog.gmu.edu/mason-core/) plus ECE 493 RS: Senior Advanced Design Project II (Mason Core) (http://catalog.gmu.edu/mason-core/).

Code	Title	Credits
Written Communication (http://catalog.gmu.edu/mason-core/#written) [2]		3
Literature (http://catalog.gmu.edu/mason-core/#literature)		3
Arts (http://catalog.gmu.edu/mason-core/#arts)		3
Western Civilization/World History (http://catalog.gmu.edu/mason-core/#western-civilization-world-history)		3
Global Understanding (http://catalog.gmu.edu/mason-core/#global)		3
Total Credits		15

[2] Lower-level requirement

4-Year Plan

Bachelor of Science in Computer Engineering Sample Plan of Study

Detailed four year plans and degree planning checklists can be found at https://advising.gmu.edu/current-student/majors-at-mason/.

Accelerated Master's

BS (any)/Statistical Science, Accelerated MS

Overview

Highly-qualified undergraduates may be admitted to the bachelor's/accelerated master's program (BAM) and obtain an undergraduate BS degree and the Statistical Science, MS (http://catalog.gmu.edu/colleges-schools/engineering-computing/school-computing/statistics/statistical-science-ms/) in an accelerated time-frame after satisfactory completion of a minimum of 138 credits.

Admitted students are able to use up to 12 graduate credits in partial satisfaction of requirements for the undergraduate degree. Upon completion and conferral of the bachelor's degree and with satisfactory performance (grade of 'B' or better) in each of the graduate courses, students are given advanced standing in the master's program.

See AP.6.7 Bachelor's/Accelerated Master's Degrees (http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7) for policies related to this program.

Students in an accelerated degree program must fulfill all university requirements for the master's degree. For policies governing all graduate degrees, see AP.6 Graduate Policies (http://catalog.gmu.edu/policies/academic/graduate-policies/).

BAM Pathway Admission Requirements

No specific undergraduate BS degree is required. Students enrolled in any BS degree may apply to the accelerated Statistical Science, MS (http://catalog.gmu.edu/colleges-schools/engineering-computing/school-computing/statistics/statistical-science-ms/) program **if such an accelerated** Statistical Science, MS (http://catalog.gmu.edu/colleges-schools/engineering-computing/school-computing/statistics/statistical-science-ms/) **pathway is allowable from the student's BS program, which will be determined by the academic advisors of both the BS and MS programs.**

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in Graduate Admissions Policies and Bachelor's/Accelerated Master's Degree policies.

Students will be considered for admission into the BAM Pathway after completion of a minimum of 60 credits with an overall GPA of 3.0.

Students who are accepted into the BAM Pathway will be allowed to register for graduate level courses after successful completion of a minimum of 75 undergraduate credits and course-specific prerequisites.

Accelerated Master's Admission Requirements

Students already admitted in the BAM Pathway will be admitted to the Statistical Science, MS program, if they have met the following criteria, as verified on the Bachelor's/Accelerated Master's Transition form:

- Completion of Mason's requirements for undergraduate degree conferral (graduation) and completion of application for graduation.
- An overall GPA of 3.00.
- Completion of the following Mason courses each with a grade of C or better.

Code	Title	Credits
MATH 213	Analytic Geometry and Calculus III	3
MATH 203	Linear Algebra	3
or MATH 321	Abstract Algebra	
STAT 250	Introductory Statistics I (Mason Core) (http://catalog.gmu.edu/mason-core/)	3
or STAT 344	Probability and Statistics for Engineers and Scientists I	
STAT 346	Probability for Engineers	3
or MATH 351	Probability	
STAT 362	Introduction to Computer Statistical Packages	3

Accelerated Pathway Requirements

To maintain the integrity and quality of both the undergraduate and graduate degree programs, students complete all credits satisfying degree requirements for the BS and MS programs, with up to twelve credits overlap chosen from the following graduate courses:

Code	Title	Credits
STAT 544	Applied Probability	3
STAT 554	Applied Statistics I	3
STAT 560	Biostatistical Methods	3
STAT 574	Survey Sampling I	3
STAT 663	Statistical Graphics and Data Exploration I	3

All graduate course prerequisites must be completed prior to enrollment. Each graduate course must be completed with a grade of B or better to apply toward the MS degree.

