ENGR-184: ENGINEERING CIRCUIT ANALYSIS

Effective Term
Fall 2024

BOT Approval Date
12/14/2023

Discipline
ENGR - Engineering Technology

Course Number
184

Course Title
Engineering Circuit Analysis

Short Title
Engineering Circuit Analysis

Credit Status (CB 04)
D - Credit - Degree applicable

Units

Lecture Units
3.00

Lab Units
1.00

Total Units
4

Hours

Lecture Contact Hours
48-54

Out of Class Hours Lecture
96-108

Lab Contact Hours
48-54

Out of Class Hours Lab
0.00

Total Contact Hours
96 - 108

Total Out of Class Hours
96 - 108

Total Student Learning Hours
192 - 216

Is this an existing Extensive Lab?
Yes

Distance Education
Yes

Distance Education

Distance Education Type
Both Fully Online and Hybrid Online

Fully Online Delivery Requirements:
a. Students must be notified via the college schedule of classes and the syllabus for the class if proctored tests are required for this course
b. Any planned face-to-face meetings, such as an orientation or study session, must be optional
c. The MSJC curriculum committee requires the use of accessible, asynchronous discussion as a component of every fully online course

Are you using publisher content?
No

Regular Substantive Interaction
Instructor-to-student, student-to-student, and student-to-content contact shall be distributed in a manner that will ensure regular substantive interaction (RSI) is maintained not only weekly but also for the duration of the course. Instructor interactions should be equivalent in time, quality and consistency to the engagement students would receive in a face-to-face course—for example, through announcements, discussion participation, personalized feedback, video messages, or other instructional communications. Instructors are expected to be responsive to student inquiries within a 24-72 hour time frame excluding holidays. RSI will be maintained through a variety of methods: • Orientation - Students must be oriented to the online and face-to-face portions at the start of the course. • Announcements - Announcements using the course management system must be posted at least weekly to keep students current on course events, due dates, materials, etc. • Discussion Forums - Content-related discussion forums within the designated CMS will include appropriate instructor participation and will be initiated and maintained, with timely feedback provided. Instructors are required to monitor the discussions and related activities to provide guidance and direction. Open-ended discussion boards may be used to further learning and interaction. • MSJC Communication – Instructor will use MSJC-administered communication tools (such as email or the designated CMS communication tools) to regularly communicate with and provide ease of access to students. • Timely Feedback - Timely feedback on student work will be provided by the instructor, which may include comments and/or rubrics, within the Grades area of the designated CMS. • Scheduled Meetings – Hybrid and synchronous courses will meet at regularly scheduled times. ADA Compliance - All course interactions and content must be designed with accessibility in mind and meet ADA requirements.

Catalog Description
This course covers electric circuit fundamentals, analysis techniques, and semiconductor devices. Topics include Ohm's law, Kirchhoff's laws, transient analysis, steady-state analysis, frequency response, Bode plots, filters, amplifiers, and CMOS logic gates. Integrated SPICE simulation and hands-on labs provide practical experience.

Requisites

Prerequisite(s)

Prerequisite(s) (must be taken before)
PHY-202 (with a grade of C or better).

Pre or corequisite(s)

Prerequisite or corequisite(s) (must be taken simultaneously if not taken before)
MATH-215

Codes

TOP Code (CB 03)
0901.00 - Engineering, General (requires Calculus) (Transfer)

CIP Code
14.0102 - Pre-Engineering.

