# Course Syllabus

**18-202:** *Mathematical Foundations of Electrical Engineering*
**Spring 2020**


**Course Instructors:**

*Soummya Kar*
PH B18, soummyak@andrew.cmu.edu
**Office Hours:** Mon/Wed 3:00pm-4:00pm ET, PH B30

*Yuejie Chi*
PH B25**,** yuejiec@andrew.cmu.edu
**Office Hours:** Tue/Wed 4:00pm-5:00pm ET, PH B25

**Teaching Assistants:**

*Harlin Lee*
 harlinl@andrew.cmu.edu
**Office Hour:** TBD

*Tian Tong*
 ttong1@andrew.cmu.edu
**Office Hour:** TBD

*Carmel Fiscko*
cfiscko@andrew.cmu.edu
**Office Hour:** TBD

*Laixi Shi*
 laixis@andrew.cmu.edu
**Office Hour:** TBD


*Mark Prettyman*
 mprettym@andrew.cmu.edu
**Office Hour:** TBD

*Yogesh Narayan Vaithiyanathan*
 yvaithiy@andrew.cmu.edu
**Office Hour:** TBD

*Alex Li*
 alexl3@andrew.cmu.edu
**Office Hour:** TBD

*Kushagra Sharma*
 kushagrs@andrew.cmu.edu
**Office Hour:** TBD


**Course Management Assistant:** Valeria McCrary
**Email Address:** vmccrary@andrew.cmu.edu
**Office Location**: HH 1112

**Class Schedule:**

| *Lecture*: | Monday and Wednesday | 12:30pm-2:20pm | BH 136A |

*Recitations*:

| *Section A* | Tuesday and Thursday | 11:30am-12:20pm | PH 125B |
| *Section B* | Tuesday and Thursday | 12:30pm-1:20pm | BH 235B |
| *Section C* | Tuesday and Thursday | 1:30pm-2:20pm | PH A20 |
| *Section D* | Tuesday and Thursday | 12:30pm-1:20pm | PH A18B |


Each student will be assigned to a recitation, in order to balance the number of students in each section. We will ask for your conflicts and preferences on the first day of lecture.

**Class Structure:**
The teaching of this course uses a three-layer structure: lectures, recitations, and office hours:

*Lectures* focus on the **high level** with **few problems** solved and do not lend themselves to a high degree of interaction. Emphasis on concepts, theorems, and sketches of proofs.

*Recitations* emphasize **working examples** that illustrate the concepts presented in the lecture. Recitations are **not lectures**, they should be **interactive**; the instructor will distribute to students one sheet with suggested problems to solve in the recitation. The students will attempt to work these problems in the recitation with the help of the instructor.

***Office hours*** are designed for **students** to **raise** any issues and **questions** they have with homework problems and any other course topic and then work through these issues with the help of the teaching staff.

There are many opportunities for contact between the teaching staff and the students. There are two lectures of 80 minutes each and two recitations of 50 minutes each. Students are strongly encouraged to attend the lectures, recitations, and office hours. Consistent attendance will help the understanding and learning of the material. The staff will be reluctant to receive students outside these assigned time slots to discuss questions about problem sets unless the student makes regular use of these times. The level of participation and interaction of students may be taken into account in the final grade.

**Course Description:**
     *Number of Units:* 12
     *Pre-requisites:* 21-122 (with C or better)
*Undergraduate Course Area:* ECE Mathematics

**Required Textbook:**
- *Mathematical Foundations of Electrical Engineering*, by J. M. F. Moura, 18-202 Course Notes, 2017 (a.k.a. Moura)
- *Introduction to Applied Linear Algebra: Vectors, Matrices, and Least Squares,* 1st Edition, by Stephen Boyd and Lieven Vandenberghe (a.k.a. vmls)

**Recommended Textbook:**
*Advanced Engineering Mathematics,* by Erwin Kreyszig, Wiley & Sons, Inc., 10th Edition, ISBN: 978-0073380377

**Brief Contents:**
The course covers topics from engineering mathematics that serve as foundations for descriptions of electrical engineering devices, signals, and systems. It is the co-requisite mathematics course for 18-220, Fundamentals of Electrical Engineering, and for 18-290, Signals and Systems. This is a Mathematics course. As such, expect theorems and proofs from time to time. This is not a Calculus course. We will mix rigor with motivation and intuition. Most of the time, we will not grind through proofs; we may require the students to learn them by studying the notes or by deriving them.