While still in undergraduate status, a maximum of 6 additional graduate credits may be taken as reserve graduate credit and applied to the master's program. Reserve graduate credits do not apply to the undergraduate degree.

For more detailed information on coursework and timeline requirements, see AP.6.7 Bachelor's/Accelerated Master's Degrees (http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7) policies.

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.

Computer Engineering, BS/Computer Engineering, Accelerated MS

Overview

Highly-qualified undergraduates may be admitted to the bachelor's/accelerated master's program and obtain a BS in Computer Engineering and an MS in Computer Engineering (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/electrical-computer/computer-engineering-ms/) in an accelerated time-frame after satisfactory completion of a minimum of 144 credits.

See AP.6.7 Bachelor's/Accelerated Master's Degrees (http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7) for policies related to this program.

Students in an accelerated degree program must fulfill all university requirements for the master's degree. For policies governing all graduate degrees, see AP.6 Graduate Policies (http://catalog.gmu.edu/policies/academic/graduate-policies/).

BAM Pathway Admission Requirements

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in Graduate Admissions Policies and Bachelor's/Accelerated Master's Degree policies.

Students will be considered for admission into the BAM Pathway after completion of a minimum of 60 credits with an overall GPA of 3.0.

Students who are accepted into the BAM Pathway will be allowed to register for graduate level courses after successful completion of a minimum of 75 undergraduate credits and course-specific prerequisites.

Accelerated Master's Admission Requirements

Students already admitted in the BAM Pathway will be admitted to the MS program, if they have met the following criteria, as verified on the Bachelor's/Accelerated Master's Transition form: 3.0 overall GPA, successfully meeting Mason's requirements for undergraduate degree conferral (graduation), and completing the application for graduation.

Accelerated Pathway Requirements

To maintain the integrity and quality of both the undergraduate and graduate degree programs, undergraduate students interested in taking graduate courses must choose from the following:

Advanced standing courses: Students may take up to 12 credits of graduate-level courses that will count as advanced standing (i.e., overlap between the BS/MS program) from the list below: Note that ECE 542 can be used to meet the ECE 465 requirement for the BS in Electrical Engineering program. An additional 9 credits of graduate-level courses from the list below may be selected to substitute in place of the 9 credits of technical electives required for the undergraduate degree:

Code	Title	Credits
ECE 505	Hardware Security	3
ECE 508	Internet of Things	3
ECE 511	Computer Architecture	3
ECE 512	Computer Architecture Security	3
ECE 516	Mobile Systems and Applications	3
ECE 521	Linear Systems and Control	3
ECE 527	Learning From Data	3
ECE 528	Introduction to Random Processes in Electrical and Computer Engineering	3
ECE 530	Sensor Engineering	3
ECE 531	Introduction to Wireless Communications and Networks	3
ECE 532	Secure Wireless Communications and Networks	3
ECE 535	Digital Signal Processing	3
ECE 542	Computer Network Architectures and Protocols	3

ECE 545	Digital System Design with VHDL	3
ECE 552	Big Data Technologies	3
ECE 554	Machine Learning for Embedded Systems	3
ECE 555	GPU Architecture and Programming	3
ECE 556	Neuromorphic Computing	3
ECE 567	Optical Fiber Communications	3
ECE 580	Small Spacecraft Engineering	3
ECE 590	Selected Topics in Engineering	3

Selected 600 level courses may be taken as well with permission of an advisor granted before registering for a given course.

Reserve credit courses: Additional courses (up to 6 credits) may be selected from the above list as credits to be put on reserve to be later applied to the graduate program. Students can take these courses while undergraduates but these reserve courses will only count for the graduate degree program.

