Glendale College

Course Outline of Record Report

Course ID 010212

Cyclical Review - September 2023

ENGR240 : Electrical Engineering Fundamentals

General Information

Author:	• Christopher Herwerth
Course Code (CB01) :	ENGR240
Course Title (CB02) :	Electrical Engineering Fundamentals
Department:	ENGR
Proposal Start:	Fall 2024
TOP Code (CB03) :	(0901.00) Engineering, General (requires Calculus) (Transfer)
CIP Code:	(14.0102) Pre-Engineering.
SAM Code (CB09) :	Non-Occupational
Distance Education Approved:	Yes
Will this course be taught asynchronously?:	No
Course Control Number (CB00) :	CCC000590155
Curriculum Committee Approval Date:	09/27/2023
Board of Trustees Approval Date:	11/21/2023
Last Cyclical Review Date:	09/27/2023
Course Description and Course Note:	ENGR 240 introduces the theory and analysis of electrical circuits and is a prerequisite course for many electrical engineering transfer pathways as well as a required course for nearly all engineering disciplines, including mechanical, computer, aerospace, manufacturing engineering and some civil engineering programs. Students learn basic circuit elements such as resistors, capacitors, inductors, operational amplifiers, circuit theorems, direct and alternating current circuits, forced and natural responses of simple circuits, sinusoidal steady state analysis and the use of computer-aided circuit analysis programs.
Justification:	Mandatory Revision
Academic Career:	• Credit
Author:	• Christopher Herwerth

Academic Senate Discipline

Primary Discipline:	• Engineering
Alternate Discipline:	No value
Alternate Discipline:	No value

Course Development

Basic Skill Status (CB08)

Course is not a basic skills course.

☐ Allow Students to Gain Credit by Exam/Challenge

Course Special Class Status (CB13)

Course is not a special class.

Pre-Collegiate Level (CB21)

Not applicable.

Grading Basis

- Grade with Pass / No-Pass Option

Course Support Course Status (CB26)

Course is not a support course

Transferability & Gen. Ed. Options

General Education Status (CB25)

Not Applicable

Transferability

Transferable to both UC and CSU

Transferability Status

Approved

C-ID	Area	Status	Approval Date	Comparable Course
ENGR	Engineering	Approved	08/25/2014	ENGR 260 - Circuit Analysis

Units and Hours

Summary

Minimum Credit Units (CB07)	4
Maximum Credit Units (CB06)	4
Total Course In-Class (Contact) Hours	108
Total Course Out-of-Class Hours	108
Total Student Learning Hours	216

Credit / Non-Credit Options

Course Type (CB04)

Credit - Degree Applicable

Noncredit Course Category (CB22)

Credit Course.

Noncredit Special Characteristics

No Value

Course Classification Code (CB11)

Credit Course.

☐ Variable Credit Course

Funding Agency Category (CB23)

Not Applicable.

☐ Cooperative Work Experience Education Status (CB10)

Weekly Student Hours

Course Student Hours

In Class	Out of Class	
Lecture Hours	3	6
Laboratory Hours	3	0
Studio Hours	0	0

Course Duration (Weeks)	18
Hours per unit divisor	54
Course In-Class (Contact) Hours	
Lecture	54
Laboratory	54
Studio	0
Total	108
Course Out-of-Class Hours	
Lecture	108
Laboratory	0
Studio	0
Total	108

Time Commitment Notes for Students

No value

Pre-requisites, Co-requisites, Anti-requisites and Advisories

Prerequisite

PHY102 - Physics for Scientists and Engineers: B

Objectives

- Calculate the electric field and potential of a charge distribution.
- Calculate the electric force on a charged body.
- Calculate the magnetic field of a current distribution.
- Calculate the magnetic force on a current-carrying wire.
- Analyze both DC and AC circuits with resistors, capacitors, and inductors.
- Describe the operation and working principles of electromagnetic devices, such as mass spectrometers, cyclotrons, electric motors, electric generators, and transformers.

AND

Prerequisite

MATH105 - Multivariable and Vector Calculus

Objectives

- Apply the vector dot and cross products to determine equations of lines and planes.
- Determine differentiability and differentiate functions of two or more variables.
- Optimize functions of two or more variables, both constrained and non-constrained, including testing for saddle points.
- Calculate two and three dimensional integrals in various coordinate systems (polar, rectangular, spherical, and cylindrical).
- Apply vector field theorems (Green's, Stokes', and Divergence) to solve problems in vector analysis.