Repeatability Code
No

Grading Option
Letter grade OR P/NP

Learning Objectives

Learning Objectives

Learning Objective
1. Develop proficiency in analyzing electrical circuits using circuit analysis techniques such as superposition, mesh analysis, nodal methods, and Kirchhoff's laws to solve complex circuit problems.
2. Analyze and investigate transient responses in first-order (RC, RL) and second-order (RLC) circuits and employ complex frequency and impedance concepts in problem-solving.
3. Analyze operational amplifier circuits (e.g., inverting, non-inverting, summing, difference) and evaluate their social impact in various industries.
4. Synthesize knowledge of AC steady-state analysis, Laplace transforms, and frequency response to design and assess passive filters using Bode plots.
5. Examine semiconductor devices, single-stage amplifiers, CMOS digital logic gates, and two-port networks, and appraise their characteristics and performance in circuits.
6. Understand the principles of CMOS technology, digital logic gates, latches, and flip-flops, and evaluate their operation and transient response in digital circuits.
7. Utilize practical laboratory experience with SPICE simulations and real-world measurements to design, analyze, and optimize electrical circuits, while actively collaborating in teams that are diverse in culture, ethnicity, and gender.
8. Effectively communicate technical concepts, circuit designs, and analysis results through written reports, oral presentations, and group discussions. Ensure communication is inclusive, considering diverse perspectives such as cultural, gender, ability, and socio-economic backgrounds, to foster a collaborative and respectful learning environment.
9. Analyze and construct Bode plots for frequency response of circuits, demonstrating the ability to interpret magnitude and phase plots, and apply this knowledge in the design and evaluation of passive filters.
10. Demonstrate mastery in the use of laboratory equipment, such as multimeters, power supplies, and oscilloscopes, to measure electrical quantities and analyze circuit performance.

Learning Outcome Information

Course Learning Outcomes

Learning Outcome
1. Students will demonstrate proficiency in applying various circuit analysis techniques to design and analyze electrical circuits.
2. Students will exhibit an understanding of the underlying principles and practical applications of key components in electrical circuits.
3. Students will effectively analyze the frequency response of electrical circuits by constructing and interpreting Bode plots, which enables them to design and evaluate filters and assess the stability of electronic systems.
4. Students will demonstrate hands-on competency in the laboratory environment, using test and measurement instruments, validating theoretical concepts, and employing simulation software for the design, analysis, and optimization of electrical circuits.
5. Students will develop critical thinking and problem-solving skills by independently exploring complex circuit-related challenges, reflecting on their understanding, and actively seeking knowledge and experiences to enhance their learning.

Program Learning Outcomes

Learning Outcome
Students will demonstrate technical skills used in the industry for engineering technology disciplines such as advanced manufacturing, civil and architectural, and electronics.
Students will use the principles of engineering design to develop a solution, device, or process that resolves or improve an existing solution.

Students will solve technical problems in engineering technology using a combination of mathematics, computer software, scientific principles, and relevant skills.

Institutional Learning Outcomes

Communication: The student will effectively express and exchange ideas through listening, speaking, reading, writing, visual works, and other modes of interpersonal expression.
Critical Thinking: The student will analyze problems, gather and synthesize relevant information, evaluate ideas, information, and evaluate alternative points of view to create, innovate and implement effective solutions.
Information and Technology Literacy: The student will access, interpret, evaluate, and apply relevant information sources and digital media effectively, and in an ethical and legal manner.
Scientific Awareness: The student will apply the scientific method of inquiry to assess potential solutions for real-life challenges by employing science-based knowledge and methodologies in daily life.
Civic
Personal
and Professional Responsibility

Content

Course Lecture Content

1. Fundamentals of Electric Circuits
    a. Ohm's law
    b. Kirchhoff's voltage and current laws
    c. Passive elements: resistors, capacitors, and inductors
    d. Contributions of diverse individuals in electrical engineering (Examples Given Below)
        i. Granville T. Woods: An African-American inventor, who held over 50 patents and contributed to the development of early electrical systems like the telephone, telegraph, and railway.
        ii. Edith Clarke: The first female electrical engineer and the first woman to be professionally employed as an electrical engineer in the United States. She invented the Clarke calculator, which simplified the calculations of electrical power transmission line impedances.
        iii. Amar Bose: An Indian-American electrical and sound engineer who founded Bose Corporation. He was known for his research on psychoacoustics, which led to the development of innovative audio equipment.
        iv. Jerry Lawson was an African-American engineer who was a pioneer in the video game industry. He is best known for inventing the video game cartridge, which allowed games to be played on home consoles. Lawson's invention revolutionized the video game industry, making it possible to play a variety of games on a single console. He also helped develop the Fairchild Channel F, the first home video game console to use cartridges. Lawson's contributions to the video game industry have had a lasting impact on entertainment and technology.
2. Circuit Analysis Techniques
    a. Nodal analysis
    b. Mesh analysis
    c. Network theorems: Superposition, Thevenin, and Norton
3. Operational Amplifiers
    a. Ideal op-amps
    b. Basic op-amp circuits: inverting, non-inverting, summing, and difference
    c. Applications of op-amps
    d. Social Impact of Op-Amps:
        i. Accessibility of technology: Operational amplifiers have made it possible to develop low-cost and portable devices, enabling greater access to technology for people in remote or underserved areas.
        ii. Medical devices: Op-amps are used in various medical devices, such as hearing aids and electrocardiogram machines, improving healthcare for people around the world.
        iii. Communication: Op-amps are essential components in many communication systems, allowing people to connect and share information over long distances.
4. Transient Analysis of First-Order Circuits
    a. RC circuits
    b. RL circuits
    c. Solving first-order differential equations
5. Transient Analysis of Second-Order Circuits
    a. RLC circuits
    b. Natural and forced responses
    c. Complex frequency and impedance

