Syllabus for ENGR065-01: Circuit Theory

Spring 2019
Instructor: Huifang Dou

Designation: ENGR 065: Circuit Theory

Catalog Description: The course has been designed to introduce fundamental principles of circuit theory commonly used in engineering research and science applications. Techniques and principles of electrical circuit analysis include basic concepts such as voltage, current, resistance, impedance, Ohm's and Kirchhoff's laws; basic electric circuit analysis; resistive circuits; transient and steady-state responses of RLC circuits; circuits with DC and sinusoidal sources; steady-state power; Laplace and Fourier transforms applications for solving circuit problems.

Text Books and Other Required Materials:
Author: J. W. Nilsson and S. Riedel
Title: Electric Circuits, 11th Edition
Published Date: 2018
Publisher: Pearson-Prentice Hall
ISBN-13: 978-0-13-474696-8
ISBN-10: 0-13-474696-1

Course Objectives Student Learning Outcomes: To develop problem-solving skills and understanding of circuit theory through the application of techniques and principles of electrical circuit analysis to common circuit problems.

Course Goals:

1. To develop an understanding of the fundamental laws and elements of electric circuits.
2. To learn the energy properties of electric elements and the techniques to measure voltage and current.
3. To understand transient, and steady-state responses of RLC circuits.
4. To develop the ability to apply circuit analysis to DC and AC circuits.
5. To understand advanced mathematical methods such as Laplace and Fourier transforms along with linear algebra and differential equations techniques for solving circuit problems.
6. To learn how to use fundamental electrical instruments, build circuits with solderless breadboards, analyze experimental data, and write experimental reports.

Learning Outcomes:

1. To be able to understand basic electrical properties.
2. To be able to analyze electrical circuits.

3. To be able to find circuit responses using Laplace transform.
4. To be able to understand signal superposition and Fourier transform.
5. To gain hands-on practice on how to use fundamental electrical instruments to measure and test electric circuits.
6. To be able to document and analyze the experimental data using appropriate tools.

Prerequisites by Topic: Introductory Physics (PHYS 9 / PHYS 19 or equivalent);
Linear Algebra and Differential Equations (MATH 024 or equivalent)

Course Policies:

1. NO CELL PHONES are allowed during lectures and labs.
2. Be on time to class and labs. Tardiness is discouraged.
3. No late assignments will be accepted. Medical or family emergency will be considered on a case-by-case basis.
4. No make-up quizzes and exams. If you miss the exam, a zero score will be assigned to the missed quiz and exam. No electronic devices other than a calculator will be allowed.
5. If you miss a class due to a personal emergency or medical reasons, please be sure to inform the instructor by e-mail.
6. Homework assignments are to be submitted by the due date. You should keep a record of your homework in HW notebooks or HW binder and be ready to present it upon request. You may discuss homework problems with your classmates, but you are responsible for your own work.
7. You are encouraged to read the sections in the textbooks related to the covered topics prior to the lecture as well as after.
8. After an assignment grade has been posted online, students must see the instructor within one week if you wish to discuss the assignment and your work. University's rules on academic honesty concerning exams and individual assignments will be strictly enforced. See UC Conduct Standards: http://studentlife.ucmerced.edu/what-we-do/student-judicial-affairs/uc-conduct-standards

Academic Dishonesty Statement:

1. Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy. Any work submitted by a student in this course for academic credit will be the student's own work.
2. You are encouraged to study together and to discuss information and concepts covered in lectures and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an email, an email attachment file, a diskette, or a hard copy. Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. The penalty for violation of this Policy can also be extended to include failure of the course and University disciplinary action.

3. During examinations, you must do your own work. Talking or discussion is neither permitted during the examinations, nor compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam and may lead to failure of the course and University disciplinary action.

Disability: Accommodations for Students with Disabilities: The University of California Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design, and diversity. Any student who feels he or she may need an accommodation based on the impact of a disability should contact me privately to discuss his or her specific needs. Also contact Disability Services at (209) 228-7884 as soon as possible to become registered and thereby ensure that such accommodations are implemented in a timely fashion.

