MS in Electrical Engineering & MS in Computer Engineering

Choosing a Specialization Area & Degree Option

Useful Hints
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 the ECE Department

Undergraduate Degrees

BS in Electrical Engineering
BS in Computer Engineering

Master Degrees

MS in Electrical Engineering
MS in Computer Engineering
MS in Telecommunications
MS in Computer Forensics

PhD Degrees

PhD in Electrical and Computer Engineering
Three Degree Options

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

OR

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

OR

10 courses + Scholarly Paper (an individual project in one of the advanced courses)
**MS EE**

- **2 out of 6 core courses**
- Up to 8 elective courses
- **MINIMUM THREE 600+ courses from a chosen specialization area**
- **MAXIMUM TWO non-ECE courses (including TCOM)**

**MS CpE**

- **2 out of 5 core courses**
- Up to 8 elective courses
- Selected from over 80 ECE, CS, ISA, SWE, TCOM, CFRS courses
- 5-7 pre-approved electives separate for each specialization area
- UP TO 50% OF non-ECE courses
Core Courses
EE Program

Two core courses, with a B or better in each, from the following:

• ECE 521 – Modern Systems Theory
• ECE 528 – Introduction to Random Processes in Electrical and Computer Engineering
• ECE 548 – Sequential Machine Theory
  or
  ECE 511 – Microprocessors
• ECE 584 – Semiconductor Device Fundamentals
  or
  ECE 565 – Introduction to Optical Electronics
Core Courses
CpE Program

Two core courses, with a B or better in each, from the following:

- CS 571 - Operating Systems
- ECE 511 - Microprocessors
- ECE 542 - Computer Network Architectures and Protocols
- ECE 545 - Digital System Design with VHDL
- ECE 548 - Sequential Machine Theory
MS EE
Specialization Areas

Summary
• Bioengineering
• Communications and Networking
• Signal Processing
• Control and Robotics
• Microelectronics/Nanoelectronics
• System Architectures
Bioengineering

- BENG 501 Bioengineering Research Methods
- BENG 525/ECE 590 Neural Engineering
- ECE 530 Sensor Engineering
- BENG 538/ECE 538 Medical Imaging
- ECE 542 Computer Network Architectures and Protocols
- BENG 551 Translational Bioengineering
- ECE 590 Biomedical Signal Processing
- ECE 620 Optimal Control Theory
- ECE 621 Systems Identification
- BENG 636 Advanced Biomedical Signal Processing
- ECE 699 Advanced Topics in Biomedical Signal Processing
- ECE 722 Kalman Filtering with Applications
- BENG 725 Computational Motor Control
- ECE 734 Detection and Estimation Theory
- BENG 738 Advanced Medical Image Processing
- ECE 738 Advanced Digital Signal Processing
- ECE 754 Optimum Array Processing I
Communications and Networking

- ECE 513 Applied Electromagnetic Theory
- ECE 528 Introduction to Random Processes in Electrical and Computer 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 567 Optical Fiber Communications
- ECE 612 Real-Time Embedded Systems
- ECE 621 Systems Identification
- ECE 630 Statistical Communication Theory
- ECE 633 Coding Theory
- ECE 635 Adaptive Signal Processing
- ECE 642 Design and Analysis of Computer Communication Networks
- ECE 643 Network Switching and Routing
- ECE 646 Cryptography and Computer Network Security
- ECE 670 Principles of C4I
- ECE 699 Software-Defined Radio
- ECE 699 Network Control
- ECE 722 Kalman Filtering with Applications
- ECE 728 Random Processes in Electrical and Computer Engineering
- ECE 731 Digital Communications
- ECE 732 Mobile Communication Systems
- ECE 734 Detection and Estimation Theory
- ECE 738 Advanced Digital Signal Processing
- ECE 741 Wireless Networks
- ECE 742 High Speed Networks
- ECE 746 Advanced Applied Cryptography
- ECE 747 Cryptographic Engineering
- ECE 751 Information Theory
- ECE 754 Optimum Array Processing I
Signal Processing