For more detailed information on coursework and timeline requirements, see AP.6.7 Bachelor's/Accelerated Master's Degrees (http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7).

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. At the completion of MS requirements, a master's degree is conferred.

Computer Engineering, BS/Electrical Engineering, Accelerated MS

Overview

Highly-qualified undergraduates may be admitted to the bachelor's/accelerated master's program and obtain a BS in Computer Engineering and an MS in Electrical Engineering (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/electrical-computer/electrical-engineering-ms/) in an accelerated time-frame after satisfactory completion of a minimum of 144 credits.

See AP.6.7 Bachelor's/Accelerated Master's Degrees (http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7) for policies related to this program.

Students in an accelerated degree program must fulfill all university requirements for the master's degree. For policies governing all graduate degrees, see AP.6 Graduate Policies (http://catalog.gmu.edu/policies/academic/graduate-policies/).

BAM Pathway Admission Requirements

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in Graduate Admissions Policies and Bachelor's/Accelerated Master's Degree policies.

Students will be considered for admission into the BAM Pathway after completion of a minimum of 60 credits with an overall GPA of 3.0.

Students who are accepted into the BAM Pathway will be allowed to register for graduate level courses after successful completion of a minimum of 75 undergraduate credits and course-specific pre-requisites.

Accelerated Master's Admission Requirements

Students already admitted in the BAM Pathway will be admitted to the MS program, if they have met the following criteria, as verified on the Bachelor's/Accelerated Master's Transition form: 3.0 overall GPA, successfully meeting Mason's requirements for undergraduate degree conferral (graduation), and completing the application for graduation.

Accelerated Pathway Requirements

To maintain the integrity and quality of both the undergraduate and graduate degree programs, undergraduate students interested in taking graduate courses must choose from the following:

Advanced standing courses: Students may take up to 12 credits of graduate-level courses that will count as advanced standing (i.e., overlap between the BS/MS program) from the list below. Note that ECE 542 can be used to meet the ECE 465 requirement for the BS in Electrical Engineering program. An additional 9 credits of graduate-level courses from the list below may be selected to substitute in place of the 9 credits of technical electives required for the undergraduate degree.

Code	Title	Credits
ECE 505	Hardware Security	3
ECE 508	Internet of Things	3
ECE 511	Computer Architecture	3
ECE 512	Computer Architecture Security	3
ECE 513	Applied Electromagnetic Theory	3
ECE 514	Grid Digitization and Automation	3
ECE 516	Mobile Systems and Applications	3
ECE 517	Cyber Infrastructure of the Smart Grid	3
ECE 518	Power System Protection and Control	3
ECE 519	Power Electronics for Modern Power Systems	3
ECE 521	Linear Systems and Control	3
ECE 527	Learning From Data	3
ECE 528	Introduction to Random Processes in Electrical and Computer Engineering	3
ECE 530	Sensor Engineering	3
ECE 531	Introduction to Wireless Communications and Networks	3
ECE 532	Secure Wireless Communications and Networks	3
ECE 535	Digital Signal Processing	3
ECE 538	Medical Imaging	3
ECE 539	Neural Engineering	3
ECE 542	Computer Network Architectures and Protocols	3
ECE 550	System Engineering Design	3
ECE 552	Big Data Technologies	3
ECE 554	Machine Learning for Embedded Systems	3
ECE 555	GPU Architecture and Programming	3
ECE 556	Neuromorphic Computing	3
ECE 565	Introduction to Optical Electronics	3
ECE 567	Optical Fiber Communications	3
ECE 580	Small Spacecraft Engineering	3
ECE 584	Semiconductor Device Fundamentals	3
ECE 586	Digital Integrated Circuits	3

ECE 587	Design of Analog Integrated Circuits	3
ECE 590	Selected Topics in Engineering	3

Selected 600 level courses may be taken as well with permission of an advisor granted before registering for a given course.

