ENGI-242: CIRCUITS 1

Engineering Courses Updates Fall 2023

Course

- ENGI-110: Introduction to Engineering
- ENGI-242: Circuits 1

Effective Term

Fall 2024

CC Approval

10/06/2023

AS Approval

10/10/2023

BOT Approval

10/19/2023

COCI Approval

5/25/2024

SECTION A - Course Data Elements

Send Workflow to Initiator

No

CB04 Credit Status

Credit - Degree Applicable

Discipline

Minimum Qualifications	And/Or
Engineering (Master's Degree)	

Subject Code

ENGI - Engineering

Course Number

242

Department

Engineering (ENGI)

Division

Science and Engineering (SE)

Full Course Title

Circuits 1

Short Title

Circuits 1

CB03 TOP Code

0901.00 - Engineering, General (requires Calculus) (Transfer)

CB08 Basic Skills Status

NBS - Not Basic Skills

CB09 SAM Code

E - Non-Occupational

Rationale

Last update was more than 6 years ago.

SECTION B - Course Description

Catalog Course Description

An introductory course in the analysis of linear circuits containing resistors, inductors, capacitors, independent and dependent voltage, and current sources. Analysis techniques are developed from Kirchhoff's network theorems and include node and loop methods, superposition and source transformations. Thevenin's and Norton's theorems are applied to DC and AC circuits. Differential equations are used to find transient response. Periodic waveform analysis including evaluation of average and rms values. AC analysis techniques include sinusoids and phasors, the concept of impedance, frequency response, and resonance. Use of simulation software, ideal operational amplifiers and transformers, approximations at high and low frequencies, impedance matching, and three-phase circuits.

SECTION C - Conditions on Enrollment

Open Entry/Open Exit

No

Repeatability

Not Repeatable

Grading Options

Letter Grade Only

Allow Audit

Yes

Requisites

Prerequisite(s)

Completion of PHYS-240 with a minimum grade of C.

Corequisite(s)

Concurrent enrollment in or previous completion of MATH-222 with a minimum grade of C.

Requisite Justification

Requisite Description

Course Not in a Sequence

Subject

MATH

Course #

222

Level of Scrutiny

Required by 4-Year Institution

Explanation

Ordinary Differential Equations (C-ID MATH 240) listed as required corequisite in the C-ID Descriptor for Circuit Analysis (C-ID ENGI 260)

Requisite Description

Course Not in a Sequence

Subject

PHYS

Course #

240

Level of Scrutiny

Required by 4-Year Institution

Explanation

Calculus-Based Physics for Scientists and Engineers: B (C-ID PHYS 210) listed as required prerequisite in the C-ID descriptor for Circuit Analysis (C-ID ENGI 260)

SECTION D - Course Standards

Is this course variable unit?

No

Units

4.00000

Lecture Hours

54.00

Lab Hours

54.00

Outside of Class Hours

108

Total Contact Hours

108

Total Student Hours

216

Distance Education Approval

Is this course offered through Distance Education?

Yes

Online Delivery Methods

DE Modalities	Permanent or Emergency Only?
Entirely Online	Permanent
Hybrid	Permanent
Online with Proctored Exams	Permanent

SECTION E - Course Content

Student Learning Outcomes

	Upon satisfactory completion of the course, students will be able to:
1.	Demonstrate knowledge and understanding of fundamental electric circuit analysis techniques, including electrical quantities and elements, steady-state voltages, currents and power for DC and AC circuits, and Thevenin and Norton equivalent of circuits with independent and dependent sources.
2.	Recognize the importance and applications of transient and steady-state response of RLC circuits, rise time and fall time of RC circuits, and frequency response of high-pass, low-pass, and resonant circuits.
3.	Perform laboratory experiments to measure electrical characteristics of resistive, RC, RL, and RLC circuits, and write laboratory reports that include a qualitative and quantitative discussion comparing the experimental and theoretical results and design applications and limitations.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1.	Explain basic circuit analysis concepts such as Kirchoff's laws.
2.	Solve circuits containing sources and resistors using various circuit analysis techniques and theorems.
3.	Use PSPICE Software to analyze circuits.
4.	Solve simple nonlinear circuit problems.

5.	Perform power calculations on resistive circuits.
6.	Solve circuit problems involving dependent sources, ideal transformers, and amplifiers.
7.	Create practical circuits using operational amplifiers.
8.	Explain the use of energy storage elements such as inductors and capacitors in circuits.
9.	Analyze the transient and steady-state response of RLC circuits.
10.	Perform basic AC circuit analysis.

