Choosing a Specialization Area & Degree Option

Useful Hints
George Mason University

Volgenau School of Engineering (VSE)

College of Science

College of Humanities & Social Sciences

School of Business

College of Education & Human Development

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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 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 Digital Forensics and Cyber Analysis

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 9 core courses
- Up to 8 elective courses
  - Minimun: 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
  - 5-8 pre-approved electives separate for each specialization area
  - Up to 50% of non-ECE courses
Two core courses, with a B or better in each, from the following:

- ECE 521: Linear Systems and Control
- 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
- ECE 526: Neural Engineering or
- ECE 527: Learning From Data
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
• Communications and Networking
• Signal Processing
• Controls and Robotics
• Nanoelectronics
• Space-Based Systems
• Bioengineering
MS EE Courses
Communications and Networking - Group 1

ECE 528 Random Processes in Electrical and Computer Engineering
ECE 531 Introduction to Wireless Communications and Networking
ECE 542 Computer Network Architectures and Protocols
ECE 630 Statistical Communication Theory
ECE 633 Coding Theory
ECE 639 Satellite Communications
ECE 642 Design and Analysis of Computer Communication Networks
ECE 643 Telecommunication Switching Systems
ECE 670 Principles of C^4I
ECE 728 Random Processes in Electrical and Computer Engineering II
ECE 731 Digital Communications
ECE 732 Mobile Communication Systems
ECE 734 Detection and Estimation Theory
ECE 741 Wireless Networks
ECE 742 High Speed Networks
ECE 751 Information Theory
ECE 699-SDR Software-Defined Radio
ECE 699-SOCS Sparse Optimization and Compressive Sensing
MS EE Courses
Communications and Networking
Group 2

ECE 508  ECE 545
  ECE 511  ECE 521  ECE 528
    ECE 535
      ECE 542
          ECE 565
            ECE 567

ECE 612
  ECE 621  ECE 622  ECE 635
    ECE 738  ECE 740
      ECE 754
        ECE 746  ECE 747
MS EE Courses
Communications and Networking – Group 2

ECE 508 Internet of Things
ECE 513 Applied Electromagnetic Theory
ECE 535 Digital Signal Processing
ECE 545 Digital System Design with VHDL
ECE 567 Optical Fiber Communications
ECE 612 Real-Time Embedded Systems
ECE 621 Systems Identification
ECE 622 Kalman Filtering with Applications
ECE 635 Adaptive Signal Processing
ECE 646 Cryptography and Computer Network Security
ECE 738 Advanced Digital Signal Processing
ECE 740 Digital Signal Processing Hardware Architectures
ECE 746 Advanced Applied Cryptography
ECE 747 Cryptographic Engineering
ECE 754 Optimum Array Processing I
MS EE Courses
Signal Processing – Group 1

ECE 527 Learning From Data
ECE 528 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 537 Introduction to Digital Image Processing
ECE 635 Adaptive Signal Processing
BENG 636 Advanced Biomedical Signal Processing
ECE 670 Principles of C⁴I
ECE 734 Detection and Estimation Theory
ECE 728 Random Processes in Electrical and Computer Engineering
ECE 738 Advanced Digital Signal Processing
ECE 740 Digital Signal Processing Hardware Architectures
ECE 754 Optimum Array Processing I

ECE 699-SDR Software-Defined Radio
ECE 699-SOCS Sparse Optimization and Compressive Sensing
MS EE Courses
Signal Processing – Group 2

ECE 508 Internet of Things
ECE 521 Linear Systems and Control
ECE 542 Computer Network Architectures and Protocols
ECE 545 Digital System Design with VHDL
ECE 612 Real-Time Embedded Systems
ECE 615 Software/Hardware Codesign
ECE 620 Optimal Control Theory
ECE 621 Systems Identification
ECE 622 Kalman Filtering with Applications
ECE 630 Statistical Communication Theory
ECE 633 Coding Theory
ECE 642 Design and Analysis of Computer Communication Networks
ECE 731 Digital Communications
ECE 732 Mobile Communication Systems
ECE 741 Wireless Networks
ECE 751 Information Theory
MSEE Courses
Control and Robotics

