MECH 0010 - FUNDAMENTALS OF ELECTRONICS

Catalog Description

Formerly known as CIE 10
Advisory: Concurrent enrollment in MECH 14
Hours: 126 (54 lecture, 72 laboratory)
Description: A fundamental study of electronic devices, circuits, and systems as applied to robotics, computers and industrial automation. Presented through hands-on, project-based experiments. (CSU)

Course Student Learning Outcomes

- CSLO #1: Construct and analyze functional electronic circuits from schematic diagrams.
- CSLO #2: Evaluate results from electronic multimeters and oscilloscopes.
- CSLO #3: Construct and evaluate electronic circuits built using solder.

Effective Term

Fall 2021

Course Type

Credit - Degree-applicable

Contact Hours

126

Outside of Class Hours

108

Total Student Learning Hours

234

Course Objectives

Lecture Objectives:
1. Evaluate how atomic theory contributes to electricity and magnetism;
2. Contrast the relationship between static charge and electromotive force (EMF).
3. Apply Ohm's Law and Watt's Law in simple DC circuits.
4. Apply Kirchhoff's voltage law and the ground concept in making simple measurements.
5. Identify circuits as series, parallel, or combination.
6. Apply Kirchhoff's current law as applied to series, parallel, and combination circuits.
7. Apply circuit laws to calculate and characterize voltage dividers.
8. Compare the characteristics of common cells and batteries.
9. Differentiate the characteristics associated with permanent magnets and electromagnets.
10. Evaluate the effect of capacitive reactance on AC circuit currents.
11. Design a simple transformer.
12. Analyze a timing circuit that depends on an RC time constant.
13. Evaluate the effect of inductive reactance on AC circuit currents.
14. Distinguish between semiconductor crystalline structures and the solid state devices that use them.
15. Design circuits to use semiconductor devices as electronic switches.
16. Analyze the performance of integrated circuits as small-signal amplifiers.
17. Summarize the truth tables for simple digital logic gates.
18. Analyze and extrapolate the behavior of digital-to-analog and analog-to-digital conversion.
Laboratory Objectives:
1. Demonstrate measurement of the basic quantities of voltage, current, and resistance in DC circuits.
2. Calculate Ohm's Law and Watt's Law results in simple DC circuits.
3. Validate by direct measurement Kirchhoff's voltage law and the ground concept in making simple measurements.
4. Validate by direct measurement Kirchhoff's current law as applied to series, parallel, and combination circuits.
5. Perform calculations and measurements of circuit elements in voltage divider circuits.
6. Construct and test simple applications of voltage dividers.
7. Construct and analyze the characteristics of common cells and batteries.
8. Measure simple AC signals with an oscilloscope.
9. Build and test a simple transformer.
10. Build and test a timing circuit that depends on an RC time constant.
11. Simulate, build, measure and test simple filter circuits made with resistors, capacitors, and inductors.
12. Build and test simple circuits with diodes.
13. Build and test a simple linear power supply using a transformer, diodes, and a filter capacitor.
14. Measure simple bipolar transistor parameters such as beta.
15. Build and test simple transistor switch and transistor amplifier circuits.
16. Build and test a simple field effect transistor circuit.
17. Build and test a simple thyristor circuit.
18. Build and test simple non-inverting and inverting operational amplifier circuits.
19. Build and test a simple RC timer circuit using a 555 timer.
20. Measure the truth tables for simple digital logic gates.

General Education Information

- Approved College Associate Degree GE Applicability
- CSU GE Applicability (Recommended-requires CSU approval)
- Cal-GETC Applicability (Recommended - Requires External Approval)
- IGETC Applicability (Recommended-requires CSU/UC approval)

Articulation Information

- CSU Transferable

Methods of Evaluation

- Objective Examinations
  - Example: Students will complete a true/false quiz on battery characteristics, e.g. A wet-cell can deliver more current then a dry-cell? T/F. Standard Grading.
- Problem Solving Examinations
  - Example: Students will calculate power dissipated in a circuit given its voltage and current. Grading based on industry standard.
- Projects
  - Example: Students will construct, test and optimize a magnetic levitation circuit (Objective 19) Grading based on industry standard.
- Reports

    - Example: Students will write a report explaining the behavior of variable-resistor divider circuits.
- Skill Demonstrations
    - Example: Students will use proper soldering technique to construct a linear power supply. Grading based on industry standard.

Repeatable

No

Methods of Instruction

- Laboratory
- Lecture/Discussion
- Distance Learning

Lab:

1. Following an instructor lecture, discussion, and explicit instruction on how to build basic Boolean logic gates, students will build and test multi-stage logic gates from these basic principles.

Lecture:

1. Instructor lecture on theory and application of Ohm's law, including relevant formulas. Students are expected to actively participate in the lecture by using circuit simulation software to verify calculations and unit relationships and visualizing results.

Distance Learning

1. The instructor will post a video demonstrating how to build and simulate circuits in an online simulator. Students will simulate and analyze circuit diagrams and schematics, using circuit simulators available on the internet. Instructor will review circuits and compare calculations to virtually measured results and evaluate student understanding thru questions following each laboratory experiment.

Typical Out of Class Assignments Reading Assignments

1. Read the textbook chapter on diode fundamentals and be prepared to discuss in class. 2. Read about transistor operation at allaboutcircuits.com website, and be prepared to apply in lab.

Writing, Problem Solving or Performance

Sample question to be answered in lab: 1. Calculate and measure voltage, current, or resistance in a simple circuit when you are given the other two quantities. Sample exam question: 2. Calculate total capacitive reactance when given circuit frequency and capacitance.

Other (Term projects, research papers, portfolios, etc.)

Build, test and evaluate performance of a full-wave rectification circuit utilizing a bridge rectifier.

Required Materials

- TAB Electronics Guide to Understanding Electricity and Electronics
    - Author: G. Randy Slone
    - Publisher: McGraw-Hill
    - Publication Date: 2000
    - Text Edition: 2nd
    - Classic Textbook?:
    - OER Link:
    - OER:
- Make: Electronics Learning by Discovery
    - Author: Charles Platt
    - Publisher: Make Books
    - Publication Date: 2015
    - Text Edition: 2nd
    - Classic Textbook?:
    - OER Link:
    - OER:
- Practical Electronics Handbook
    - Author: Ian Sinclair and John Dunton
    - Publisher: NEWNES
    - Publication Date: 2007
    - Text Edition: 6th
    - Classic Textbook?:
    - OER Link:
    - OER:
- Lessons in Electric Circuits
    - Author: Kuphaldt, Tony R.
    - Publisher: www.allaboutcircuits.com - Design Science License
    - Publication Date:
    - Text Edition:
    - Classic Textbook?:
    - OER Link:
    - OER:

Other materials and-or supplies required of students that contribute to the cost of the course.

1. Scientific Calculator, including number conversions and engineering units. 2. Safety Glasses (meeting national Z-87 standard).