6. AC Steady-State Analysis
    a. Phasors and impedance
    b. AC power and three-phase circuits
    c. Resonance in series and parallel circuits
7. Laplace Transform Techniques
    a. Laplace transforms in circuit analysis
    b. Transfer functions
    c. Convolution and inverse Laplace transforms
8. Frequency Response and Bode Plots
    a. Frequency response of circuits
    b. Bode plots: magnitude and phase
    c. Passive filter design
9. Two-Port Networks
    a. Two-port parameters
    b. Interconnections of two-port networks
    c. Applications in circuit analysis
10. Semiconductor Devices
    a. Diodes: characteristics and applications
    b. Bipolar-junction transistors (BJTs): characteristics and biasing
    c. Field-effect transistors (FETs): characteristics and biasing
11. Single-Stage Amplifiers
    a. Small-signal analysis
    b. Voltage transfer curves
    c. Gain and frequency response
12. CMOS Digital Logic Gates
    a. Introduction to CMOS technology
    b. Basic CMOS gates: inverter, NAND, and NOR
    c. Latches and flip-flops
    d. Transient analysis of CMOS gates
13. Circuit Simulation with SPICE
    a. Introduction to SPICE
    b. DC, AC, and transient analyses
    c. Device models and simulation of circuits

Course Lab Content

The lab content will incorporate SPICE simulation (Such as LTSpice or PSpice) throughout allowing students an opportunity to check their work and use industry-standard tools.

1. Introduction to SPICE Circuit Simulation
    a. Overview of SPICE simulation software
    b. Creating and editing circuit schematics
    c. Basic DC, AC, and transient simulations
    d. Analysis of simulation results
    e. Troubleshooting and optimization of circuit designs
2. Basic Circuit Elements and Measurements
    a. Familiarization with laboratory equipment (multimeter, power supply, oscilloscope)
    b. Measuring resistance, capacitance, and inductance
    c. Verification of Ohm’s law and Kirchhoff’s laws
3. Circuit Analysis Techniques
    a. Nodal and mesh analysis experiments
    b. Verification of network theorems: Superposition, Thevenin, and Norton
4. Operational Amplifier Circuits
    a. Inverting and non-inverting amplifiers
    b. Summing and difference amplifiers
    c. Integrator and differentiator circuits
    d. SPICE simulation of op-amp circuits
5. Transient Analysis of First-Order Circuits and SPICE Simulation

   a. RC circuit charging and discharging
   b. RL circuit response to step inputs
   c. Time constants and first-order circuit response
   d. SPICE transient analysis of first-order circuits
6. Transient Analysis of Second-Order Circuits
   a. RLC series circuit response
   b. RLC parallel circuit response
   c. Resonant frequency and damping factor
7. AC Steady-State Analysis
   a. Phasor analysis of AC circuits
   b. Imped ance measurements
   c. Series and parallel resonance
8. Frequency Response, and Bode Plots
   a. Frequency response of passive filters
   b. Bode plot construction and interpretation
   c. Design and testing of low-pass, high-pass, band-pass, and band-stop filters
   d. SPICE simulation of frequency response and filter circuits
9. Two-Port Networks and SPICE Simulation
   a. Measurement of two-port parameters (Z, Y, H, or S parameters)
   b. Interconnection of two-port networks
   c. Analysis of interconnected two-port networks
10. Semiconductor Devices and SPICE Simulation
    a. Diode I-V characteristics and rectifier circuits
    b. BJT characteristics and biasing
    c. FET characteristics and biasing
11. Single-Stage Amplifiers
    a. Small-signal analysis of common-emitter and common-source amplifiers
    b. Gain and frequency response measurements
    c. Effect of coupling and bypass capacitors
    d. SPICE simulation of single-stage amplifiers
12. CMOS Digital Logic Gates
    a. CMOS inverter, NAND, and NOR gate characterization
    b. Latches and flip-flops
    c. Propagation delay and rise/fall time measurements

Methods of Instruction

Method

Lecture

Integration

Deliver in-person lectures to present course material, using visual aids like slides, diagrams, and physical components. For example, when teaching about operational amplifiers (op-amps), explain the function and characteristics of ideal op-amps, and present different op-amp circuits like inverting, non-inverting, summing, and difference amplifiers. Encourage active student participation through questions and discussions, such as asking students to explain how op-amps are used in various real-world applications.