Topics:

CIRCUIT PARAMETERS AND FUNDAMENTAL LAWS I
Electric charge; Electric work; Potential; Potential difference; Electric current; Power; Energy; Resistance; Ohm's law; Kirchhoff's law. Branch; Node; Mesh; Circuit elements in series; Circuit elements in parallel.

CIRCUIT PARAMETERS AND FUNDAMENTAL LAWS II
Ideal current source; Ideal voltage generator; Internal resistance; Mesh current method; Node voltage method; Thevenin's equivalent circuits; Norton's equivalent circuits; Superposition's theorem; Capacitors; Inductors; An electromagnetic flux.

OPERATIONAL AMPLIFIERS
Impedance mismatching issue; Ideal op-amp model; Voltage follower; Gain; Addition/subtraction; Integrator; Differentiator; Other useful operations; Active filters; CMRR and practical issues.

LAPLACE AND FOURIER TRANSFORM
The Laplace's transform; Fourier transform; Initial value theorem and final value theorem; Transient phenomena with the Laplace transform; Circuit analysis in the s domain; Resonance; Frequency response; Cutoff frequency; Pole; Zero; Low- pass filter; High-pass filter.

COMPLEX IMPEDANCE AND ADMITTANCE
Resistance; Capacitive and inductive reactance; Impedance; Conductance; Capacitive and inductive susceptance; Admittance; Series and parallel equivalent circuit.

CIRCUITS TRANSIENT AND STEADY-STATE RESPONSE
RC, RL and RLC circuits; Time constant; Step response; Transient response; Sinusoidal source; Frequency; Angular frequency; Phase angle; Root mean square; Time domain; Frequency domain; Passive circuits elements in frequency domain; Circuits analysis in frequency domain.

CIRCUIT SYSTEMS
System classifications; Time domain responses; Frequency domain responses; Block diagrams manipulation and op-amps realizations.

Class/Laboratory Schedule:

Lectures: Mondays and Wednesdays 1:30 – 2:45 am CLSSRM 105

Labs: ENGR-065-02L: Tuesday 9:00 - 11:50 am; Room SCIENG 172
ENGR-065-03L: Thursday 9:00 – 11:50 am; Room SCIENG 172
ENGR-065-04L: Tuesday 12:00 - 2:50 pm; Room SCIENG 172
ENGR-065-05L: Thursday 12:00 – 2:50 pm; Room SCIENG 172
ENGR-065-06L: Tuesday 3:00 - 5:50 pm; Room SCIENG 172
ENGR-065-07L: Thursday 3:00 - 5:50 pm; Room SCIENG 172
ENGR-065-08L: Wednesday 3:00 - 5:50 pm; Room SCIENG 172
ENGR-065-09L: Friday 3:00 -5:50 pm; Room SCIENG 172

Midterm/ Final Exam Schedule:

In-class quizzes, pop quizzes, one midterm exam, and final exam
Final Exam: May 11th, 11:30 am – 2:30 am CLSSRM 105

Assessment/Grading Policy:

Grading Scheme:
Attendance (5%)
Labs (15%)
Homework (10%)
Quizzes (15%)
Midterm exam (25%)
Final exam (30%)

Grade Distribution
Grade Total Scores (%)
A+ 99+
A 95 - 99
A- 90 - 94
B+ 87 - 89
B 83 - 86
B- 80 - 82
C+ 77 - 79
C 73 - 76
C- 70 - 72
D+ 67 - 69
D 63 - 66
D- 60 - 62
F < 60

Coordinator Contact Information:

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Office Hours: Mondays and Wednesdays from 12:15 – 1:15 PM or by appointment
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Teaching Assistants (TAs):

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We will be using CatCourses for posting the syllabus, lecture notes, assignments, lab documents, announcements, and grades.