ECE 510 Real-Time Concepts
ECE 521 Linear Systems and Control
ECE 528 Introduction to Random Processes in ECE
ECE 590 Humanoid Robotics/Robot Design
ECE 612 Real-Time Embedded Systems
ECE 619 Nonlinear Systems and Control
ECE 620 Optimal Control Theory
ECE 621 Systems Identification
ECE 622 Kalman Filtering with Applications
ECE 627 Adaptive Control
ECE 635 Adaptive Signal Processing
ECE 673/SYST 620 Discrete Event Systems
ECE 699 Cooperative Control of Multi-Agent Systems/Network Control
MSEE Courses
Nanoelectronics

ECE 513 Applied Electromagnetic Theory
ECE 565 Introduction to Optical Electronics
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 684 MOS Device Electronics
ECE 685 Nanoelectronics
ECE 699 Sensor Device Technology
ECE 780 Radio Frequency Electronics
Space-Based Systems (1)

- Required Course:
  ECE 590 Small Spacecraft Design and Engineering

Two courses from the following list:

**Space:**
- ECE 513 Applied Electromagnetic Theory
- ECE 530 Sensor Engineering
- ECE 550/SYST 520 System Engineering Design
- ECE 699 Small Satellite Development
Space-Based Systems (2)

Choose two out of the three groups of courses listed below, and then take at least two courses from each of the selected groups (4 courses minimum; taking other courses from all three groups encouraged):

*Communications and Signals:*

- ECE 528 Introduction to Random Processes in Electrical and Computer Engineering
- ECE 535 Digital Signal Processing
- ECE 630 Statistical Communication Theory
- ECE 639 Satellite Communications
- ECE 699 Software Defined Radio
- ECE 754 Optimum Array Processing I
Space-Based Systems (3)

Control:
ECE 521 Linear Systems and Control
ECE 620 Optimal Control Theory
ECE 622 Kalman Filtering with Applications
ECE 627 Adaptive Control

Embedded Systems:
ECE 511 Microprocessors
ECE 545 Digital System Design with VHDL
ECE 612 Real-Time Embedded Systems
ECE 615 Software/Hardware Codesign
Bioengineering

- BENG 501 Bioengineering Research Methods
- ECE 521 Linear Systems and Control
- ECE 526/BENG 525 Neural Engineering
- ECE 530 Sensor Engineering
- ECE 535 Digital Signal Processing
- ECE 537 Introduction to Digital Image Processing
- 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
- ECE 622 Kalman Filtering with Applications
- BENG 636 Advanced Biomedical Signal Processing
- ECE 699 Advanced Topics in Biomedical Signal Processing
- ECE 734 Detection and Estimation Theory
- BENG 738 Advanced Medical Image Processing
- ECE 738 Advanced Digital Signal Processing
- ECE 754 Optimum Array Processing I
MS CpE
Specialization Areas
Summary
<table>
<thead>
<tr>
<th>Pre-Approved Electives</th>
<th>CpE Digital Systems Design</th>
<th>CpE Microprocessors and Embedded Systems</th>
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<tbody>
<tr>
<td></td>
<td>ECE 545 Digital System Design with VHDL</td>
<td>ECE 510 Real-Time Concepts</td>
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<td>ECE 586 Digital Integrated Circuits</td>
<td>ECE 511 Microprocessors</td>
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<td></td>
<td>ECE 615 Software/Hardware Codesign</td>
<td>ECE 590 Mobile Systems &amp; Apps</td>
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<td>ECE 645 Computer Arithmetic</td>
<td>ECE 611 Advanced Microprocessors</td>
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<tr>
<td></td>
<td>ECE 681 VLSI Design for ASICs</td>
<td>ECE 612 Real-Time Embedded Systems</td>
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<td>ECE 682 VLSI Test Concepts</td>
<td>ECE 615 Software/Hardware Codesign</td>
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<td></td>
<td>ECE 740 DSP Hardware Architectures</td>
<td>ECE 699 Green Computing and Heterogeneous Architectures</td>
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<tr>
<td></td>
<td>ECE 584, 684, … (technology)</td>
<td>CS 540, 583 (languages, algorithms)</td>
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<tr>
<td></td>
<td>ECE 511, 611, … (microprocessors)</td>
<td>CS 635 (parallel machines)</td>
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<td></td>
<td>ECE 646, 746, 747 … (applications)</td>
<td>ECE 542, 642, 742 (networks)</td>
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<td>ECE 42, 681 (digital design)</td>
<td>ECE 645 (digital design)</td>
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<td></td>
<td>ECE 548 (sequential mach. theory)</td>
<td>ECE 658 (sequential mach. theory)</td>
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<td>ECE 699 (advanced mobile systems)</td>
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<td></td>
<td>ECE 590 (small spacecraft design)</td>
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Design level