Rudiments of Set Theory, Complex Analysis, Vector and Matrix Calculus, Determinants. Inverses. Linear Algebra, Vector spaces. Linear independence. Scalar products. Eigenvalues and eigenvectors. Linear transforms. Systems of linear algebraic equations. Linear constant coefficients ordinary difference and differential equations. Systems of linear first order differential and difference equations. Time permitting, Fourier Analysis

and other topics may be covered. Note that 18-290 does cover Fourier Analysis and other transform techniques, so you will get coverage of these topics for sure in that course.

**Course Canvas:**
To access the course canvas from an Andrew Machine, go to the login page at: https://cmu.instructure.com/. You should check the course Canvas daily for announcements and handouts.

**Course Piazza:**
Students are encouraged to use Piazza which is integrated into the Canvas. Piazza is a discussion/Q&A site that this course will utilize for student, TA, and professor interaction. You will find a link to Piazza on the Course Canvas page.

**Homework:**
Expect about 10-12 homeworks, roughly, one per week, see schedule below for when homeworks are handed out. Homeworks are due on the marked time on the assignment and all homeworks are handled through gradescope.

Late homeworks will not be graded. Solutions to the homeworks will be posted the day the homework is due.

Students are encouraged to study together if they feel this helps them to understand and master better the subject matter. However, because problem sets are graded and their grade contributes to the final course grade, problem sets should correspond to the individual work of each student. It is okay to discuss a problem with colleagues. It is NOT okay to hand in a homework that does not reflect your understanding of the problems, or a homework that copies someone else' solution. Because you are in this course to learn this material, and a great part of the learning process is you working the homeworks yourself, you are NOT allowed to consult or use in any way, shape, or form the solutions to specific Homework problems from previous years (if in fact you could or do find them).

**Exams:**
There are four exams given throughout the semester, scheduled during Lecture times. Lecture time is 12:30pm-2:20pm. Be seated by 12:15PM on these days.

> **Exam 1:** Wednesday, February 12
> **Exam 2:** Wednesday, March 4
> **Exam 3:** Wednesday, April 8
> **Exam 4:** Wednesday, April 29 (last day of class)

There is no exam during CMU finals period.

Exams are cumulative and closed book. Students are allowed (also cumulatively) one new page of notes per exam. Unless extreme substances (such as medical emergency, in which cases proofs are needed), no make-up exams will be scheduled.

**Quizzes:**
From time to time, there may be unannounced 5 to 10 minute quizzes in recitation or lectures. Students will NOT be given advance notice of the quiz. Quizzes may or may NOT be graded, at the discretion of the instructors. Graded quizzes will count for the final grade. **In no case, will make-up quizzes be scheduled**.

**Grading Algorithm:**

Homework   22%   (10-12 homeworks, lowest 2 will be dropped.)
Exams       75%   (4 exams)
Quizzes     3%   (lowest 2 will be dropped.)

We will compute for each student a numerical score. Exams, homeworks, and quizzes are graded and their grades contribute to the numerical score. The lowest grades of two homeworks will be dropped. The lowest grades of two quizzes will be dropped. The homeworks contribute 22% to the numerical score, while the quizzes contribute 3% to the numerical score. For the exams, we will put more weights on highly performed exams. Sort all exam scores in a decreasing manner. We will compute the weighted average of the exams by weighting them by (150%, 100%, 100%, 50%).

The final grade is a letter grade A, B, C, D or Fail. The numerical scores are converted into a letter grade according to the following:

Grade = A if numerical score greater than or equal to 90 %
Grade = B if numerical score greater than or equal to 80 %
Grade = C if numerical score greater than or equal to 70 %
Grade = D if numerical score greater than or equal to 50 %
Grade = F if numerical score smaller than 50 %

In exceptional cases, students whose numerical score falls at slightly below one of the above thresholds may end-up with a higher letter grade if the staff strongly advocates that the student's understanding of the course material should correspond to a higher letter grade.

Re-grades on any course materials will only be granted if a serious mistake in the grading has taken place. The course instructors are the only ones to be approached for a re-grade of any course material. No material will be accepted for a re-grade more than one week after it has been available for collection by the student. If materials are submitted for re-grading, the entire piece of work is subject to re-grade (not just the part requested by the student).

