MS in Electrical Engineering & MS in Computer Engineering

Choosing a Concentration and Degree Option
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Volgenau School of Engineering

Eight Departments:

- **ECE** – Electrical and Computer Engineering
- **BENG** – Bioengineering
- **CS** – Computer Science
- **IST** – Information Sciences and Technology
- **CEIE** – Civil, Environmental, and Infrastructure Engineering
- **STAT** – Statistics
- **SEOR** – Systems Engineering and Operations Research
- **ME** – Mechanical Engineering
ACADEMIC PROGRAMS RUN BY ECE

• Undergraduate Degree
  • BS in Electrical Engineering
  • BS in Computer Engineering

• Master Degree
  • MS in Electrical Engineering
  • MS in Computer Engineering
  • MS in Telecommunications
  • MS in Digital Forensics

• Ph.D. Degree
  • PhD in Electrical and Computer Engineering
ECE DEPARTMENT PROGRAMS

MS in Electrical Engineering
MS EE

- Communications & Networking
- Signal Processing
- Control & Robotics
- Electronics
- Space-Based Systems
- Bioengineering

MS in Computer Engineering
MS CpE

- Computer Architecture & Embedded Systems
- Computer Networks
- Digital Signal Processing
- Digital Systems Design
- Internet of Things & Network Security
- Space-Based Systems

CONCENTRATIONS
PATHWAYS TO MS DEGREE IN ECE

1. 8 courses + 2 semesters of ECE 799 Master’s Thesis

OR

2. 9 courses
   + 1 semester of ECE 798 Research Project
   + Scholarly Paper
   (typically equivalent to the ECE 798 report & presentation)

OR

3. 10 courses
   + Scholarly Paper
   (an individual project in one of the advanced courses)
DEGREE REQUIREMENTS

1. Core Course Requirement
   • 15 credit hours selected from the list of core courses specific to a given program

2. Concentration Requirement
   • 1 concentration = 2 required courses + 3 concentration electives (min. 2 upper-level)

3. Upper-Level Course Requirement
   • 3 upper-level (600 and above)
   • MSEE: ECE other than ECE 698, 798, 799
   • MSCpE: ECE or CS other than ECE 799

4. ECE Course Requirement
   • MSEE: max. 2 non-ECE courses
   • MSCpE: max. 2 non-ECE + 2 CFRS, CS, ISA, or SWE courses
5. GPA Requirement
   • A maximum of 6 credits of courses with grades of C or B- can be applied toward the degree

6. Seminar Requirement
   • 6 graduate seminars approved for the degree program

7. Thesis, Research Project, or Scholarly Paper
   • ECE 799: Master’s Thesis : 6 credit hours
   • ECE 798: Research Project : 3 credit hours
   • ECE 797: Scholarly Paper : 0 credit hours

The same course can be used to fulfill multiple requirements, e.g., core, concentration, upper-level, ECE, etc.
BENEFITS OF CONCENTRATIONS

- Concentration appears on a student’s transcript
- Concentration can be declared at the time of application to a program
- Progress of study can be monitored using DegreeWorks
- Concentration requirements easily enforceable using DegreeWorks
- Statistics how many students follow each concentration
- Statistics how many students graduate with a given concentration
MS EE

CORE COURSES
SELECT 15 CREDITS FROM THE FOLLOWING:

- ECE 511 Computer Architecture
- ECE 521 Linear Systems and Control
- ECE 526 Neural Engineering
- ECE 528 Introduction to Random Processes in ECE
- ECE 535 Digital Signal Processing
- ECE 542 Computer Network Architectures and Protocols
- ECE 580 Small Spacecraft Engineering
- ECE 584 Semiconductor Device Fundamentals
- ECE 586 Digital Integrated Circuits
- ECE 587 Design of Analog Integrated Circuits
- ECE 621 Systems Identification
- ECE 630 Statistical Communication Theory
- ECE 799 Master's Thesis (6 credits)
SELECT 15 CREDITS FROM THE FOLLOWING:

- ECE 505 Hardware Security
- ECE 508 Internet of Things
- ECE 511 Computer Architecture
- ECE 516 Mobile Systems and Applications
- ECE 527 Learning From Data
- ECE 528 Introduction to Random Processes in ECE
- 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 611 Advanced Computer Architecture
- ECE 646 Applied Cryptography
- ECE 799 Master's Thesis (6 credits)
MS EE CONCENTRATIONS

- Communications and Networking
- Signal Processing
- Controls and Robotics
- Electronics
- Space-Based Systems
- Bioengineering
MSEE Communications and Networking

ECE 528 Introduction to Random Processes in ECE
ECE 542 Computer Network Architectures and Protocols

At least 3 courses from the following list:
1. ECE 508 Internet of Things
2. ECE 531 Introduction to Wireless Communications and Networking
3. ECE 567 Optical Fiber Communications
4. ECE 630 Statistical Communication Theory
5. ECE 631 Software-Defined Radio
6. ECE 633 Error Control Coding
7. ECE 639 Satellite Communications
8. ECE 642 Design and Analysis of Computer Communication Networks
9. ECE 643 Network Switching and Routing
10. ECE 646 Applied Cryptography

next page ....
MSEE Communications and Networking

11. ECE 728 Random Processes in ECE
12. ECE 731 Digital Communications
13. ECE 732 Mobile Communication Systems
14. ECE 734 Detection and Estimation Theory
15. ECE 741 Wireless Networks
16. ECE 742 High-Speed Networks
17. ECE 751 Information Theory
MSEE Communications and Networking

*not on the list, an alternative prerequisite sufficient for ECE 631 & 633

All prerequisites are recommendations only and can be waived with the permission of the respective instructor.
MSEE Signal Processing

ECE 528 Introduction to Random Processes in ECE
ECE 535 Digital Signal Processing

At least 3 courses from the following list:
1. ECE 521 Linear Systems and Control
2. ECE 527 Learning From Data
3. ECE 530 Sensor Engineering
4. ECE 537 Introduction to Digital Image Processing
5. ECE 538 Medical Imaging
6. ECE 545 Digital System Design with VHDL
7. ECE 621 Systems Identification
8. ECE 622 Kalman Filtering with Applications
9. ECE 630 Statistical Communication Theory
10. ECE 631 Software-Defined Radio

next page …
11. ECE 633 Error Control Coding
12. ECE 635 Adaptive Signal Processing
13. ECE 728 Random Processes in ECE
14. ECE 731 Digital Communications
15. ECE 732 Mobile Communication Systems
16. ECE 734 Detection and Estimation Theory
17. ECE 738 Advanced Digital Signal Processing
18. ECE 740 Digital Signal Processing Hardware Architectures
19. ECE 751 Information Theory
20. ECE 754 Optimum Array Processing
MSEE Signal Processing

*not on the list, an alternative prerequisite sufficient for ECE 631 & 633

*All prerequisites are recommendations only and can be waived with the permission of the respective instructor.*
MSEE Control and Robotics

ECE 521 Linear Systems and Control
ECE 528 Introduction to Random Processes in ECE

At least 3 courses from the following list, including at least two different than ECE 612, 635, and 673:
1. ECE 612 Real-Time Embedded Systems
2. ECE 619 Nonlinear Systems and Control
3. ECE 620 Optimal Control Theory
4. ECE 621 Systems Identification
5. ECE 622 Kalman Filtering with Applications
6. ECE 627 Adaptive Control
7. ECE 635 Adaptive Signal Processing
8. ECE 673 Discrete Event Systems
*not on the list of courses for this specialization area

All prerequisites are recommendations only and can be waived with the permission of the respective instructor.
MSEE Electronics

ECE 584 Semiconductor Device Fundamentals
ECE 586 Digital Integrated Circuits

At least 3 courses from the following list:
1. ECE 513 Applied Electromagnetic Theory
2. ECE 565 Introduction to Optical Electronics
3. ECE 587 Design of Analog Integrated Circuits
4. ECE 681 VLSI Design for ASICs
5. ECE 684 MOS Device Electronics
6. ECE 685 Nanoelectronics
7. ECE 686 Sensor Device Technology
8. ECE 780 Radio Frequency Electronics
MSEE Electronics