Course Content

1. Circuit Variables
   a. Electrical Engineering: An Overview
   b. The International System of Units
   c. Circuit Analysis: An Overview
   d. Voltage and Current
   e. The Ideal Basic Circuit Element
   f. Power and Energy
2. Circuit Elements
   a. Voltage and Current Sources
   b. Electrical Resistance (Ohm's Law)
   c. Construction of a Circuit Model
   d. Kirchhoff's Laws
   e. Analysis of a Circuit Containing Dependent Sources
3. Simple Resistive Circuits
   a. Resistors in Series
   b. Resistors in Parallel
   c. The Voltage-Divider and Current-Divider Circuits
   d. Voltage Division and Current Division
   e. Measuring Voltage and Current
   f. Measuring Resistance—The Wheatstone Bridge
   g. Delta-to-Wye (Pi-to-Tee) Equivalent Circuits
4. Techniques of Circuit Analysis
   a. Terminology
   b. Introduction to the Node-Voltage Method
   c. The Node-Voltage Method and Dependent Sources
   d. The Node-Voltage Method: Some Special Cases
   e. Introduction to the Mesh-Current Method
   f. The Mesh-Current Method and Dependent Sources
   g. The Mesh-Current Method: Some Special Cases
   h. The Node-Voltage Method Versus the Mesh-Current Method
   i. Source Transformations
   j. Thévenin and Norton Equivalents
   k. More on Deriving a Thévenin Equivalent
   l. Maximum Power Transfer
   m. Superposition
5. The Operational Amplifier
   a. Operational Amplifier Terminals
   b. Terminal Voltages and Currents
   c. The Inverting-Amplifier Circuit
   d. The Summing-Amplifier Circuit
   e. The Noninverting-Amplifier Circuit
   f. The Difference-Amplifier Circuit
   g. A More Realistic Model for the Operational Amplifier
6. Inductance, Capacitance, and Mutual Inductance
   a. The Inductor
   b. The Capacitor
   c. Series-Parallel Combinations of Inductance and Capacitance
   d. Mutual Inductance
   e. A Closer Look at Mutual Inductance

7. Response of First-Order RL and RC Circuits
   a. The Natural Response of an RL Circuit
   b. The Natural Response of an RC Circuit
   c. The Step Response of RL and RC Circuits
   d. A General Solution for Step and Natural Responses
   e. Sequential Switching
   f. Unbounded Response
   g. The Integrating Amplifier
8. Natural and Step Responses of RLC Circuits
   a. Introduction to the Natural Response of a Parallel RLC Circuit
   b. The Forms of the Natural Response of a Parallel RLC Circuit
   c. The Step Response of a Parallel RLC Circuit
   d. The Natural and Step Response of a Series RLC Circuit
   e. A Circuit with Two Integrating Amplifiers
9. Sinusoidal Steady-State Analysis
   a. The Sinusoidal Source
   b. The Sinusoidal Response
   c. The Phasor
   d. The Passive Circuit Elements in the Frequency Domain
   e. Kirchhoff's Laws in the Frequency Domain
   f. Series, Parallel, and Delta-to-Wye Simplifications
   g. Source Transformations and Thévenin-Norton Equivalent Circuits
   h. The Node-Voltage Method
   i. The Mesh-Current Method
   j. The Transformer
   k. The Ideal Transformer
   l. Phasor Diagrams
10. Sinusoidal Steady-State Power Calculations
   a. Instantaneous Power
   b. Average and Reactive Power
   c. The rms Value and Power Calculations
   d. Complex Power
   e. Power Calculations
   f. Maximum Power Transfer
11. Balanced Three-Phase Circuits
   a. Balanced Three-Phase Voltages
   b. Three-Phase Voltage Sources
   c. Analysis of the Wye-Wye Circuit
   d. Analysis of the Wye-Delta Circuit
   e. Power Calculations in Balanced Three-Phase Circuits
   f. Measuring Average Power in Three-Phase Circuits

Lab Content (Lab activities need to be detailed and compliment the lecture content of the course):

1. Introduction to test equipment and measurement of electrical quantities and/or characteristics.
2. Measure resistances, currents and voltages using a multimeter.
3. Measure periodic signals including their amplitudes, periods, and phase shifts using an oscilloscope.
4. Measure characteristics in networks of linear and nonlinear resistors.
5. Measure characteristics in networks of resistors and capacitors.
6. Measure characteristics in networks of resistors and inductors.
7. Measure characteristics in RLC networks.
8. Simulate and characterize Operational Amplifier circuits.
9. Write a laboratory report for each experiment that includes a discussion comparing experimental, theoretical, and/or simulated results.

Methods of Instruction

Methods of Instruction

Types	Examples of learning activities
Lab	Thevenin Equivalence, Maximum Power Transfer, Natural and Step Response of RC and RL Circuits, Series and Parallel RCL Circuits
Lecture	Lecture of course content.
Other	Video presentations. Individual and group problem solving in the classroom. Individual and group laboratory experiments. Peer oriented guided instruction where the students help one another under the guidance of an instructor.
Observation and Demonstration	Circuit demonstrations. Demonstrations of computer circuit simulations.
Discussion	Problem Solving Techniques, Circuit Analysis Techniques Comparison.