AND

Co-Requisite

MATH108 - Ordinary Differential Equations

Objectives

- Select the appropriate method of solution, given a list of first order differential equations.

- Solve both homogeneous and nonhomogeneous differential equations with constant coefficients of second or higher order.
- Use the Laplace transform to solve nonhomogeneous differential equations with constant coefficients and initial conditions.
- Use power series to solve differential equations with variable coefficients.
- Use eigenvalues of matrices to solve systems of linear differential equations.
- Approximate solutions to first order differential equations by using numerical methods on a computer.
- Apply the techniques of solution to applications from at least two different areas of the physical sciences.

Entry Standards

Entry Standards

No value

Specifications

Methods of Instruction

Methods of Instruction	Lecture
Methods of Instruction	Laboratory
Methods of Instruction	Multimedia
Methods of Instruction	Demonstrations
Methods of Instruction	Discussion
Methods of Instruction	Guest Speakers
Methods of Instruction	Field Activities (Trips)

Out of Class Assignments

- Assignments (e.g., set-up, organize, and solve a circuit including a circuit diagram)
- Written laboratory reports (e.g., explain the results of a step response experiment using Resistor and Inductor (RL), Resistor and Capacitor (RC), and Resistor, Inductor, and Capacitor (RLC) circuits)

- Project (e.g., design and simulate a circuit using an engineering software tool such as PSpice or MATLAB and then create the circuit using a breadboard and basic circuit elements such as resistors, inductors, and capacitors and compare)

Methods of Evaluation	Rationale
Exam/Quiz/Test	Quizzes
Presentation (group or individual)	Project and lab presentations
Exam/Quiz/Test	Midterm exams
Exam/Quiz/Test	Final examination

Textbook Rationale

Electric Circuit Analysis (9780471365716) is included in the C-ID Descriptor for this course.

Textbooks

Author	Title	Publisher	Date	ISBN
Nilsson, James W. and Riedel, Susan A.	Electric Circuits	Pearson	2023	9780137648375
Johnson, David, E., Johnson, Johnny R., Hilburn, John L., and Scott, Peter D.	Electric Circuit Analysis	Wiley	1999	9780471365716
Boylestad, Robert L. and Olivari, Brian	Laboratory Manual for Introductory Circuit Analysis	Pearson	2023	9780137283644

Other Instructional Materials (i.e. OER, handouts)

Description	Circuit Design Software PSpice
Author	No value
Citation	http://www.cadence.com/
Online Resource(s)	

Description	LTspice
Author	No value
Citation	analog.com
Online Resource(s)	

Materials Fee

No value

Learning Outcomes and Objectives

Course Objectives

Analyze and solve direct current circuit (DC) problems with independent and dependent sources to determine voltage, current, resistance, energy and power.

Find the complete response for first and second-order circuits to input signals modeled by wave forms that are direct current, step, window, ramp, decaying exponential, and sinusoidal.

Apply phasors and the concept of impedance to analyze circuits with sinusoidal input under steady-state conditions and to find the frequency response of linear, time in variant circuits.

Design simple first and second-order filter circuits given specifications in terms of signal measurements in decibels.

Define superposition with respect to circuit analysis.

Find the Thevenin and Norton equivalent of a given circuit.

Demonstrate nodal and loop analyses to determine current and voltage.

Select the most effective circuit analysis technique to solve a circuit.

Design circuits using operational amplifiers (op amps) and predict their behavior.

Solve differential equations applied to transient first and second order Resistance, Inductance, and Capacitance (RLC) circuits.

Calculate the energy and power in circuit elements such as resistors, inductors, and capacitors in sinusoidal steady-state circuits.

Determine the average and complex power in Alternating Current (AC) circuits.

Calculate the power factor for given electrical loads.

Analyze circuits that include one or multiple transformers.

Use impedance to determine natural and forced response of a circuit system

Use PSpice, MATLAB or other computer-aided design or simulation software for the design and analysis of elementary circuits.

SLOs

Explain the basic concepts of direct current (DC), alternating current (AC) including circuit elements and analyze the state of a circuit at all circuit locations. Expected Outcome Performance: 70.0

Analyze and compare important and commonly used electrical engineering circuit elements, designs and configurations such as operational amplifiers, RC, RL, and RLC circuits. Expected Outcome Performance: 70.0

Use higher mathematics such as differential equations and computer aided design software like PSpice, MATLAB, or LABVIEW to formulate, analyze and design circuit behavior. Expected Outcome Performance: 70.0

Experimentally verify and communicate key concepts of electrical engineering such as Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Ohm's Law, series and parallel circuits, and superposition. Expected Outcome Performance: 70.0

Additional SLO Information

Does this proposal include revisions that might improve student attainment of course learning outcomes?