ECE 513  ECE 565  ECE 587  

ECE 684

ECE 584

ECE 685  ECE 686

ECE 586  ECE 545*

ECE 681

ECE 780

* not a part of this specialization area

All prerequisites are recommendations only and can be waived with the permission of the respective instructor.
MSEE Space-Based Systems

ECE 511 Computer Architecture
ECE 580 Small Spacecraft Engineering

At least 3 courses from the following list:
1. ECE 510 Real-Time Concepts
2. ECE 513 Applied Electromagnetic Theory
3. ECE 521 Linear Systems and Control
4. ECE 528 Introduction to Random Processes in ECE
5. ECE 530 Sensor Engineering
6. ECE 535 Digital Signal Processing
7. ECE 545 Digital System Design with VHDL
8. ECE 550 Systems Engineering Design

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MSEE Space-Based Systems

9. ECE 612 Real-Time Embedded Systems
10. ECE 615 Software/Hardware Codesign
11. ECE 620 Optimal Control Theory
12. ECE 622 Kalman Filtering with Applications
13. ECE 627 Adaptive Control
14. ECE 630 Statistical Communication Theory
15. ECE 631 Software Defined Radio
16. ECE 635 Adaptive Signal Processing
17. ECE 639 Satellite Communications
18. ECE 754 Optimum Array Processing I
19. ECE 660/SYST 682 Space Systems Engineering
All prerequisites are recommendations only and can be waived with the permission of the respective instructor.
MSEE Bioengineering

ECE 526 Neural Engineering
ECE 538 Medical Imaging

At least 3 courses from the following list:
1. BENG 501 Bioengineering Research Methods
2. BENG 636 Advanced Biomedical Signal Processing
3. BENG 738 Advanced Medical Image Processing
4. ECE 521 Linear Systems and Control
5. ECE 528 Introduction to Random Processes in ECE
6. ECE 530 Sensor Engineering
7. ECE 535 Digital Signal Processing
8. ECE 537 Introduction to Digital Image Processing
9. ECE 542 Computer Network Architectures and Protocols

next page …
MSEE Bioengineering

8. ECE 620 Optimal Control Theory
9. ECE 621 Systems Identification
10. ECE 622 Kalman Filtering with Applications
11. ECE 734 Detection and Estimation Theory
12. ECE 738 Advanced Digital Signal Processing
13. ECE 754 Optimum Array Processing I
All prerequisites are recommendations only and can be waived with the permission of the respective instructor.
MS CPE CONCENTRATIONS

SUMMARY
MS CPE CONCENTRATIONS

Computer Architecture & Embedded Systems
Computer Networks
Digital Signal Processing
Digital System Design
Hardware Security & Cryptographic Engineering
Internet of Things & Network Security
Space-Based Systems
Computer Arch. & Embedded Systems

ECE 511 Computer Architecture
ECE 516 Mobile Systems and Applications

At least 3 courses from the following list:
1. CS 571 Operating Systems
2. CS 583 Analysis of Algorithms
3. ECE 508 Internet of Things
4. ECE 510 Real-Time Concepts
5. ECE 545 Digital System Design with VHDL
6. ECE 611 Advanced Computer Architecture
7. ECE 612 Real-Time Embedded Systems
8. ECE 615 Software/Hardware Codesign
9. ECE 616 Advanced Mobile Systems and Applications
All prerequisites are recommendations only and can be waived with the permission of the respective instructor.
MSCpE Computer Networks

ECE 528 Introduction to Random Processes in ECE
ECE 542 Computer Network Architectures and Protocols

At least 3 courses from the following list:
1. ECE 508 Internet of Things
2. ECE 531 Introduction to Wireless Communications and Networking
3. ECE 633 Error Control Coding
4. ECE 642 Design and Analysis of Computer Communication Networks
5. ECE 643 Network Switching and Routing
6. ECE 646 Applied Cryptography
7. ECE 741 Wireless Networks
8. ECE 742 High-Speed Networks
9. ECE 746 Advanced Applied Cryptography
All prerequisites are recommendations only and can be waived with the permission of the respective instructor.
MSCpE Digital Signal Processing