DE Adaptations for MOI

Record video lectures or create narrated slide presentations with closed captioning and transcripts to ensure accessibility for all students, allowing them to engage with the content asynchronously. Lecture materials, including alternative text for images and screen-reader-friendly documents, will be made available on the Course Management System. Discussion forums will be utilized to foster student engagement, with features like adjustable font sizes and high-contrast themes. Students can ask questions, discuss the material, and share their experiences in solving first-order circuit problems, ensuring an inclusive and accessible online learning environment.

Method

Homework

Integration

Assign homework problems that reinforce lecture content and help students practice circuit analysis techniques. Provide solutions and discuss common mistakes in class to address misconceptions.

DE Adaptations for MOI

Utilize the course management system assignment feature to assign and collect homework electronically, ensuring all materials are screen-reader-friendly and offer alternative text descriptions where needed. Where auto-grading is employed, ensure feedback is clear and accessible. Use clear, legible fonts for individual feedback on student submissions and provide feedback in multiple formats, such as written comments or audio recordings. Offer optional practice problems or quizzes with adjustable font sizes, high-contrast themes, and closed captioning for any audio components, enabling students to self-assess their understanding in an inclusive and accessible manner.

Method

In-class Exercises

Integration

Provide short in-class exercises that allow students to apply lecture content and practice problem-solving skills. Use these exercises as opportunities to address misconceptions and provide immediate feedback.

DE Adaptations for MOI

Design online quizzes, interactive simulations, or problem-solving activities with accessibility in mind, allowing students to engage asynchronously. Ensure all content, including simulations, is compatible with screen readers, offers alternative text descriptions, and provides keyboard navigation options. Utilize the CMS's quiz feature or accessible external tools to deliver these activities. When providing instant feedback, ensure it's presented in clear, legible fonts with options for text-to-speech. Explanations for incorrect answers should be available in multiple formats, such as written text, audio descriptions, or closed-captioned videos, ensuring an inclusive and accessible learning experience.

Method

Group Projects

Integration

Assign group projects that require students to apply their knowledge and skills to real-world problems. Encourage diverse teams by forming groups with a mix of different backgrounds, experiences, and perspectives. This helps students learn from one another, fosters creativity, and leads to innovative solutions. Provide guidance and support throughout the project development process and encourage students to present their work in class. For example, a project on designing a power supply system could benefit from diverse perspectives in terms of efficiency, environmental impact, and accessibility.

DE Adaptations for MOI

Develop project guidelines and resources in the CMS with accessibility features, such as screen-reader-friendly documents and alternative text for images, enabling students to work independently or collaborate online. Promote inclusive team dynamics by encouraging diverse team compositions. Utilize accessible collaboration tools such as Canvas Groups or external platforms such as Microsoft Teams, Zoom, or Discord, ensuring they offer features like closed captioning and adjustable font sizes. Schedule video conferences with sign language interpreters or real-time captioning for progress updates and final presentations, highlighting the value of each team member's contributions. When providing feedback and grading through the CMS, ensure feedback formats are diverse (e.g., written, audio) and consider the varied perspectives and insights presented in the projects, fostering an inclusive and accessible project experience.

Method

Lab Activities

Integration

Course will integrate lab sessions where students work with real-world components and equipment to build and analyze circuits. Use lab activities to reinforce lecture content and help students develop practical skills.

DE Adaptations for MOI

For fully online students, detailed lab manuals will be provided in accessible formats, ensuring they are screen-reader-friendly with alternative text descriptions for diagrams or images. These will be complemented by closed-captioned video demonstrations. Students will be required to purchase remote lab kits, which include oscilloscopes, soldering irons, multimeters, breadboards, and electrical components. Comprehensive user guides will accompany these kits, detailing safe and effective usage of each tool and component. Simulation tools like SPICE, compatible with accessibility features, will further support remote lab activities. Students are encouraged to collaborate virtually using accessible platforms and submit lab reports or results through the course management system.