- ECE 521 Modern Systems Theory
- ECE 528 Introduction to Random Processes in Electrical and Computer Engineering
- ECE 531 Introduction to Wireless Communications and Networks
- ECE 535 Digital Signal Processing
- ECE 537 Introduction to Digital Image Processing
- ECE 542 Computer Network Architectures and Protocols
- ECE 545 Digital System Design with VHDL
- ECE 590 Biomedical Signal Processing
- ECE 612 Real-Time Embedded Systems
- ECE 615 Software/Hardware Codesign
- ECE 620 Optimal Control Theory
- ECE 621 Systems Identification
- ECE 630 Statistical Communication Theory
- ECE 633 Coding Theory
- ECE 635 Adaptive Signal Processing
- ECE 642 Design and Analysis of Computer Communication Networks
- ECE 670 Principles of C4I
- ECE 699 Advanced Topics in Biomedical Signal Processing
- ECE 699 Software-Defined Radio
- ECE 699 Learning from Data
- ECE 720 Multivariable and Robust Control
- ECE 722 Kalman Filtering with Applications
- ECE 728 Random Processes in Electrical and Computer Engineering
- ECE 731 Digital Communications
- ECE 732 Mobile Communication Systems
- ECE 734 Detection and Estimation Theory
- ECE 738 Advanced Digital Signal Processing
- ECE 740 Digital Signal Processing Hardware Architectures
- ECE 741 Wireless Networks
- ECE 751 Information Theory
- ECE 754 Optimum Array Processing I
Control and Robotics

- ECE 510 Real-Time Concepts
- ECE 521 Modern Systems Theory
- ECE 528 Introduction to Random Processes in Electrical and Computer Engineering
- ECE 542 Computer Network Architectures and Protocols
- ECE 590 Humanoid Robotics
- ECE 590 Robot Design
- ECE 612 Real-Time Embedded Systems
- ECE 620 Optimal Control Theory
- ECE 621 Systems Identification
- ECE 624 Control Systems
- ECE 650 Robotics
- ECE 673/SYST 620 Discrete Event Systems
- ECE 699 Network Control
- ECE 720 Multivariable and Robust Control
- ECE 722 Kalman Filtering with Applications
Microelectronics/Nanoelectronics

- 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 680 Physical VLSI Design
- ECE 681 VLSI Design for ASICs
- ECE 682: VLSI Test Concepts
- ECE 684 MOS Device Electronics
- ECE 745 ULSI Microelectronics
- ECE 780 Radio Frequency Electronics
System Architectures

- ECE 542 Computer Network Architectures and Protocols
- ECE 673/SYST 620 Discrete Event Systems
- ECE 674/SYST 621 System Architecture Design
- ECE 675/SYST 622 System Integration and Architecture Evaluation
MS CpE
Specialization Areas
Summary
<table>
<thead>
<tr>
<th></th>
<th>CpE Digital Systems Design</th>
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<th>CpE Microprocessors and Embedded Systems</th>
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</table>
| **Pre-Approved Electives** | ECE 545 Digital System Design with VHDL  
  ECE 586 Digital Integrated Circuits  
  ECE 590 Internet of Things  
  ECE 645 Computer Arithmetic  
  ECE 681 VLSI Design for ASICs  
  ECE 699 Software/Hardware Codesign  
  ECE 699 Physical Design for IoT  
  ECE 740 DSP Hardware Architectures | **Suggested Electives** | ECE 510 Real-Time Concepts  
  ECE 511 Microprocessors  
  ECE 590 Mobile Systems & Apps  
  ECE 611 Advanced Microprocessors  
  ECE 612 Real-Time Embedded Systems  
  ECE 615 Software/Hardware Codesign  
  ECE 699 Heterogeneous & Green Computing |
| **Suggested Electives** | ECE 584, 684, … (technology)  
  ECE 511, 611, … (microprocessors)  
  ECE 646, 746, 747 … (applications) | **Professors** | K. Gaj, H. Homayoun, J.-P. Kaps, A. Sasan  
<table>
<thead>
<tr>
<th>Design level</th>
<th>Digital System Design with VHDL</th>
<th>Computer Arithmetic</th>
<th>Software/Hardware Codesign</th>
<th>VLSI Design for ASICs</th>
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<tr>
<td>algorithmic</td>
<td>CpE core</td>
<td>ECE 545</td>
<td>ECE 645</td>
<td>ECE 615</td>
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<td>register-transfer</td>
<td>ECE 545</td>
<td>ECE 645</td>
<td>ECE 615</td>
<td>ECE 681</td>
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<td>gate</td>
<td>ECE 586 Digital Integrated Circuits</td>
<td>ECE 587</td>
<td>ECE 680</td>
<td>ECE 681</td>
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<td>layout</td>
<td>ECE 584 Semiconductor Device Fundamentals</td>
<td>ECE 684 MOS Device Electronics</td>
<td>ECE 685 Nano-electronics</td>
<td>ECE 780 RF Electronics</td>
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<td>Pre-Approved Electives</td>
<td>CpE Computer Networks</td>
<td>CpE Network and System Security</td>
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<td>ECE 528 Random Processes in ECE</td>
<td>ECE 542 Computer Network Architectures and Protocols</td>
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<td>ECE 747 Cryptographic Engineering</td>
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<td>ECE 742 High-Speed Networks or ECE 741 Wireless Networks</td>
<td>ISA 656 Network Security</td>
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<tr>
<th>Suggested Electives</th>
<th>CS 672, CS 756 (performance)</th>
<th>ISA 562, 564, 674, 765, 767 (network security)</th>
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<td>ECE 746, 747 (security)</td>
<td>ECE 642, 741, 742 (computer networks)</td>
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<td></td>
<td>ECE 511, 611 (microprocessors)</td>
<td>ECE 545, 645 (hardware implementations)</td>
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<td></td>
<td>ECE 531, 630, 633, 731, 732, 733, 737, 739 (communications)</td>
<td>ECE 511, 611 (microprocessors)</td>
</tr>
</tbody>
</table>