ECE 535 Digital Signal Processing
ECE 545 Digital System Design with VHDL

At least 3 courses from the following list:
1. ECE 527 Learning From Data
2. ECE 528 Introduction to Random Processes in ECE
3. ECE 530 Sensor Engineering
4. ECE 531 Introduction to Wireless Communications and Networking
5. ECE 537 Introduction to Digital Image Processing
6. ECE 615 Software/Hardware Codesign
7. ECE 631 Software-Defined Radio
8. ECE 633 Error Control Coding
9. ECE 635 Adaptive Signal Processing
10. ECE 645 Computer Arithmetic
11. ECE 738 Advanced Digital Signal Processing
12. ECE 740 Digital Signal Processing Hardware Architectures
All prerequisites are recommendations only and can be waived with the permission of the respective instructor.
MSCpE Digital System Design

ECE 511 Computer Architecture
ECE 545 Digital System Design with VHDL

At least 3 courses from the following list:
1. ECE 505 Hardware Security
2. ECE 527 Learning From Data
3. ECE 586 Digital Integrated Circuits
4. ECE 615 Software/Hardware Codesign
5. ECE 645 Computer Arithmetic
6. ECE 680 Physical VLSI Design
7. ECE 681 VLSI Design for ASICs
8. ECE 682 VLSI Test Concepts
9. ECE 740 Digital Signal Processing Hardware Architectures
MSCpE Digital Systems Design

ECE 505  ECE 527  ECE 511  ECE 535*  ECE 545  ECE 586

ECE 615  ECE 645  ECE 680  ECE 681  ECE 682

ECE 740

*not on the list of courses for this specialization area

All prerequisites are recommendations only and can be waived with the permission of the respective instructor.
Hardware Security & Cryptographic Eng.

ECE 505 Hardware Security
ECE 545 Digital System Design with VHDL

At least 3 courses from the following list:
1. ECE 511 Computer Architecture
2. ECE 527 Learning From Data
3. ECE 542 Computer Network Architectures and Protocols
4. ECE 586 Digital Integrated Circuits
5. ECE 615 Software/Hardware Codesign
6. ECE 633 Error Control Coding
7. ECE 645 Computer Arithmetic
8. ECE 646 Applied Cryptography
9. ECE 681 VLSI Design for ASICs
10. ECE 682 VLSI Test Concepts
11. ECE 746 Advanced Applied Cryptography
12. ECE 747 Cryptographic Engineering
All prerequisites are recommendations only and can be waived with the permission of the respective instructor.
MSCpE IoT & Network Security

ECE 508 Internet of Things
ECE 542 Computer Network Architectures and Protocols

At least 3 courses from the following list:
1. ECE 510 Real-Time Concepts
2. ECE 511 Computer Architecture
3. ECE 530 Sensor Engineering
4. ECE 611 Advanced Computer Architecture
5. ECE 612 Real-Time Embedded Systems
6. ECE 633 Error Control Coding
7. ECE 642 Design and Analysis of Computer Communication Networks
8. ECE 646 Applied Cryptography
9. ECE 746 Advanced Applied Cryptography
10. ECE 747 Cryptographic Engineering
11. SWE 619 Object-Oriented Software Specification and Construction
12. SWE 681 Secure Software Design and Programming
All prerequisites are recommendations only and can be waived with the permission of the respective instructor.
MSCpE Space-Based Systems

ECE 511 Computer Architecture
ECE 580 Small Spacecraft Engineering

At least 3 courses from the following list:
1. ECE 510 Real-Time Concepts
2. ECE 528 Introduction to Random Processes in ECE
3. ECE 530 Sensor Engineering
4. ECE 535 Digital Signal Processing
5. ECE 545 Digital System Design with VHDL
6. ECE 611 Advanced Computer Architecture
9. ECE 612 Real-Time Embedded Systems
10. ECE 615 Software/Hardware Codesign
11. ECE 631 Software Defined Radio
12. ECE 635 Adaptive Signal Processing
13. ECE 646 Applied Cryptography
14. ECE 740 Digital Signal Processing Hardware Architectures
15. ECE 747 Cryptographic Engineering
All prerequisites are recommendations only and can be waived with the permission of the respective instructor.
The role of graduate coordinators:

- initial interviews with the potential candidates helping them to choose the right concentration
- dealing with any exceptional circumstances
- coordinating program reviews
TRANSFER

• possible only after **one semester** of studies at GMU

• **requires permission** from the directors of the proposed and the current programs

• especially **easy within the ECE** Department, i.e., between the MS EE and MS CpE programs

CREDIT TRANSFER

Overall Policy:
• In order to be applied to a given concentration, all course credits transferred from
  • other universities
  • non-degree status
must be approved by the student’s advisor prior to being presented for the final approval to the Department Chair.

Limitations
• up to 12 credit hours, including courses taken at GMU in non-degree status
• all courses taken within 6 years of first enrollment at GMU
• grade of B or better
Before completing 6 credit hours of coursework, each student must submit to the department a plan of study that has been approved by the academic advisor.

This plan should be kept up to date by regular consultation with the academic advisor.

A final, signed version of the plan must be turned in when the student submits a graduation application.
REMAINING IN THE PROGRAM

- Total degree GPA of **3.0 (B) or better**
  - degree GPA takes into account only courses applied toward graduation

- **No more than two C or B- grades** may be applied toward graduation

- Graduate students who receive grades of **F in two courses**, or **nine credit hours of unsatisfactory grades** (C or worse) are very likely to be **dismissed** from the university. Exceptions are extremely rare.
SEMINAR REQUIREMENT

• Minimum of 6 approved seminars
• Seminar types limited to
  ➢ ECE Distinguished Series Seminars
  ➢ ECE Departmental Seminars
  ➢ PhD Thesis Presentations
  ➢ PhD Seminars
• Students must register for ECE 795 Engineering Seminar in their final semester of the program
• Seminar attendance record signed by any faculty member attending the seminar
• Final version submitted to the ECE Department
• Back-up copies highly recommended
CHOOSING A GRADUATION OPTION WITHIN A DEGREE

MS EE & MS CPE
CHOOSING A GRADUATION OPTION

1. MS Thesis Option
   - 8 courses
   - ECE 799 MS Thesis (6 cr. hrs)

2. Research Project Option
   - 9 courses
   - Scholarly paper + ECE 798 Research Project

3. Scholarly Paper Option
   - 10 courses
   - Scholarly paper
MASTER’S THESIS

- Recommended for students interested in research and considering pursuing Ph.D. studies in the future

- Topic typically proposed by a faculty member.

- Topics suggested by a student and/or related to the student’s job allowed

- RA positions available for selected topics

- Student works closely with his/her academic advisor, for at least two semesters

- Conference/journal publication expected as a result of the student’s research

MS Thesis Option

8 courses

ECE 799 MS Thesis (6 cr. hrs)
Student must register (and pay for) at least 6 credit hours of ECE 799 Master’s Thesis

After registering for ECE 799 once, the students must register for at least one credit hour of ECE 799 every Spring and Fall semester until they graduate.

Oral defense open to general public in front of a three-faculty-member thesis committee.

Temporary grades for all but last ECE 799 are IP = In Progress. These grades are changed after the successful defense to S – Satisfactory.

Taking ECE 799 does not affect your GPA.
• Mandatory for all students who choose not to write a thesis

• Students can fulfill the ECE 797 Scholarly Paper requirement through an individual, course-based project:
  • in a 600 level or above ECE course
  • worth at least 20% of the course grade
  • a rigorous written report with substantial literature review
  • a short, professional oral presentation with visual aids
SCHOLARLY PAPER

- List of courses that can be used to satisfy the scholarly paper requirement available on the ECE website
- A successful scholarly paper recorded by awarding a satisfactory (S) grade for ECE 797 Scholarly Paper
After completing 18 credit hours of graduate work, a student