Lecture Calendar:

Week 1	Jan. 23	Syllabus, Engineering Overview, SI units. (Chap. 1)
Week 2	Jan. 25, 30	Voltage, Current, Power, Energy, (Chap. 1) Power Sources. Passive Sign Convention, Ohm's law (Chap 2). HW 1
Week 3	Feb. 4, 6	KCL, KVL (Chap 2). Resistors in Series and in Parallel, Voltage and Current Dividers (Chap. 3) HW 2
Week 4	Feb. 11, 13	Node-Voltage Method, Mesh-Current Method (Chap. 4) HW 3
Week 5	Feb. 18, 20	No Lecture on Feb. 18 (Presidents Day) Source Transformation, Thévenin Equivalent, Norton Equivalent. (Chap. 4) HW 4
Week 6	Feb. 25, 27	Maximum Power Transfer, Superposition (Chap. 4) HW 5
Week 7	Mar. 4, 6	Terminal Voltages and Currents, Inverting- Amplifier Circuits, Summing-Amplifier Circuits, Noninverting-Amplifier Circuits, Difference-Amplifier Circuits; CMRR. (Chap. 5) HW 6
Week 8	Mar. 11, 13	Review and Midterm Exam
Week 9	Mar. 18, 20	Inductors, Capacitors, Series-Parallel Combinations of Inductance and Capacitance. (Chap. 6) HW 7
Week 10	Mar. 25, 27	No Lectures (Spring Break)
Week 11	Apr. 1, 3	Step and Impulse Function, Laplace Transform, Functional Transform, Operational Transform (Chap. 12) HW 8
Week 12	Apr. 8, 10	Inverse Transforms, Responses of First-Order RL and RC Circuits (Chap. 12) HW 9
Week 13	Apr. 15, 17	Poles and Zeros, Initial- and Final-Value Theorem. Circuit Element Analysis in the s Domain. (Chap. 13) HW 10
Week 14	Apr. 22, 24	Analysis Techniques in the s Domain and Examples (Chap. 13) HW 11
Week 15	Apr. 29, May 1	Transfer Functions, Sinusoidal Steady-State Reponses. Power Calculation (Chap. 13) HW 12
Week 16	May. 6, 8	Filters, Fourier Series and Fourier Transform (Chap. 14, 15, 16) Review for Final Exam
Week 17	May. 11	Final Exam

Lab Calendar:

Week 1		Jan. 22	No Labs.
Week 2	Lab 1	Jan. 28 – Feb. 1	Introduction to Electrical Circuits Lab, Lab Reports, Safety, Lab Rules, and Use of Power Supplies and Multimeters
Week 3	Lab 2	Feb. 4 - 8	Electrical Measurements, Use of Breadboards, and Ohm's Law
Week 4	Lab 3	Feb. 11 - 15	Resistor Combinations, Voltage and Current Dividers, and Wheatstone Bridge
Week 5		Feb. 18 - 22	No Labs (Presidents Day)
Week 6	Lab 4	Feb. 25 – Mar. 1	Series and Parallel Circuits and Node Voltage Methods
Week 7	Lab 5	Mar. 4 - 8	Thévenin Equivalent Circuits
Week 8	Lab 6	Mar. 11 - 15	Superposition
Week 9	Lab 7	Mar. 18 - 22	Circuit Simulations in Matlab
Week 10		Mar. 25 - 29	No Labs (Spring Recess)
Week 11	Lab 8	Apr. 1 - 5	Introduction to the Use of PSPICE
Week 12	Lab 9	Apr. 8 - 12	The Operational Amplifier
Week 13	Lab 10	Apr. 15 - 19	Transient Responses of First-Order RL and RC Circuits
Week 14	Lab 11	Apr. 22 - 26	Transient Responses of Second Order RLC Circuits (simulation)
Week 15		Apr. 29 – May 3	No Labs
Week 16		May 6 - 10	No Labs. Final Exam Week