**Tentative Course Calendar:**

| Date | Day | Class Activity |
|------|-----|----------------|
| **January** | | |
| 13 | Mon. | L1 |
| 15 | Wed. | L2 |
| 20 | Mon. | Martin Luther King Day; No Classes |
| 22 | Wed. | L3 |
| 27 | Mon. | L4 |
| 29 | Wed. | L5 |
| **February** | | |
| 3 | Mon. | L6 |
| 5 | Wed. | L7 |
| 10 | Mon. | L8 |
| 12 | Wed. | **Exam 1** |
| 17 | Mon. | L9 |
| 19 | Wed. | L10 |
| 24 | Mon. | L11 |
| 26 | Wed. | L12 |
| **March** | | |
| 2 | Mon. | L13 |
| 4 | Wed. | **Exam 2** |
| 6 | Fri. | Mid-Semester Break; No Classes |
| 9-13 | M-F | Spring Break; No Classes |
| 16 | Mon. | L14 |
| 18 | Wed. | L15 |
| 23 | Mon. | L16 |
| 25 | Wed. | L17 |
| 30 | Mon. | L18 |
| **April** | | |
| 1 | Wed. | L19 |
| 6 | Mon. | L20 |
| 8 | Wed. | **Exam 3** |
| 13 | Mon. | L21 |
| 15 | Wed. | L22 |
| 17 | Fri. | Spring Carnival; No Classes |
| 20 | Mon. | L23 |
| 22 | Weds. | L24 |
| 27 | Mon. | L25 |
| 29 | Wed. | **Exam 4** |
| **May** | | |
| 1 | Fri. | Last Day of Class |
| 4-11 | | Final Examinations |

**Education Objectives (Relationship of Course to Program Outcomes):**

*(a) an ability to apply knowledge of mathematics, science, and engineering:*
This course emphasizes mathematics for electrical and computer engineering. Through problem solving in class (mostly in recitations and tutorials) and in the homeworks,

students learn how to use the material taught in Lecture to solve specific problems. In Lectures, Recitations, and Homeworks there are numerous examples where Mathematics solve practical problems. We motivate with examples from Electrical and Computer Engineering the teaching of Mathematics.

### *(f) an understanding of professional and ethical responsibility:*
Students are encouraged to study in group and when working on their homeworks, but they are taught to understand that their homework solutions should reflect their understanding of the homework problems. So, it is not ethical or appropriate to hand in a solution that is copied from someone else' solution, past or present.

### *(g) an ability to communicate effectively:*
The students are encouraged to take an active role in Lectures, Recitations, and Tutorials. Students have to hand-in their homework almost weekly and receive weekly feedback on their performance. The final grade may very much depend on how well someone in the teaching staff can vouch for the student's knowledge, so, they are encouraged to take an active role in the course and show their full knowledge of the course material.

### *(i) life-long learning*
A recognition of the need for and an ability to engage in life-long learning.

### *(j) Art of learning*
By emphasizing concepts at the basic level, the Course encourages the students to  practice the art of learning, hopefully, for life.

### ECE Academic Integrity Policy
**(**http://www.ece.cmu.edu/programs-admissions/masters/academic-integrity.html**):**
The Department of Electrical and Computer Engineering adheres to the academic integrity policies set forth by Carnegie Mellon University and by the College of Engineering. ECE students should review fully and carefully Carnegie Mellon University's policies regarding Cheating and Plagiarism; Undergraduate Academic Discipline; and Graduate Academic Discipline. ECE graduate student should further review the Penalties for Graduate Student Academic Integrity Violations in CIT outlined in the CIT Policy on Graduate Student Academic Integrity Violations. In addition to the above university and college-level policies, it is ECE's policy that an ECE graduate student may not drop a course in which a disciplinary action is assessed or pending without the course instructor's explicit approval. Further, an ECE course instructor may set his/her own course-specific academic integrity policies that do not conflict with university and college-level policies; course-specific policies should be made available to the students in writing in the first week of class.

*This policy applies, in all respects, to this course.*

### CMU Academic Integrity Policy (http://www.cmu.edu/academic-integrity/index.html)**:**

In the midst of self exploration, the high demands of a challenging academic environment can create situations where some students have difficulty exercising good judgment. Academic challenges can provide many opportunities for high standards to evolve if students actively reflect on these challenges and if the community supports discussions to aid in this process. It is the responsibility of the entire community to establish and maintain the integrity of our university.

This site is offered as a comprehensive and accessible resource compiling and organizing the multitude of information pertaining to academic integrity that is available from across the university. These pages include practical information concerning policies, protocols and best practices as well as articulations of the institutional values from which the policies and protocols grew. The Carnegie Mellon Code, while not formally an honor code, serves as the foundation of these values and frames the expectations of our community with regard to personal integrity.

*This policy applies, in all respects, to this course.*
**The Carnegie Mellon Code**
Students at Carnegie Mellon, because they are members of an academic community dedicated to the achievement of excellence, are expected to meet the highest standards of personal, ethical and moral conduct possible.

These standards require personal integrity, a commitment to honesty without compromise, as well as truth without equivocation and a willingness to place the good of the community above the good of the self. Obligations once undertaken must be met, commitments kept.

