

# ECE 0401: ECE Analytical Methods

## FALL, 2024

**INSTRUCTOR:** Yu-Sheng Lin  
**OFFICE:** N514  
**EMAIL:** yusheng.lin@scupi.cn  
**OFFICE HOURS:** Wed.: 9:10 – 11:55 AM, Thu.: 9:10 – 11:55 AM or by appointment  
**LECTURES:** Thu.: 1:50 – 4:25 PM, Zone 3 - 104  
**EXTBOOK:** Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley, ISBN: 978-0-470-91361-1  
**TEACHING ASSISTANT:** Junle Li  
**PREREQUISITE:** ENGR 0012

**COURSE OBJECTIVES:**

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.

**LEARNING OUTCOMES FOR THIS COURSE:**

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

**GRADE DETERMINATION:**

Homeworks	20%
Quizzes	20%
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.).

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

**QUIZZES:** In-class quizzes will be arranged generally prior to the exams. Each quiz will have up to a few questions or problems related to the learned content and help the preparation for exams. The lowest one quiz grade will be dropped when calculating final grades. Each student must complete the quizzes individually.

**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.

**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 48 hours after the submission due date. The lowest one homework grade will be dropped when calculating final grades. While discussion between students is allowed for solving homework problems, each student must write and submit the homework individually.

**ATTENDANCE:** Less than 60% attendance might be failed for this course. Students will be given excused absences only in cases of a certified medical excuse, or a family emergency. Students missing homework because of an excused absence must submit the completed assignments after they return. Students missing an exam because of an excused absence will take the exam at another time arranged by the instructor.

**MAKE-UP POLICY:** Late homework submission will be accepted up to 48 hours after the initial 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.

**MATERIAL COVERED:** The sequence of the sections covered in this class is:

Week	Descriptions
1-2 (09/12)	Matrices, vectors: addition, scalar multiplication, and transpose, matrix & vector multiplication, linear systems, introductory matrix algebra, Gauss elimination, electrical network (ECE application)
3 (09/19)	Linear independence
4 (09/26)	Rank of matrix, vector space, basis vectors, existence, uniqueness, matrix inversion, determinants, projections, mathematical modeling, separable ODE's, continuity equation (ECE application)
5 (10/03)	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
6 (10/10)	Homogeneous linear second order ODE's: Repeated roots, start complex roots and damping, homogeneous linear second order ODE's: Finish complex roots and dampin
7 (10/17)	Non-homogeneous second order ODE's: Forcing function and particular solution, non-homogeneous second order ODE's: Method of undetermined coefficients
8 (10/24)	Midterm exam
9 (10/31)	Complex arithmetic, step function, exponential function
10 (11/07)	Sinusoidal & complex exponential, mean value and RMS value, composite waveforms, phasors
11 (11/14)	The unilateral and bilateral Laplace transforms, Laplace transforms of step, exponential and sinusoidal functions, properties of the Laplace transform
12 (11/21)	Inverse Laplace transforms and partial fraction expansion, impedances in the s-domain (ECE application), transfer function
13 (11/28)	Introduction to Fourier transform and relationship to Laplace transform, examples with bode plot, using Laplace transforms to solve circuits and differential equations, non-zero initial conditions
14 (12/05)	Double integrals, double integrals over rectangles
15 (12/12)	Double integrals over general regions, calculating electric charge accumulated on a charged surface (ECE Application)
16 (12/19)	Partial derivatives
17 (12/26)	Final Exam Week