Reserve credit courses: Additional courses (up to 6 credits) may be selected from the above list as credits to be put on reserve to be later applied to the graduate program. Students can take these courses while undergraduates but these reserve courses will only count for the graduate degree program.

For more detailed information on coursework and timeline requirements, see AP.6.7 Bachelor's/Accelerated Master's Degrees (http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7).

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. At the completion of MS requirements, a master's degree is conferred.

Computer Engineering, BS/Operations Research, Accelerated MS

Overview

Highly-qualified undergraduates may be admitted to the bachelor's/accelerated master's program and obtain a Computer Engineering, BS and an Operations Research, MS (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/systems-operations-research/operations-research-ms/) in an accelerated time-frame after satisfactory completion of a minimum of 144 credits.

Admitted students are able to use up to 12 graduate credits in partial satisfaction of requirements for the undergraduate degree. Upon completion and conferral of the bachelor's degree and with satisfactory performance (grade of 'B' or better) in each of the graduate courses, students are given advanced standing in the master's program.

See AP.6.7 Bachelor's/Accelerated Master's Degrees (https://catalog.gmu.edu/policies/academic/graduate-policies/#text) for policies related to this program.

Students in an accelerated degree program must fulfill all university requirements for the master's degree. For policies governing all graduate degrees, see AP.6 Graduate Policies (https://catalog.gmu.edu/policies/academic/graduate-policies/).

BAM Pathway Admission Requirements

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in Graduate Admissions Policies and Bachelor's/Accelerated Master's Degree policies.

Computer Engineering, BS students will be considered for admission into the BAM Pathway after completion of a minimum of 60 credits with an overall GPA of at least 3.3, and completion of all MATH and PHYS 160/161, and PHYS 260/261 requirements. Students must additionally complete MATH 203 Linear Algebra prior to applying for the graduate program.

Students who are accepted into the BAM Pathway will be allowed to register for graduate level courses after successful completion of a minimum of 75 undergraduate credits and course-specific pre-requisites.

Accelerated Master's Admission Requirements

The criteria for admission are identical to criteria for admission to the Operations Research, MS (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/systems-operations-research/operations-research-ms/) program. Students already admitted in the BAM Pathway will be admitted to the Operations Research, MS (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/systems-operations-research/operations-research-ms/) program, if they have met the following criteria, as verified on the Bachelor's/Accelerated Master's Transition form:

- An overall GPA of at least 3.3
- Successfully meeting Mason's requirements for undergraduate degree conferral (graduation) and completing the application for graduation.

Accelerated Pathway Requirements

To maintain the integrity and quality of both the undergraduate and graduate degree programs, undergraduate students interested in taking graduate courses must choose from the following:

Advanced Standing course: Students must complete all credits that satisfy requirements for both the BS and MS programs. Up to four courses (12 credits) of approved master's level courses taken as part of the undergraduate degree may be applied to the graduate degree. The courses selected for this purpose must be approved by the academic advisors of both the BS and MS programs and by the SEOR department chair.

- Students selecting up to two courses (6 credits) of approved master's level courses may select from the Electrical and Computer Engineering courses given below.
- Students selecting up to three or four courses (9 or 12 credits) of approved master's level courses may select at most two courses from the Electrical and Computer Engineering course list and select the remaining courses from the Systems Engineering and Operations Research course list given below. Note that ECE 542 can be used to meet the ECE 465 requirement for the Computer Engineering, BS program. Students are highly recommended to select courses marked as core courses because it applies to the master's degree regardless of the graduate-level concentration chosen in the Operations Research, MS (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/systems-operations-research/operations-research-ms/). The undergraduate version of these courses, if any, may *not* be applied toward the Operations Research, MS (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/systems-operations-research/operations-research-ms/). Credit may not be received for both the undergraduate and graduate version of these courses.
- Some of the courses in the Systems Engineering and Operations Research course list applies only to certain concentrations in the Operations Research, MS (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/systems-operations-research/operations-research-ms/) program.
- Students must pay attention to the prerequisites required for a course, and the master's degree concentration that the course may satisfy.