As members of the Carnegie Mellon community, individuals are expected to uphold the standards of the community in addition to holding others accountable for said standards. It is rare that the life of a student in an academic community can be so private that it will not affect the community as a whole or that the above standards do not apply.

The discovery, advancement and communication of knowledge are not possible without a commitment to these standards. Creativity cannot exist without acknowledgment of the creativity of others. New knowledge cannot be developed without credit for prior knowledge. Without the ability to trust that these principles will be observed, an academic community cannot exist.

The commitment of its faculty, staff and students to these standards contributes to the high respect in which the Carnegie Mellon degree is held. Students must not destroy that respect by their failure to meet these standards. Students who cannot meet them should voluntarily withdraw from the university.

*This policy applies, in all respects, to this course.*

**Carnegie Mellon University's Policy on Cheating**
(http://www.cmu.edu/academic-integrity/cheating/index.html) states the following:
According to the University Policy on Academic Integrity, cheating "occurs when a student avails her/himself of an unfair or disallowed advantage which includes but is not limited to:

- Theft of or unauthorized access to an exam, answer key or other graded work from previous course offerings.

- Use of an alternate, stand-in or proxy during an examination.
- Copying from the examination or work of another person or source.
- Submission or use of falsified data.
- Using false statements to obtain additional time or other accommodation.
- Falsification of academic credentials."

*This policy applies, in all respects, to this course.*

**Carnegie Mellon University's Policy on Plagiarism**
(http://www.cmu.edu/academic-integrity/plagiarism/index.html) states the following:
According to the University Policy on Academic Integrity, plagiarism "is defined as the use of work or concepts contributed by other individuals without proper attribution or citation. Unique ideas or materials taken from another source for either written or oral use must be fully acknowledged in academic work to be graded. Examples of sources expected to be referenced include but are not limited to:
- Text, either written or spoken, quoted directly or paraphrased.
- Graphic elements.
- Passages of music, existing either as sound or as notation.
- Mathematical proofs.
- Scientific data.
- Concepts or material derived from the work, published or unpublished, of another person."

*This policy applies, in all respects, to this course.*

**Carnegie Mellon University's Policy on Unauthorized Assistance**
(http://www.cmu.edu/academic-integrity/collaboration/index.html) states the following:
According to the University Policy on Academic Integrity, unauthorized assistance "refers to the use of sources of support that have not been specifically authorized in this policy statement or by the course instructor(s) in the completion of academic work to be graded. Such sources of support may include but are not limited to advice or help provided by another individual, published or unpublished written sources, and electronic sources. Examples of unauthorized assistance include but are not limited to:
- Collaboration on any assignment beyond the standards authorized by this policy statement and the course instructor(s).
- Submission of work completed or edited in whole or in part by another person.
- Supplying or communicating unauthorized information or materials, including graded work and answer keys from previous course offerings, in any way to another student.
- Use of unauthorized information or materials, including graded work and answer keys from previous course offerings.
- Use of unauthorized devices.
- Submission for credit of previously completed graded work in a second course without first obtaining permission from the instructor(s) of the second course. In the case of concurrent courses, permission to submit the same work for credit in two courses must be obtained from the instructors of both courses."

*This policy applies, in all respects, to this course.*

**Carnegie Mellon University's Policy on Research Misconduct** (http://www.cmu.edu/academic-integrity/research/index.html) states the following:

According to the University Policy For Handling Alleged Misconduct In Research, "Carnegie Mellon University is responsible for the integrity of research conducted at the university. As a community of scholars, in which truth and integrity are fundamental, the university must establish procedures for the investigation of allegations of misconduct of research with due care to protect the rights of those accused, those making the allegations, and the university. Furthermore, federal regulations require the university to have explicit procedures for addressing incidents in which there are allegations of misconduct in research."

The policy goes on to note that "misconduct means:

- fabrication, falsification, plagiarism, or other serious deviation from accepted practices in proposing, carrying out, or reporting results from research;

- material failure to comply with Federal requirements for the protection of researchers, human subjects, or the public or for ensuring the welfare of laboratory animals; or

- failure to meet other material legal requirements governing research."

"To be deemed misconduct for the purposes of this policy, a 'material failure to comply with Federal requirements' or a 'failure to meet other material legal requirements' must be intentional or grossly negligent."

To become familiar with the expectations around the responsible conduct of research, please review the guidelines for Research Ethics published by the Office of Research Integrity and Compliance.

*This policy applies, in all respects, to this course.*

**Take care of yourself.** Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek suppor

Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website at http://www.cmu.edu/counseling/. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can  help.

 If you have questions about this or your coursework, please let me know.