1. Chooses a 600-700 level course to fulfill his/her ECE 797 requirement

2. Registers for ECE 797 via Patriot Web by first requesting an override from the Academic Programs Coordinator, Ms. Patricia Sahs (psahs@gmu.edu), before the last day to add classes

3. Chooses a project topic in consultation with the instructor

4. Submits a single ECE 797 Entry Form, signed by the instructor and the student, to the Main Office by the end of the 5th week of classes in a given semester

5. Works on a project individually

6. Submits written report and gives short oral presentation

7. Asks the instructor to fill and sign the ECE 797 Evaluation Form, and submits this form to the main ECE Office
The paper and presentation must follow accepted standards for
- English
- Technical merit
- Literature analysis
- Citation of references
- GMU Honor Code

In order to pass, the student cannot receive an Unacceptable score for any evaluated outcome

Students are encouraged to sign for ECE 797 in their last but one semester, which guarantees at least two attempts
Honor Code:

Do not copy other student’s work
Do not copy from the web without using quotation marks around copied text
Usually no more than 40% of content may be directly quoted
All quotations must have a reference cited
ECE students are sent to the honor court each year

Based on Prof. Allnutt, TCOM Fall 2006 Orientation, telecom.gmu.edu, Aug. 2006
Possible end of Academic Career at GMU

Based on Prof. Allnutt, TCOM Fall 2006 Orientation, telecom.gmu.edu, Aug. 2006
FUNDING YOUR EDUCATION
FUNDING YOUR EDUCATION

• Teaching Assistantships (TA)
• Research Assistantships (RA)
• Work on Campus
TEACHING ASSISTANT

• 10 or 20 hours per week

• Salary + out-of-state to in-state tuition release

• Grading, recitations, and labs for selected ECE undergraduate and a few ECE and TCOM graduate courses

• About 25 20-hr-per-week positions available each semester.

• Applications need to be submitted to the ECE main office in the middle of the preceding semester

• Deadlines and detailed procedures announced on the ECE website

• Preference given to senior students maintaining good GPA, with no C’s or F’s
RESEARCH ASSISTANT

10 or 20 hours per week, salary + tuition

Research in the area of interest of a given ECE faculty member

Work on a research grant of a given professor

Candidates selected individually by each professor

Preference given to students with good GPA, with no C’s or F’s, with excellent grades in courses taught by the given faculty member

Documented practical skills and experience in the area of research of the given faculty member very welcome

MS Thesis option, earlier publications, and Ph.D. plans a plus

Very rarely granted to students in the first semester of their studies
SKILLS ARE IMPORTANT (RA & TA):

- Practical skills, such as documented knowledge of:
  - Matlab,
  - PSpice,
  - VHDL,
  - C/C++,
  - Python,
  - Assembly languages,
  - Xilinx Vivado,
  - Xilinx ISE,
  - ModelSim,
  - FPGA boards,
  - Microcontroller boards,
  - measurement equipment,
  - telecommunication equipment,
  - etc.

are very welcome
WORK ON CAMPUS

• Up to 20 hours per week, **salary, no tuition**

• For international students, the requirement to take 9 credit hours per semester to **maintain the full-time status**

• Available positions
  - department offices
  - GMU library
  - post-office
  - computer labs
  - bookstore
  - cafeteria, etc.
A WISE MAN ONCE SAID ...

- Graduate courses require much more outside work/study than undergraduate courses.

- You may want to limit your enrollment to just one course if you work full time, and two courses if you work part time.

- Higher level courses require a larger amount of work than lower level courses and build on material from the lower level courses.

- Courses with projects are particularly time consuming.

- Try to take no more than two such course per semester if possible.

- Your degree is not a race. Get understanding, not just a credit. Give yourself enough time for each subject.
A WISE MAN CONTINUED ...

• Plan your courses ahead. Talk with your advisor.

• Make your plan of study coherent.

• Avoid a mere hodge-podge of various courses.

• Study groups are particularly helpful but be aware of the GMU honor code rules.

• Start early; if you fail the first midterm or the first project, it might be already impossible to catch up.

• Talk with instructor and your advisor if you start to think you might be having problems (academic or personal).

• Listen to friends, believe faculty.
THANK YOU