Digital System Design with VHDL

Computer Arithmetic

Software/Hardware Codesign

VLSI Design for ASICs

algorithmic

CpE core

ECE core

ECE 545

ECE 645

ECE 615

ECE 681

register-transfer

ECE 586

Digital Integrated Circuits

ECE 587

Analog Integrated Circuits

ECE 680

Physical VLSI Design

ECE 685

Nano-electronics

ECE 780

RF Electronics

gate

device

ECE 584

EE core

Semiconductor Device Fundamentals

ECE 684

MOS Device Electronics

ECE 685

Nanoelectronics

ECE 780

RF Electronics
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<td>ECE 528 Random Processes in ECE</td>
<td>ECE 508 Internet of Things</td>
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<tr>
<td>ECE 531 Introduction to Wireless Communication &amp; Networks</td>
<td>ECE 542 Computer Network Architectures and Protocols</td>
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<td>ECE 646 Cryptography and Computer Network Security</td>
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<td>ECE 633 Coding Theory</td>
<td>ECE 746 Advanced Applied Cryptography</td>
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<td>ECE 642 Design and Analysis of Computer Networks</td>
<td>ECE 747 Cryptographic Engineering</td>
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<td>ECE 646 Cryptography and Computer Network Security</td>
<td>ISA 656 Network Security</td>
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<tr>
<td>ECE 741 Wireless Networks</td>
<td>ISA 562, 564, 674, 765, 767 (network security)</td>
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<tr>
<td>ECE 742 High-Speed Networks</td>
<td>ECE 642, 741, 742 (computer networks)</td>
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<td>CS 672, CS 756 (performance)</td>
<td>ISA 562, 564, 674, 765, 767 (network security)</td>
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<td>ECE 746, 747 (security)</td>
<td>ECE 642, 741, 742 (computer networks)</td>
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<td>ECE 511, 611 (microprocessors)</td>
<td>ECE 545, 645 (hardware implementations)</td>
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<td>ECE 531, 630, 633, 731, 732, 733, 737, 739 (communications)</td>
<td>ECE 511, 611 (microprocessors)</td>
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<tr>
<td>B.L. Mark, B. Jabbari, K. Zeng</td>
<td>K. Gaj, J.-P. Kaps, J. Jones, A. Sasan</td>
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<td>CpE Digital Signal Processing</td>
<td>CpE Internet of Things</td>
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<td><strong>Suggested Electives</strong></td>
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<tr>
<td>ECE 681 (ASIC)</td>
<td>ECE 527 (machine learning)</td>
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<td>ECE 511, 611 (microprocessors)</td>
<td>ECE 537 (image processing)</td>
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<td>ECE 528 (math background)</td>
<td>ECE 642, 742 (networks)</td>
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<td>ECE 635, 754 (advanced DSP)</td>
<td>ECE 645, 681 (digital design)</td>
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<td>ECE 731, 735 (applications)</td>
<td>ECE 611 (microprocessors)</td>
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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

• application form available at
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 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

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
Scholarly Paper (2)

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
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

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

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.

Possible end of Academic Career at GMU

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, C/C++, Python, Assembly languages,
Xilinx Vivado, Xilinx ISE, ModelSim, FPGA boards, Microcontroller
boards, 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 Ph.D. 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 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.
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???