

**Department of Electrical and Computer Engineering
University of Massachusetts Amherst**

**ECE 201 – Analytical Tools for ECE
Fall 2022**

Description: This course will study basic mathematical tools built upon your calculus background *and* the application of these tools to electrical and computer engineering problems. In particular, there will be four main topics: complex numbers and functions; linear algebra; differential equations; Laplace transforms. For each of these topics, we will motivate the mathematics from engineering applications, work from very basic manipulations (“nuts and bolts”) to higher level mathematical understanding, and then finally return to apply what we have learned in application. Throughout, we will focus on the engineering context (“Why are these mathematical tools so important to electrical and computer engineers?”) and the relation between the four major topics.

Prerequisites: MA 132

Course Format: Three 50-minute lectures (MWF 10:10am, Goessman Laboratory 20); one 75-minute Discussion (Tu 11:30am; Tu 1:00pm; Tu 2:30pm) in ELAB 306.

Objectives: Students completing this course will be able to:

1. Use complex numbers, complex algebra and complex functions, including being fluent in complex number arithmetic and conversion between rectangular and polar forms.
2. Use matrix manipulation rules and understand basic concepts in vector spaces. Use matrices to analyze systems of linear differential equations.
3. Understand and solve simple first and second order differential equations.
4. Use Laplace transforms for solving simple differential equations.
5. Apply linear algebra and differential equations to the modeling, analysis, and design of electrical and computer systems.

Instructor:

Dennis Goeckel (goeckel@ecs.umass.edu)

Office Hours: Monday, 3:00pm-4:30pm; Marcus 215L

Additional office hours will be added many weeks; watch for Moodle announcements (or send email to meet outside office hours.)

Teaching Assistants:

Samantha Klein (samanthaklei@umass.edu)

Office Hours: Wednesday, 5pm-7pm, Place: Marcus Hall 205

Ivan Williams (inwilliams@umass.edu)

Office Hours: Thursday, 5pm-7pm, Place: Marcus Hall 205

Textbook: None required. You are responsible for everything covered in class notes or on homework. A text that roughly follows the course material is: *Advanced Engineering Mathematics*, by Erwin Kreyszig, but most students do just fine if they focus on an in-depth understanding of the material in the class notes.

Grading Policy: The course grade will be based on the following components. Note that there are a lot of graded components so that each one can be relatively “low stakes.”

1. Homeworks -- 15%
2. Weekly Discussion Quizzes – 10%
3. Pre-Exam Discussion Quizzes – 10%
4. Midterm 1 (Time: Wednesday, Sept 28th, 7-9pm; ELAB II 119, ELAB 304) – 12.5%
5. Midterm 2 (Time: Monday, October 24th, 7-9pm; Place: TBD) – 15.0%
6. Midterm 3 (Time: Wednesday, November 16th, 7-9pm; Place: TBD) – 17.5%
7. Final Exam (Time: Monday, Dec 19th, 10:30am-12:30pm; Place: Goes 20) – 20%

Course Overview (subject to modification):

1. Complex Numbers and Functions: rectangular and polar form; Euler’s formula; mathematical operations with complex numbers; kth root and logarithm; complex functions, including magnitude and phase. Applications to cellphones, circuit design, and general linear system design.
2. Linear Algebra: Matrices: basic operations, elementary row operations, Gaussian elimination, inversion, determinants, solving linear equations; linear transformations; basics of vector spaces; eigenvalues, eigenvectors, and diagonalization. Applications to circuit analysis, communications, machine learning.
3. Differential Equations: Introduction and modeling; numerical solutions via Euler’s scheme; separable differential equations; first-order linear differential equations; second-order linear differential equations. Interpretation of solutions in applications: circuits, control and robotics.
4. Laplace Transforms: Introduction and definition; solution of differential equations. Application to circuit analysis, control, and robotics.

Ground Rules: You are allowed to work together on homeworks; however, each student must submit their own solutions. Also recall that homeworks are really only preparation for the exams, so do not rely too heavily on other students for help. **Academic dishonesty** (either taking or giving answers, use of extra cribsheets, etc.) on a quiz or exam will be dealt with harshly; you will receive an “F” for the course, and there may be further disciplinary action.

Health and Wellbeing.

You are not alone at UMass – many people care about your wellbeing and many resources are available to help you thrive and succeed. The College recognizes that coursework is challenging and that classes are not the only demand in your life. Success in this course and the College of Engineering depends heavily on your personal health and wellbeing. Recognize that while stress is an expected part of the college experience, it can be compounded by unexpected setbacks or life changes outside the classroom. Strive to reframe challenges as an unavoidable pathway to success. Reflect on your role in taking care of yourself throughout the term, before the demands of exams and projects reach their peak. Please feel free to reach out to me about any difficulty you may be having that may impact your performance as soon as it occurs and before it becomes too overwhelming.