For hybrid courses, labs will be conducted in person, ensuring hands-on experience with the provided equipment and direct instructor guidance.

Method

Papers and Reports

Integration

The course requires lab reports that require students to explore topics in-depth, synthesize information, and present their findings in a clear and concise manner. Provide guidance on the structure, content, and expectations.

DE Adaptations for MOI

Utilize the CMS assignment feature to collect papers and reports electronically, ensuring that the submission interface is screen-reader-friendly and offers clear, accessible instructions. When providing feedback, use diverse formats such as written comments, audio recordings, or video explanations with closed captioning to cater to varied learning preferences. Implement rubrics with clear, legible fonts and alternative text descriptions to ensure consistency in grading and accessibility for all students. Offer virtual office hours or online discussions with real-time captioning or sign language interpreters, if needed, to support students during the writing process, ensuring an inclusive and accessible feedback and support system.

Methods of Evaluation

Method

Exams/Tests

Integration

Conduct in-person exams, including midterms and finals, with the following criteria of assessment:

Foundational Knowledge: Multiple-choice questions will assess students' grasp of basic principles and theories in engineering circuit analysis.
Conceptual Understanding: Short answer questions will probe deeper into students' understanding, requiring explanations and interpretations of topics such as operational amplifiers and AC steady-state analysis.
Practical Application: Problem-solving questions will challenge students to apply their knowledge in real-world scenarios, especially in areas like transient analysis. Their ability to derive solutions, justify their methods, and interpret results will be key indicators of their mastery of the course content.

DE Adaptations for MOE

Online exams will be administered through the course management system, ensuring the interface is screen-reader-friendly and offers alternative text descriptions for any diagrams or images. The exams will comprise digital multiple-choice quizzes for foundational knowledge, interactive short answer questions with keyboard navigation options for conceptual understanding, and accessible simulation-based tasks for practical application. Topics such as operational amplifiers and transient analysis will be highlighted.
To uphold academic integrity and accessibility, exams will be time-limited, feature randomized questions with clear, legible fonts, and prioritize application-based assessment over rote memorization. Feedback on exam performance will be provided within a set timeline, such as 72 hours post-exam deadline, in diverse formats including written comments and audio explanations to cater to varied student preferences.

Method

Group Projects

Integration

Assign group projects that require collaboration and application of course concepts, such as designing a power-efficient amplifier circuit or creating a filter circuit using passive components. Form diverse teams, ensuring a mix of backgrounds, experiences, and perspectives to foster creativity, problem-solving, and innovative solutions. Assess students based on the quality of their work, teamwork, and ability to communicate their findings, as well as their ability to leverage the diverse strengths of their team members.

DE Adaptations for MOE

Facilitate group projects through the CMS, ensuring all collaborative tools and discussion boards are screen-reader-friendly and offer alternative text descriptions for any embedded content. Encourage students to form diverse teams in the online environment, emphasizing the importance of diversity in enhancing collaboration and learning outcomes. When assessing students' contributions, communication, and the quality of the final project submission, use clear and accessible rubrics with legible fonts and alternative text descriptions. Feedback on group projects will be provided within a set timeline, such as 72 hours post-due date, in diverse formats including written comments, audio recordings, or video explanations with closed captioning. This ensures students understand their performance and their ability to effectively work within a diverse team in an inclusive online setting.

Method

Papers

Integration

Require students to write lab reports following each lab session to document their work, observations, and conclusions. The reports should include an introduction, objectives, methodology, data analysis, results, discussion, and conclusions. For example, after a lab session on transient analysis of first-order circuits, students would write a report detailing their observations and calculations on RC circuit charging and discharging. Assess students based on the clarity, organization, and accuracy of their reports, as well as their ability to analyze and interpret data.

DE Adaptations for MOE

Utilize the course management system to assign, collect, and provide feedback on lab reports, ensuring the interface is intuitive and screen-reader-friendly. Students can upload their lab reports as accessible file formats or submit them through the CMS with clear, legible instructions. Offer clear guidelines, templates, and grading rubrics designed with accessibility in mind, including alternative text descriptions and adjustable font sizes, to guide students in understanding expectations and enhancing their lab report writing skills. Feedback on lab reports will be provided within a set timeline, such as 72 hours post-deadline, in diverse formats like written comments, audio recordings, or video explanations with closed captioning. Virtual office hours or discussion boards, equipped with real-time captioning or sign language interpreters upon request, will be available to address questions and clarify any doubts students may have while working on their lab reports.

