Sichuan University - Pittsburgh Institute

ECE 0401 **ECE Analytical Methods** **Spring 2024**

Note: This syllabus is subject to changes during the semester. Any changes to the syllabus will be announced in class or posted on the Blackboard course area.

Introduction/Learning Objectives: This course provides the fundamental mathematical background to solve problems in electrical and computer engineering (ECE). Upon completion of this course, student should be able to:

1. Solve systems of equations and use linear algebra techniques to determine linear independence.
2. Solve first and second order differential homogeneous and nonhomogeneous equations for arbitrary and specified initial conditions.
3. Perform calculations using complex numbers, convert sinusoids to phasors and vice-versa using Euler's identity, and explain the difference between complex numbers and phasors.
4. Analyze step, exponential, sinusoidal and composite waveforms.
5. Calculate the Laplace and inverse Laplace transform for a given function and use Laplace transform to compute a system's frequency response for both magnitude and phase.
6. Carry out double integrals and carry out partial derivatives of multivariate functions.

Prerequisites: MATH 0230 - Analytic Geometry and Calculus 2; ENGR 0012 – Engineering Computing

Applicable ABET Outcomes:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

Instructor: Dr. Jianzhao Li
Office Hours: Tue.: 1:50 – 5:30 PM, Wed.: 9:10 – 11:55 AM, or by appointment
Location: Zone 3 – 319A, Liberal Arts Building, or online if needed.
Email: jianzhao.li@scupi.cn **(Please include "ECE 0401" and some topic keywords in the subject line.)**

Lectures: Wed.: 1:50 – 4:25 PM, SCUPI Building Room 209

Textbook: *Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley, ISBN: 978-0-470-91361-1*

Grading:

Homework	25%
Quizzes	15%
Midterm Exam	30%
Final Exam	30%

Letter grades will be determined from accumulated point totals and assigned according to the scale below.

A: 90 - 100	A-: 85 - 90	B+: 80 - 85	B: 76 - 80	B-: 73 - 76
C+: 70 - 73	C: 66 - 70	C-: 63 - 66	D: 60 - 63	F: < 60

Note: Up to 5% points could be granted to the final grade based on the overall course performance (lecture attendance, homework submission punctuality, course engagement such as in-class question answering and discussion, etc.).

Homework: Homework problems will be assigned throughout the semester. All finished homework needs to be submitted online by the specified due date. Homework will be graded and solutions for all homework problems will be posted 24 hours after the submission due date. While discussion between students is allowed for solving homework problems, each student must write and submit the homework individually.

Quizzes: In-class quizzes will be arranged prior to exams. Each quiz will have up to a few questions or problems related to the learned content and help the preparation for exams. Each student must complete the quizzes individually.

Exams: There will be one midterm exam and one final exam. Exact exam dates will be announced at least two weeks ahead of time.

Late Work and Make-up Policy: Late homework submission will be accepted up to 24 hours after the due date with a 20% penalty, unless an extension request is approved **prior to the homework due date**. Extensions are granted at the instructor's discretion. In general, **no** make-ups for quizzes and exams will be allowed. Exceptions will only be made for special circumstances such as a medical emergency. If you cannot attend a quiz or an exam, you must contact the instructor prior to the quiz and exam. Failure to do so will result in a zero grade on that quiz or exam.

Grade Rebuttal: For any quiz or exam, you have one week to request correction if you feel your answer might be mis-graded. No correction will be made a week after the quiz or exam grade is posted.

Disability Services: If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact the instructor as early as possible in the semester. Reasonable accommodations will be arranged for this course.

Communication with Instructor for Absence: In any situation regarding class absence, a student who becomes ill or has other emergency issues is responsible for communicating

with the instructor. Please contact the instructor via email prior to the class to be involved.

Academic Integrity: Students in this course will be expected to comply with the SCUPI and/or University of Pittsburgh's Policy on Academic Integrity. Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include, but is not limited to, the confiscation of the examination of any individual suspected of violating University Policy.

Audio/Video Recording: To ensure free and open discussion, students may not record lectures, discussions and/or any other class activities without the advance written permission from the instructor, and any such recording properly approved in advance can solely be limited to the student's own private use.

Tentative Course Topics (subject to changes):

- Matrices, vectors: addition, scalar multiplication, and transpose, matrix & vector multiplication, linear systems, introductory matrix algebra, Gauss elimination
- Linear dependence and independence
- Rank of matrix, vector space, basis vectors, existence, uniqueness, matrix inversion, determinants, projections, mathematical modeling, separable ODE's
- Linear first order ODEs, integration factor, capacitor charging (ECE application), homogeneous linear second order ODE's: Euler's identity, rectangular & polar coordinates, characteristic equation, two real roots
- Homogeneous linear second order ODE's: Repeated roots, complex roots and damping
- Non-homogeneous second order ODE's: Forcing function and particular solution, method of undetermined coefficients
- Complex arithmetic, step function, exponential function
- Sinusoidal & complex exponential, mean value and RMS value, composite waveforms, phasors
- The unilateral and bilateral Laplace transforms, Laplace transforms of step, exponential and sinusoidal functions, properties of the Laplace transform, inverse Laplace transforms and partial fraction expansion, impedances in the s-domain (ECE application)
- Transfer function, bode plot, using Laplace transforms to solve circuits and differential equations, non-zero initial conditions
- Double integrals, double integrals over rectangles
- Double integrals over general regions, calculating electric charge accumulated on a charged surface (ECE Application)
- Partial derivatives