Circuits & Signals I
Fall, 2023
Lecture: on M W F, 10:00 – 10:50 in Cramer 107

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Course Description: This course will cover the principles of electrical circuit analysis. Topics include Kirchhoff's laws, equivalent circuits, dependent sources, node and mesh analyses, signals, RLC components. Introductory circuits and operational amplifier circuits will be introduced as examples.

Mode of Instruction: Face-to-face lectures on M W F, 10:00 - 10:50 in Cramer 107. Lecture recordings are uploaded to Canvas (*Panopto Recordings*). Lecture notes written in Microsoft OneNote are exported to PDF and uploaded to Canvas (*Assignments/Lecture Notes*).

Pre-requisites: *MATH 1520* (Calculus and Analytic Geometry II)

Place in Curriculum: This course is normally offered in Fall semester. It is a requirement for the Electrical Engineering major.

Course Learning Outcomes:
After completion of this course, students are expected to be able to:

- Analyze circuits with basic elements using Ohm's law, KCL, and KVL.
- Calculate instantaneous power absorbed or supplied by elements.
- Apply nodal or mesh analysis to form system of linear equations and solve it.
- Understand the principles of op-amp, non-ideal source, and superpositions.
- Leverage Thevenin's Theorem and Norton's Theorem to evaluate the load conditions.
- Analyze circuits with energy-storage elements, e.g., capacitors and inductors.
- Resolve the integrodifferential equations with non-zero initial conditions and inputs.

Program Learning Outcomes: https://www.nmt.edu/academics/eleceng/undergrad/index.php

Course Requirements:
Textbook: *Elementary Linear Circuit Analysis (Second Edition). Leonard S. Bobrow, Oxford University Press 1987.*

Course schedule

Date	Chapter	Topic
Aug. 14		Syllabus and Canvas Navigation
Aug. 16, 18, 21, 23, 25	Chap. 1	Sources, Ohm's Law, KCL, KVL, Instantaneous Power
Aug. 28, 30, Sep. 1	Chap. 2	Nodal Analysis
Sep. 4	Holiday	Labor Day
Sep. 6, 8	Chap. 2	Mesh Analysis
Sep. 11, 13, 15	Chap. 3	Op-Amp, Non-Ideal Sources, Thevenin's Theorem
Sep. 18		Midterm 1 Review
Sep. 20		Midterm 1 (Until Chap. 2)
Sep. 22, 25	Chap. 3	Norton's Theorem, Superposition
Sep. 27, 29, Oct. 2, 4, 6, 9	Chap. 4	Inductor, Capacitor, Input Functions, Integrodifferential Equations, Initial Conditions
Oct. 11	Chap. 5	Zero-Input and Zero-State Response
Oct. 13	Holiday	49ers
Oct. 16, 18, 20, 23	Chap. 5	Linearity and Superposition, Non-Zero Initial Conditions
Oct. 25, 27	Chap. 6	RLC Circuits, Overdamp, Underdamp, Critically-damp
Oct. 30		Midterm 2 Review
Nov. 1		Midterm 2 (Until Chap. 4)
Nov. 3, 6, 8	Chap. 6	Non-Zero Inputs and Initial Conditions
Nov. 10, 13, 15, 17	Chap. 8	Complex Number, Time/Frequency Domain Analysis
Nov. 20, 22, 24	Holiday	Thanksgiving Break
Nov. 27, 29, Dec. 1		Final Term Review

Grading:

- Homework: 40%
- 2 Midterm: 20% each
- Final term: 20%

A	90-100	C	70-72
A-	86-89	C-	66-69
B+	83-85	D+	63-65
B	80-82	D	60-62
B-	76-79	F	<60
C+	73-75		

Homework and exams: There will be 8 homework, 2 midterm exams and 1 final exam. Homework grading is more effort-based while exams require students to complete the problems correctly. In other words, exams are graded more harshly than homework. Homework will be available by the date when the needed materials have been covered in the courses. Homework will be due by one week after the available date, e.g., if HW 1 is available on Aug. 25, it is due by 11:59 pm on Aug. 31. Submission of homework will be done via Canvas online assignment

portal. Exams will be done in the classroom on the scheduled dates. Students may work together on homework but must turn in individual assignments that CANNOT BE IDENTICAL. Late homework will not be accepted unless requested via email before the due date with a valid reason. Students must work on exams individually. There will be no make-up exams except in the case of extraordinary circumstances.

In-class open discussion: For review purpose, the 10 minutes from the beginning of the class will sometimes be reserved for an interactive in-class open discussion. The goal of this discussion is to encourage students to regularly review the course contents and practice technical presentation and communication. During this time, students may raise a topic to discuss (e.g., what are the differences between nodal analysis and mesh analysis). The instructor may also lead the open discussion with a general topic or a specific problem. *The in-class open discussion does NOT have any impact on the course final grade.*

Some important notes:

1. Questions for homework or exam. Circuit and signal analysis typically requires detailed explanation alongside the notations and equations in the solution to a problem. Students are encouraged to include their thought process behind the screenshot of the solution. This will allow the instructor to better identify and address any areas of confusion or misunderstanding. The instructor is readily available for in-person or Zoom meetings to clarify any issues or questions students may have.
2. Notation and indexing. Proper notation is crucial in circuit analysis. Clearly marking the currents and voltages (e.g., i1, i2, v1, v2, etc) is necessary for understanding the derivation process and the resulting equations. Without clear notations, interpreting the steps in the solution can be challenging, if not impossible.
3. Solver for system of equations. Students are encouraged to use programmable scientific calculator (e.g., TI-84 Plus CE), linear algebra software (e.g., MATLAB), or online solver (e.g., https://www.symbolab.com/solver/system-of-equations-calculator/) to resolve the system of equations in homework or exams.