Method

Homework

Integration

Assign regular homework problems or exercises related to topics like nodal analysis, transient analysis of second-order circuits, or frequency response and Bode plots to reinforce the concepts learned in class. Provide feedback and grading based on their performance and understanding.

DE Adaptations for MOE

Leverage the CMS to assign and collect homework, ensuring the interface is screen-reader-friendly with clear, accessible instructions. When providing feedback, commit to a clear timeline, such as within 72 hours of due date. Offer feedback in diverse formats, including written comments, audio recordings, or video explanations with closed captioning, catering to varied student preferences. Utilize rubrics designed with clear, legible fonts and alternative text descriptions for any visual elements, promoting consistency in grading. When employing automated grading tools, ensure feedback is clear, accessible, and offers options for text-to-speech to enhance understanding.

Assignments

Assignment Type

Writing

In-class and/or outside of class

Outside of class

Formative or Summative

Summative

Assignment

Assignment 1: DEI in Engineering Circuit Analysis (Individual Project)

Objective: To explore the contributions of diverse individuals in the field of electrical engineering and understand the importance of diversity, equity, and inclusion (DEI) in engineering circuit analysis.

Instructions:

Research and select a diverse individual who has made a significant contribution to the field of electrical engineering, circuit analysis, or a related area. You may choose from the examples provided below or find another individual on your own.
Suggested individuals for the report:

Granville T. Woods: African-American inventor who held over 50 patents and contributed to the development of early electrical systems.
Edith Clarke: The first female electrical engineer and the first woman to be professionally employed as an electrical engineer in the United States.
Amar Bose: Indian-American electrical and sound engineer who founded Bose Corporation.
Jerry Lawson: African-American engineer who was a pioneer in the video game industry.
Hedy Lamarr: Austrian-American actress and inventor who co-developed a frequency-hopping spread spectrum communication system, which later laid the groundwork for modern wireless technologies.
Guity Nashat Becker: Iranian-American engineer who worked on the development of photovoltaic solar cells.
Radia Perlman: American computer programmer and network engineer, known for her invention of the spanning-tree protocol (STP).
Write a paper of 500 to 1,000 words discussing the following:
a. A brief biography of the individual, including their background and experiences.
b. An overview of their key contributions to electrical engineering or circuit analysis.
c. The challenges they faced and overcame in their career.
d. The impact of their work on the field of electrical engineering and technology.
e. A reflection on the importance of diversity, equity, and inclusion in engineering circuit analysis and how the selected individual's contributions exemplify the benefits of diverse perspectives in the field.

Use at least 3 academic sources to support your analysis, and provide proper citations per APA in your paper.

Submit your paper through the CMS by the specified due date.

Grading Criteria: Your paper will be graded based on the quality of your research, depth of analysis, clarity of writing, proper citation of sources, and the connection made between the selected individual and the broader themes of DEI in engineering circuit analysis.

How assignment will be adapted in online format

All assignments will be submitted through the CMS, ensuring the submission interface is intuitive and screen-reader-friendly with clear, accessible instructions. Feedback will be provided within 72 hours of the due date, adhering to the instructor's grading feedback policy. Feedback mechanisms, whether through the CMS grade book, chat, or other accessible video conferencing software, will be equipped with features like closed captioning, text-to-speech options, and alternative text descriptions. All materials provided to students and communications, including announcements, guidelines, and resources, will meet accessibility guidelines, ensuring an inclusive and accessible learning experience for all students.

Assignment Type

Writing

In-class and/or outside of class

In-class
Outside of class

Formative or Summative

Formative

Assignment

Here are a list of example problems that can be given for this class as in-class exercises or homework to assess students comprehension of the topics:

1. Fundamentals of Electric Circuits:
Problem: Calculate the equivalent resistance of the following resistors connected in series: R1 = 10Ω, R2 = 20Ω, and R3 = 30Ω.