No

Is this proposal submitted in response to learning outcomes assessment data?

No

If yes was selected in either of the above questions for learning outcomes, explain and attach evidence of discussions about learning outcomes.

No Value

SLO Evidence

No Value

Course Content

Lecture Content

Introduction (6 hours)

- Circuit variables
- Circuit theory and electrical engineering definitions
- Units, International system of units (SI)
- Circuit analysis overview
- Basic circuit element
- Voltage and current
- Power and energy

Elements of an Ideal Basic Circuit (4 hours)

- Ohm's Law and resistive circuits

- Kirchhoff's Laws
- Ideal circuit elements
- Voltage and current sources, resistors, inductors, capacitors

Resistive Circuits (4 hours)
- Resistors in series
- Resistors in parallel
- Voltage division, current division

Methods of Analyzing Circuits (4 hours)
- Node voltage and mesh circuit analysis
- Thevenin and Norton equivalent circuits
- Source transformation
- Maximum power transfer and maximum efficiency
- Superposition, dependent and independent sources

Operational Amplifiers (op amp) (6 hours)
- Op amp terminals
- Ideal model analysis of op amps
- Realistic op amp models
- Voltage gain and current limitations

Inductance and Capacitance (4 hours)
- Inductors
- Capacitors
- Mutual inductance

Response of RC, RL, and RLC circuits (6 hours)
- RC resistor and capacitor, RL resistor and Inductor, RLC Resistor, Inductor and Capacitator (using L for inductor instead of I)
- Parallel and series RLC circuits
- Natural response of RC, RL, and RLC circuits
- Step response of RC, RL, and RLC circuits
- Transient response of RLC circuits
- Complete response (sum of natural and forced response) of RLC circuits

Sinusoidal Analysis (6 hours)
- Sinusoidal steady state analysis
- Phasor, complex impedance, power factor
- Transformer

Frequency Response of Alternating Current (AC) Circuits (6 hours)
- First and Second Order AC Circuits
- Resonance

Alternating Current (AC) Power (4 hours)
- Power transfer
- Power factor correction

Three Phase Power (4 hours)
- Single-phase three wire systems
- Three-phase systems
- Single-phase vs. three-phase power delivery and efficiency

Total Lecture Hours 54

Laboratory/Studio Content

Introduction (3 hours)
- Laboratory safety
- Units
- Measurement and testing equipment
- Engineering team dynamics, inclusive work environment, and group effectiveness
- Conducting lab experiments with rotating leadership roles so that each student is involved

Virtual Circuit Analysis (3 hours)
- Computer simulation of circuits
- Software

Circuit Design and Construction (3 hours)
- Breadboard
- Wiring and element connection

Circuit Measurement (3 hours)
- Measurement tools
- Accuracy and precision
- Uncertainty in measurements
- Measuring resistance, voltage, current, and power

Circuit Schematics (3 hours)
- Reading schematics
- Compare real circuits

Verify Electrical Circuit Concepts (6 hours)
- Ohm's Law
- Voltage and current division
- Kirchhoff Current and Voltage Laws (KCV and KVL)
- Power dissipation
- Series and parallel circuits
- Equivalent circuits
- Thevenin and Norton equivalent circuits
- Superposition

Operational Amplifier (op amp) Circuits (6 hours)
- Ideal and practical limits
- Input and output of op amps
- Simulated and real op amps
- Application of op amps

Step Response of RL, RC, and RLC Circuits (6 hours)
- Graphical displays
- Calculations

Frequency Response of RL, RC, and RLC Circuits (6 hours)
- Resonance

Transformers and Power Supplies (3 hours)
- Safety with transformers and power suppliers

Electronic Filters (3 hours)
- Ideal filter

Bipolar Transistors and Amplifiers (3 hours)
- Testing output

MOSFET (3 hours)
- Metal-Oxide-Semiconductor Field Effect Transistor (MOSFET)
- Aspects of MOSFET
- Applications

Troubleshooting Circuits (3 hours)
- Testing circuits
- Troubleshooting and repair of basic circuits

Total Laboratory Hours 54