<p>| Professors | B. Jabbari, B.L. Mark, B.P. Paris, Z. Tian | K. Gaj, J. Kaps |</p>
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<th>Pre-Approved Electives</th>
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<td>ECE 535 Digital Signal Processing</td>
<td>ECE 681 (ASIC)</td>
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<tr>
<td>ECE 537 Introduction to Digital Image Processing</td>
<td>ECE 511, 611 (microprocessors)</td>
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<tr>
<td>ECE 545 Digital System Design with VHDL</td>
<td>ECE 528 (math background)</td>
</tr>
<tr>
<td>ECE 645 Computer Arithmetic</td>
<td>ECE 635, 754 (advanced DSP)</td>
</tr>
<tr>
<td>ECE 740 DSP Hardware Architectures</td>
<td>ECE 731, 735 (applications)</td>
</tr>
<tr>
<td>ECE 768 Advanced Digital Signal Processing</td>
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**Professors**

Graduate Coordinators

MS CpE: Dr. Kris Gaj  MS EE: Dr. Bijan Jabbari

Responsibilities:

• initial interviews with the potential candidates helping them to choose the right specialization area
• keeping a record of students pursuing particular specialization areas and graduating within a given specialization area
• approving transfers between two specialization areas
• dealing with any exceptional circumstances
Transfers and Degree Requirements
Transfer between Programs

• 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

Transfer of Credit

In order to be applied to a given specialization area, 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
Plan of Study

A tentative plan of study must be submitted by each student to the student’s advisor and the main ECE office no later than before the end of the second semester in the degree program at GMU.
Degree Requirements

• total degree GPA of 3.0 (B) or better
  (degree GPA takes into account only courses
  applied toward graduation)

• no more than two C grades 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
MS EE & MS CpE

MS Thesis Option

8 courses

ECE 799 Master’s Thesis (6 cr. hrs)

Research Project Option

9 courses

ECE 798 Research Project Scholarly paper

Scholarly Paper Option

10 courses

Scholarly paper
**Master’s Thesis (1)**

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.
Master’s Thesis (2)

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
Scholarly Paper (1)

Mandatory for all students who choose not to write an MS research 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

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 Patriotweb 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
Scholarly Paper (3)

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
If the reference is from a web source, the date of extracting the information must also be given as well as the URL.

Rules regarding all written work

• Honor Code
  – Do not copy other student’s work
  – Do not copy from the web without using quotation marks around copied work
  – 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
Rules regarding all written work

- **Honor Code**
  - Do not copy other students' work
  - Do not copy from the web without using quotation marks around copied work
  - Usually no more than 40% of content may be directly quoted
  - All quotations must have a reference cited
  - About 1% of TCOM students are sent to the honor court each year

Based on Prof. Allnutt, TCOM Fall 2006 Orientation, telecom.gmu.edu, Aug. 2006
Funding Your Education
Options available for international students

- Teaching Assistantships (TA)
- Research Assistantships (RA)
- Work on Campus
ECE Teaching Assistantships

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

Practical skills, such as documented knowledge of
Matlab, PSpice, VHDL, Aldec Active HDL, Xilinx ISE and Vivado,
FPGA boards, C/C++, Python, assembly language, microcontrollers,
measurement equipment, telecommunication equipment, etc.
are very welcome
Research Assistantships

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 maintaining 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 PhD plans a plus

Very rarely granted to students in the first semester of their studies
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.
Tips-n-Hints for Success

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 one 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.
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!

Questions???