2. Circuit Analysis Techniques; Problem: Use nodal analysis to find the current through resistor R1 in the circuit below.
Components: R1 = 5Ω, R2 = 10Ω, R3 = 15Ω, V1 = 10V, and V2 = 5V.

```
+----R1----+----R2----+
| | |
V | V
(V1) | (V2)
- | -
| | |
+----R3----+----GND---+
```

3. Transient Analysis of First-Order Circuits:
Problem: For the RC circuit below, find the time constant (τ) and the voltage across the capacitor (Vc) after 5 time constants when the switch is closed at t = 0.
Components: R = 1kΩ and C = 1μF.

```
+---/ -----+----R---+----C----+
| switch| | |
V | | |
(DC) +---------+----------+
- |
| |
+---------+
```

How assignment will be adapted in online format

All assignments will be submitted through the CMS, ensuring the submission interface is intuitive and screen-reader-friendly with clear, accessible instructions. Feedback will be provided within 72 hours of submission, adhering to the instructor's grading feedback policy. Feedback mechanisms, whether through the CMS grade book, chat, or other accessible video conferencing software, will be equipped with features like closed captioning, text-to-speech options, and alternative text descriptions. All materials provided to students and communications, including announcements, guidelines, and resources, will meet accessibility guidelines, ensuring an inclusive and accessible learning experience for all students.

Assignment Type

Reading

In-class and/or outside of class

In-class
Outside of class

Formative or Summative

Formative

Assignment

Objective:
The purpose of this assignment is to deepen students' understanding of the technical challenges and requirements associated with integrating renewable energy sources into the power grid. Students will read assigned articles, focusing on components like inverters

and energy storage systems, and participate in an in-class discussion to explore the complexities of incorporating renewables into the grid.

Instructions:

Assigned Articles:

1. Integration of renewable energy into the grid, 2020, Monash Energy Institute
URL: https://www.monash.edu/energy-institute/news-events/latest-news/articles/2020/integration-of-renewable-energy-into-the-grid

2. Renewable Energy Integration, Renewable Energy Integration
URL: https://www.nrel.gov/grid/renewable-energy-integration.html

3. Changing the Game by Linking Nuclear and Renewable Energy Systems, 2016, Department of Energy.
URL: https://www.energy.gov/eere/articles/changing-game-linking-nuclear-and-renewable-energy-systems

Read the assigned articles carefully and take notes on the main points and key examples related to the technical challenges of integrating renewable energy sources into the power grid, paying special attention to inverters, energy storage systems, and other necessary components.
Participate in an in-class discussion on the scheduled date. You are expected to contribute thoughtfully and substantively to the conversation, sharing your understanding of the difficulties and potential solutions for incorporating renewables into the grid. Reflect on the roles of inverters and energy storage systems, as well as any other relevant components or technologies.
After the in-class discussion, write a 300-word reflection on the most significant takeaways from the reading materials and the discussion. Submit your reflection through the course management system.

Prompts for discussion:

What are the main technical challenges of integrating renewable energy sources into the power grid?
How do inverters contribute to the effective integration of renewable energy sources, such as solar and wind power, into the grid?
What role do energy storage systems play in addressing the intermittent nature of renewable energy generation?
Are there any other key components or technologies that are essential for the successful integration of renewable energy sources into the power grid?

How assignment will be adapted in online format

To adapt this assignment for an online anytime class, replace the in-class discussion with an asynchronous online discussion. Students will engage in the discussion via the course's CMS, ensuring the interface is screen-reader-friendly. They will contribute a minimum of three thoughtful and substantive posts in the discussion forum, using the provided prompts that come with clear, accessible instructions. All reading materials and reflection components will be provided in accessible formats. The grading criteria will be designed with clear, legible fonts and alternative text descriptions. Feedback on students' contributions will be provided within 72 hours of submission, ensuring timely responses in an inclusive and accessible online discussion experience for all students.

Course Materials

Textbooks

Fundamentals of Electric Circuits, 7th Edition, by Charles Alexander & Matthew Sadiku (2021) | 9781260226409

Electric Circuits, 12th edition, by James Nilsson & Susan Riedel, (2023) | 9780137648375

Class Size Information

Class Size

32

Class Size Category

G - Large lab 32

Diversity and Inclusion

Explain how diversity and inclusion(e.g., gender, culture/race, sexuality, etc.) is infused into the course.

Course Content: We have integrated the contributions of diverse individuals in electrical engineering, such as Granville T. Woods, Edith Clarke, Amar Bose, and Jerry Lawson, highlighting the achievements of engineers from different backgrounds and cultures.

