Syllabus for ENGR065-01: Circuit Theory

Summer 2021
Instructor:
Derek Hollenbeck

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: 978-0134746968
ISBN-10: 0134746961

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

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 two software to simulate circuits, analyze simulation data, and write lab 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 experience on how to simulate 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 lecture.
2. Be on time for class and lab. Tardiness is discouraged.
3. No late assignments and lab reports will be accepted. Medical or family emergencies will be considered on a case-by-case basis.
4. No make-up exams. If you miss the exam, a zero score will be assigned to the missed exam. No electronic devices other than a calculator will be allowed.
5. If you miss a class due to personal emergencies 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 your HW notebook 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, you must see the instructor within one week if you wish to discuss your assignment and grade.
9. The 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 you in this course for academic credit will be your own work.
2. You are encouraged to study together and to discuss information and concepts covered in the lectures and the sections with other students. You can give "consulting" help to or receive "consulting" help from other 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 e-mail, an e-mail 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 discussing is not permitted during the examinations, nor comparing papers, copying from others or collaborating 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; Thévenin's equivalent circuits; Norton's equivalent circuits; Superposition's theorem; Capacitors; Inductors; Electromagnetic fluxes.

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 series; 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.

SIGNALS
Signal classifications; Signal representations using Fourier series and Fourier transform; Ideal and practical passive filters.

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

Class/laboratory Schedule:

Lectures: Wednesday and Friday 2:30 – 5:15 pm Online (Zoom)

Labs: ENGR-065-02L: Tuesday/Thursday 11:15 -2:00 pm; Online
ENGR-065-03L: Tuesday/Thursday 3:00 - 5:45 pm; Online
ENGR-065-04L: Wednesday/Friday 11:15 – 2:00 pm; Online

Midterm/ Final Exam Schedule:

Online Quizzes, one midterm exam, and final exam
Midterm Exam: 4:00 pm – 5:15pm July 22st, 2021, Online
Final Exam: 2:30 pm – 5:30 pm Aug. 12th, 2021, Online

Assessment/Grading Policy:

Grading Scheme:

Labs (20%)
Homework (10%)
Quizzes (15%)
Midterm exam (25%)
Final exam (30%)

Grade Distribution
Grade Total Scores (%)

A+ 97+
A 95 - 96
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:

Instructor: Derek Hollenbeck
E-mail: dhollenbeck@ucmerced.edu
Office Hours: 2:30 – 4:30 pm on Tuesdays or by appointments
Zoom: https://ucmerced.zoom.us/j/5685516396

Teaching Assistants (TAs):
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We will be using CatCourses for posting the syllabus, lecture notes, assignments, lab documents, announcements, and grades.

You are responsible for checking and monitoring the grades of your homework, lab, quizzes, and exams.

Lecture Calendar:

Week 1	Jun 22, 24	Syllabus, Engineering Overview, SI units. (Chap. 1) Voltage, Current, Power, Energy, Power Sources. Passive Sign Convention, Ohm's law. KCL, KVL (Chap. 2) (Homework 1 assigned)
Week 2	Jun. 29, Jul 1	Resistors in Series and in Parallel, Voltage and Current Dividers (Chap. 3) Node-Voltage Method, Mesh-Current Method (Chap. 4) (Homework 2 assigned)
Week 3	Jul. 6, 8	Source Transformation, Thévenin Equivalent, Norton Equivalent (Chap. 4). Superposition (Chap. 4) (Homework 3 assigned)
Week 4	Jul. 13, 15	Terminal Voltages and Currents, Inverting- Amplifier Circuits, Summing-Amplifier Circuits, Noninverting-Amplifier Circuits, Difference-Amplifier Circuits; CMRR (Chap. 5) and Review (Homework 4 assigned)
Week 5	Jul. 20, 22	Midterm Exam. Inductors, Capacitors, Series-Parallel Combinations of Inductance and Capacitance (Chap. 6). Laplace Transform, Functional Transform (Chap. 12) (Homework 5 assigned)
Week 6	Jul. 27, 29	Operational Transform, Inverse Transforms (Chap 12) Responses of First Order RL and RC Circuits Poles and Zeros, Initial- and Final-Value Theorem, Transfer Functions, RLC Circuit Analysis in the s Domain (Chap. 13) (Homework 6 assigned)
Week 7	Aug. 3, 5	Thévenin and Norton Equivalent Circuits, Node-Voltage in the s Domain, Sinusoidal Steady-State. (Chap. 13)
Week 8	Aug. 10, 12	Review Final Exam

Lab Calendar:

Week 1	Jun 20 – 24	No labs
Week 2	Jun. 27 – Jul. 1	No Labs due to Independence Day Holiday
Week 3	Jul 4 – 8	Lab 1: Circuit Simulations in Matlab Lab 2: Resistor Combinations, Voltage and Current Dividers
Week 4	Jul 11 – 15	Lab 3: Series and Parallel Circuits and Node Voltage Methods Lab 4: Thévenin Equivalent Circuits
Week 5	Jul. 18 – 22	Lab 5: Superposition Lab 6: Introduction to the Use of PSPICE
Week 6	Jul. 25 – 29	Lab 7: The Operational Amplifier Lab 8: Transient Responses of First-Order RL and RC Circuits
Week 7	Aug. 1 – 5	Lab 9: Lab 10: Transient Responses of Second-Order RLC Circuits (simulation)
Week 8	Aug. 8 -12	No Labs. Final Exam Week