You can learn about the confidential mental health services available on campus by calling the Center for Counseling and Psychological Health (CCPH) by visiting their website at umass.edu/counseling. There are many other resources on campus for students facing personal, financial or life challenges to find support, stay in school, and graduate (<https://www.umass.edu/studentlife/single-stop>). Within the College, you may reach out to myself, your academic advisor, the Office of Student Affairs (<http://engineering.umass.edu/current-students/academics-advising>) or the Office of Community Equity and Inclusion (rees@umass.edu). I encourage you to contact support services on campus that stand ready to assist you. Remember that I am here to help you find the resources you need.

Accessibility Support Services.

Your success in this class is important to me. We all learn differently and bring different strengths and needs to the class. The University of Massachusetts Amherst is committed to making reasonable, effective and appropriate accommodations to meet the needs of all students and help create a barrier-free campus. If you have a qualifying disability and require accommodations while participating in this course, please work with Disability Services to have an accommodation letter sent to me in a timely manner. If you have a disability but are not yet affiliated with Disability Services, please register with Disability Services (<https://www.umass.edu/disability/students>). Information on services and materials for registering are also available on their website www.umass.edu/disability.

If you are eligible for exam accommodations, I am happy to offer those to you – often in a quiet conference room with access to a Teaching Assistant for questions. Alternatively, they can be administered by the exam proctoring center. Contact Disability Services immediately, and comply with their exam scheduling policies, including the requirement that you book your exams at least seven days in advance of the exam date. *It is incumbent upon you contact me during the first few weeks of the semester, or shortly following registration with Disability Services, to ensure that your accommodations are being sufficiently met, including extra time and note-taking access, as applicable.*

Finally, beyond disability accommodations, if there are aspects of the course that prevent you from being fully included in the class, please let me know as soon as possible. Together we'll develop strategies to meet both your needs and the requirements of the course.

Academic Honesty Statement.

Maintaining the integrity of scholarship and research within institutions of higher education requires a cultural commitment. All members of the UMass Amherst community are expected to be knowledgeable of and uphold our academic honesty policies (<https://www.umass.edu/honesty/>). Academic dishonesty includes but is not limited to cheating, fabrication, plagiarism, and *abetting or facilitating* dishonesty. Instructors are requested to take reasonable steps to address academic misconduct, and appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Any person who has reason to believe that a fellow student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor or an alternate, trusted member of the faculty or College administration as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair. Community members may fill out the College's classroom experience form (<https://tinyurl.com/UMassEngineerClassroom>) to report academic dishonesty anonymously. Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent.

Cheating and Plagiarism Policy

The University Academic Honesty Policy Applies in this and all courses. This policy can be found on the University Web Page (<https://www.umass.edu/honesty/>). Appendix B covers plagiarism, cheating,

fabrication, and facilitating dishonesty. Students are expected to be familiar with the definitions and examples provided.

Inclusivity.

Everyone should feel that they are an integral part of the community and that all individuals and their perspectives are respected. A diversity of perspective and experience provides a valuable source of ideas, problem solving strategies, and engineering creativity. If you feel that your contribution is not being valued or respected for any reason, please speak with me privately. If you wish to communicate with someone else in the College or University, there are several ways to do so anonymously or to provide contact information if you so choose:

1. Notify the University Diversity, Equity, and Inclusion Office through the “Report a Climate Incident” form: <https://www.umass.edu/diversity/incident-report-form>
Note that this form requires sharing name and contact information.
2. Speak with Assistant Dean Dr. Paula Rees (rees@umass.edu).
3. Report an incident anonymously to the College of Engineering Diversity, Equity, and Inclusion Office
 - Climate Concerns and Suggestions - <https://tinyurl.com/UMassEngineerClimate>
 - Classroom Experience - <https://tinyurl.com/UMassEngineerClassroom>
4. Reach out to the departmental DEI Committee –]
 - Anonymous ECE feedback form: <https://ece.umass.edu/ece-diversity-equity-inclusion> (scroll down for feedback link)

We are all members of an academic community with a shared responsibility to cultivate a climate where all individuals are valued and where both they and their ideas are treated with respect.

Pronouns and Names.

Everyone has the right to be addressed by the name and pronouns that they use for themselves. Students can indicate their preferred/chosen first name and pronouns on SPIRE, which appear on class rosters. Please let me know what name and pronouns I should use for you if they are not on the roster. A student’s chosen name and pronouns are to be respected at all times in the classroom. To learn more, please see this resource:

https://www.umass.edu/stonewall/sites/default/files/pronouns_intro.pdf

Gender Respect and Title IX.

The University of Massachusetts Amherst aspires to be a university environment that is free of discrimination, sexual harassment, and sexual violence. Faculty have the responsibility to inform students of resources and reporting options. If you or someone you know has experienced sexual assault, sexual misconduct, or sexual discrimination please see <https://www.umass.edu/titleix/what-to-do> for information about resources and reporting options. A report to the Title IX Coordinator may be made at any time (including during non-business hours) by using the Title IX Coordinator’s email (TitleIXCoordinator@umass.edu), telephone number (413.545.6124) or mail. UMass Amherst is committed to supporting community members who report concerns of prohibited conduct. Please reach out to me if you would like assistance connecting with any of these resources/options.