Assignments: We created an assignment that requires students to research and write a report on the contributions of an underrepresented individual in the field of electrical engineering, emphasizing the importance of recognizing and appreciating diverse voices and perspectives in the field.

Group Projects: We encourage forming diverse teams for group projects, which can foster greater creativity and problem-solving by bringing together individuals with different backgrounds and experiences. This promotes an inclusive learning environment and helps students appreciate the value of diverse perspectives.

Discussion Assignment: We developed a reading and discussion assignment on the integration of renewable energy into the power grid, which encourages students to consider global energy challenges and the importance of equitable access to resources and technology.

Describe how assignments, instruction, evaluation, course content, and interactions are contextualized for diverse learners promoting an equitable course.

Assignments: We have designed assignments that cater to different learning styles and promote active engagement, such as the research report, group projects, and reading/discussion assignments. These assignments allow students to explore topics in-depth, collaborate with peers, and engage in critical thinking, ensuring an equitable learning experience for all students.

Instruction: We have employed various methods of instruction, such as lectures, group projects, lab activities, and discussions, to cater to diverse learning preferences and ensure that all students have equal opportunities to learn and succeed in the course.

Evaluation: Our methods of evaluation include a mix of homework problems, lab reports, quizzes, and group projects, which provide multiple opportunities for students to demonstrate their understanding and mastery of the course material. This balanced approach ensures that diverse learners have an equitable chance to excel in the course.

Course Content: By incorporating diverse perspectives and contributions in electrical engineering, we have made the course content more inclusive and relevant to a wide range of students. This approach fosters a sense of belonging and demonstrates the value of diversity in the field of electrical engineering.

Interactions: We have created opportunities for students to engage with each other and the course material through group projects, discussions, and online forums. These interactions promote collaboration, peer learning, and open dialogue, ensuring an inclusive and supportive learning environment for all students.

Interactions

Explain how the course will incorporate student-to-student interaction.

Group Projects: Students will work together in diverse teams to complete group projects, fostering collaboration, communication, and problem-solving among peers.

In-Class Discussions: Students will engage in discussions during face-to-face classes, allowing them to share ideas, opinions, and experiences related to the course content.

Online Discussion Forums: For the online anytime course, students will participate in discussion forums on the course management system, enabling them to engage in asynchronous conversations with their peers.

Peer Review: Students will have the opportunity to review and provide feedback on each other's work, such as research reports and lab reports, fostering a sense of collaboration and shared learning.

Explain how the course will incorporate instructor-to-student interaction.

Lectures: In face-to-face classes, the instructor will deliver lectures, answer questions, and provide clarification on course material.

Office Hours: The instructor will hold regular office hours for both face-to-face and online anytime students, allowing them to ask questions, seek guidance, and receive personalized feedback.

Online Communication: The instructor will interact with online anytime students through email, video conferences, and discussion boards, providing timely feedback and support.

Assessment Feedback: The instructor will provide detailed feedback on assignments, lab reports, quizzes, and exams to help students improve their understanding and performance.

Explain how the course will incorporate student-to-content interaction.

Lectures: Students will attend lectures or watch recorded lectures (for online anytime students) to learn and engage with the course material.

Reading Assignments: Students will complete reading assignments from the textbook and supplementary resources, deepening their understanding of the course content.

Homework Problems & Lab Activities: Students will work on homework problems and lab activities that require them to apply the concepts and theories learned in class, fostering a deeper understanding of the material.

Research and Discussion Assignments: Students will engage with course content by researching specific topics and participating in discussions, allowing them to explore the subject matter in greater depth.

Explain how the course will incorporate student-to-self interaction (metacognitive).

Reflection Prompts: Throughout the course, students will be given prompts to reflect on their learning, progress, and challenges, encouraging them to think critically about their understanding and performance.

Self-Assessment: Students will be encouraged to assess their own learning and progress through self-assessment activities, such as reviewing their performance on quizzes and exams, identifying areas for improvement, and setting goals for future learning.

Independent Research: Assignments like the research report and discussion activities will require students to conduct independent research and critically analyze information, fostering a deeper understanding of the material and promoting self-directed learning.

Time Management: Students, particularly in the online anytime course, will need to manage their time effectively to complete assignments, readings, and other course requirements, encouraging self-discipline and personal responsibility for their learning.

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