Select at most two from the following Electrical and Computer Engineering courses:

Code	Title	Credits
ECE 505	Hardware Security	
ECE 508	Internet of Things	
ECE 511	Computer Architecture	
ECE 512	Computer Architecture Security	
ECE 516	Mobile Systems and Applications	
ECE 521	Linear Systems and Control	
ECE 527	Learning From Data	
ECE 528	Introduction to Random Processes in Electrical and Computer Engineering	
ECE 530	Sensor Engineering	
ECE 531	Introduction to Wireless Communications and Networks	
ECE 535	Digital Signal Processing	
ECE 542	Computer Network Architectures and Protocols	
ECE 545	Digital System Design with VHDL	
ECE 554	Machine Learning for Embedded Systems	
ECE 555	GPU Architecture and Programming	
ECE 556	Neuromorphic Computing	
ECE 567	Optical Fiber Communications	
ECE 580	Small Spacecraft Engineering	
ECE 590	Selected Topics in Engineering	

Select the remaining from the following Systems Engineering and Operations Research courses:

Code	Title	Credits
SYST 521	Network Analysis	
OR 538	Analytics for Financial Engineering and Econometrics	
OR 541	Operations Research: Deterministic Models (Core)	
OR 542	Operations Research: Stochastic Models (Core)	
OR 568	Applied Predictive Analytics (Core)	
OR 588	Financial Systems Engineering I: Introduction to Options, Futures, and Derivatives	

While still in undergraduate status, a maximum of 6 additional graduate credits may be taken as reserve graduate credit and applied to the master's program. Reserve graduate credits do not apply to the undergraduate degree.

For more detailed information on coursework and timeline requirements, see AP.6.7 Bachelor's/Accelerated Master's Degrees (https://catalog.gmu.edu/policies/academic/graduate-policies/#text).

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. At the completion of MS requirements, a master's degree is conferred.

Computer Engineering, BS/Systems Engineering, Accelerated MS

Overview

Highly-qualified undergraduates may be admitted to the bachelor's/accelerated master's program and obtain a Computer Engineering, BS and a Systems Engineering, MS (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/systems-operations-research/systems-engineering-ms/) in an accelerated time-frame after satisfactory completion of a minimum of 144 credits.

Admitted students are able to use up to 12 graduate credits in partial satisfaction of requirements for the undergraduate degree. Upon completion and conferral of the bachelor's degree and with satisfactory performance (grade of 'B' or better) in each of the graduate courses, students are given advanced standing in the master's program.

See AP.6.7 Bachelor's/Accelerated Master's Degrees (https://catalog.gmu.edu/policies/academic/graduate-policies/#text) for policies related to this program.

Students in an accelerated degree program must fulfill all university requirements for the master's degree. For policies governing all graduate degrees, see AP.6 Graduate Policies (https://catalog.gmu.edu/policies/academic/graduate-policies/).

BAM Pathway Admission Requirements

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in Graduate Admissions Policies and Bachelor's/Accelerated Master's Degree policies.

Computer Engineering, BS students will be considered for admission into the BAM Pathway after completion of a minimum of 60 credits with an overall GPA of at least 3.3, and completion of all MATH, PHYS 160/161, and PHYS 260/261 requirements.

Students who are accepted into the BAM Pathway will be allowed to register for graduate level courses after successful completion of a minimum of 75 undergraduate credits and course-specific pre-requisites.

Accelerated Master's Admission Requirements

The criteria for admission are identical to criteria for admission to the Systems Engineering, MS (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/systems-operations-research/systems-engineering-ms/) program. Students already admitted in the BAM Pathway will be admitted to the Systems Engineering, MS (https://catalog.gmu.edu/colleges-schools/engineering/systems-operations-research/systems-engineering-ms/) program, if they have met the following criteria, as verified on the Bachelor's/Accelerated Master's Transition form:

- An overall GPA of at least 3.3
- Successfully meeting Mason's requirements for undergraduate degree conferral (graduation) and completing the application for graduation.