Instructor-Initiated Online Contact Types

Announcements/Bulletin Boards
Chat Rooms
Discussion Boards
E-mail Communication
Video or Teleconferencing

Student-Initiated Online Contact Types

Chat Rooms
Discussions
Group Work

Course design is accessible

Yes

Methods of Evaluation

Methods of Evaluation

Types	Examples of classroom assessments
Homework	Homework Assignments (Problems from End of Chapter, Problems from Handouts, Simulations)
Exams/Tests	Midterm Exams Final Exam
Lab Activities	Lab Participation and Reports Examples: 1. A series RL circuit is connected to a 110-V ac source. If the voltage across the resistor is 85 V, find the voltage across the inductor. 2. A battery has a short-circuit current of 20-A and an open-circuit voltage of 12 V. If the battery is connected to an electric bulb of resistance 2-Ohms, calculate the power dissipated by the bulb.

Assignments

Reading Assignments

Read assignments from the text and class handouts.

Examples:

1. Read Section 4.7 on Derivation of Thevenin's ad Norton's Theorems.
2. Read Section 5.9 on Op Amp Circuit Analysis with PSpice.

Writing Assignments

Complete all written and oral assignments, including homework assignments.

Complete all laboratory reports.

Complete circuit simulation assignments.

Examples:

1. In Chapter 3, you learned five different circuit analysis techniques. In a list of steps clearly indicate how you can decide with analysis technique to use on a given circuit. Be sure to use terminology discussed in Chapters 1 through 3.
2. Circuit design enables engineers to solve problems requiring new electrical circuits. In 200 words or less describe some of the tradeoffs involved in circuit design. Feel free to use a circuit design example to point out the tradeoffs.

Other Assignments

Homework Problem (Sample Problems):

1. Derive the expression for maximum power using the Thevenin Equivalent circuit.
2. In a Wheatstone bridge circuit, $R_1 = R_4 = 300$ Ohms and $R_2 = R_3 = 150$ Ohms. Find the current through a 50 Ohm galvanometer connected across terminals A and B when the source voltage is 100 V.

SECTION F - Textbooks and Instructional Materials

Material Type

Textbook

Author

Nilsson and Riedel

Title

Electric Circuits

Edition/Version

12th

Publisher

Pearson

Year

2023

ISBN #

9780137648436

Material Type

Textbook

Author

Charles Alexander and Matthew Sadiku

Title

Fundamentals of Electric Circuits

Edition/Version

7th

Publisher

McGraw Hill

Year

2021

ISBN #

9781260226409

Proposed General Education/Transfer Agreement

Do you wish to propose this course for a UC Transferable Course Agreement (UC-TCA)?

Yes

Course Codes (Admin Only)

ASSIST Update

No

C-ID Approval Dates

C-ID Descriptor	Approval Date
Potential to submit for C-ID ENGR 260 but not currently approved due to lack of Diff Equations co-requisite	

CB00 State ID

CCC000160858

CB10 Cooperative Work Experience Status

N - Is Not Part of a Cooperative Work Experience Education Program

CB11 Course Classification Status

Y - Credit Course

CB13 Special Class Status

N - The Course is Not an Approved Special Class

CB23 Funding Agency Category

Y - Not Applicable (Funding Not Used)

CB24 Program Course Status

Program Applicable

Allow Pass/No Pass

No

Only Pass/No Pass

No

Reviewer Comments

Stacey Howard (showard) (Thu, 28 Sep 2023 17:52:53 GMT): Added anticipated Fall 2023 effective date as no rearticulation required.

Stacey Howard (showard) (Thu, 28 Sep 2023 18:25:31 GMT): Selected anticipated fall 2023 begin date as no rearticulation required for existing CSU/UC transferability. No matching C-ID descriptor currently.

Stacey Howard (showard) (Thu, 28 Sep 2023 18:26:38 GMT): Correction on last comment: Anticipated fall 2024 implementation.

Stacey Howard (showard) (Thu, 28 Sep 2023 18:45:37 GMT): ENGI 160 - Anticipated Fall 2024 begin date of COR update ok as no rearticulation for CSU/UC transferability required. Changed term from fall 2025 to 2024. Please add "group" to term or final project. Highly recommended to add this as UC Davis will not articulate this course for any applicable major agreement in ASSIST without inclusion of a group term project. Thank you!

Stacey Howard (showard) (Thu, 28 Sep 2023 19:21:38 GMT): ENGR 242 - Suggestion addition of Differential Equations (C-ID MATH 240) as co-requisite. Previous C-ID denial due to missing co-req as per C-ID ENGR 260 descriptor and reviewer.

Stacey Howard (showard) (Thu, 28 Sep 2023 19:58:57 GMT): ENGI 240 - Anticipated fall 2024 implementation ok as CSU/UC rearticulation is not required.

Stacey Howard (showard) (Thu, 28 Sep 2023 20:10:50 GMT): ENGR 241 - Anticipated begin date of fall 2024 ok as CSU/UC rearticulation not required. C-ID ENGR 130 submission expired. Resubmission required.