Accelerated Pathway Requirements

To maintain the integrity and quality of both the undergraduate and graduate degree programs, undergraduate students interested in taking graduate courses must choose from the following:

Advanced Standing course: Students must complete all credits that satisfy requirements for both the BS and MS programs. Up to four courses (12 credits) of approved master's level courses taken as part of the undergraduate degree may be applied to the graduate degree. The courses selected for this purpose must be approved by the academic advisors of both the BS and MS programs and by the SEOR department chair.

- Students selecting up to two courses (6 credits) of approved master's level courses may select from the Electrical and Computer Engineering courses given below.
- Students selecting up to three or four courses (9 or 12 credits) of approved master's level courses may select at most two courses from the Electrical and Computer Engineering course list and select the remaining courses from the Systems Engineering and Operations Research course list given below. Note that ECE 542 can be used to meet the ECE 465 requirement for the Computer Engineering, BS program. Students are highly recommended to select courses marked as core courses because it applies to the master's degree regardless of the graduate-level concentration chosen in the Systems Engineering, MS (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/systems-operations-research/systems-engineering-ms/) program. The undergraduate version of these courses, if any, may *not* be applied toward the Systems Engineering, MS (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/systems-operations-research/systems-engineering-ms/). Credit may not be received for both the undergraduate and graduate version of these courses.
- Except for the courses marked as core, any course chosen from either course list can be used to satisfy SYST 505 Systems Engineering Principles core requirement in the Systems Engineering, MS (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/systems-operations-research/systems-engineering-ms/) program.
- Some of the courses in the Systems Engineering and Operations Research course list applies only to certain concentrations in the Systems Engineering, MS (http://catalog.gmu.edu/colleges-schools/engineering-computing/engineering/systems-operations-research/systems-engineering-ms/) program.
- Students must pay attention to the prerequisites required for a course, and the master's degree concentration that the course may satisfy.

Select at most two from the following Electrical and Computer Engineering courses:

Code	Title	Credits
ECE 505	Hardware Security	
ECE 508	Internet of Things	
ECE 511	Computer Architecture	
ECE 512	Computer Architecture Security	
ECE 516	Mobile Systems and Applications	
ECE 521	Linear Systems and Control	
ECE 527	Learning From Data	
ECE 528	Introduction to Random Processes in Electrical and Computer Engineering	
ECE 530	Sensor Engineering	
ECE 531	Introduction to Wireless Communications and Networks	
ECE 535	Digital Signal Processing	
ECE 542	Computer Network Architectures and Protocols	
ECE 545	Digital System Design with VHDL	
ECE 554	Machine Learning for Embedded Systems	
ECE 555	GPU Architecture and Programming	
ECE 556	Neuromorphic Computing	
ECE 567	Optical Fiber Communications	
ECE 580	Small Spacecraft Engineering	
ECE 590	Selected Topics in Engineering	

Select the remaining from the following Systems Engineering and Operations Research courses:

Code	Title	Credits
SYST 510	Systems Definition and Cost Modeling (Core)	
SYST 520	System Engineering Design (Core)	
SYST 530	Systems Engineering Management I (Core)	
SYST 542	Decision Support Systems Engineering	
SYST 573	Decision and Risk Analysis	
SYST 538	Analytics for Financial Engineering and Econometrics	
SYST 568	Applied Predictive Analytics	
SYST 584	Heterogeneous Data Fusion	
SYST 588	Financial Systems Engineering I: Introduction to Options, Futures, and Derivatives	

While still in undergraduate status, a maximum of 6 additional graduate credits may be taken as reserve graduate credit and applied to the master's program. Reserve graduate credits do not apply to the undergraduate degree.

For more detailed information on coursework and timeline requirements, see AP.6.7 Bachelor's/Accelerated Master's Degrees (https://catalog.gmu.edu/policies/academic/graduate-policies/#text).

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. At the completion of MS requirements, a master's degree is conferred.