Western Technical College

10660123 Industrial Electronic Devices

Course Outcome Summary

Course Information

Description	This course provides an introduction to semiconductor principles and operation including testing and troubleshooting. Diode types, characteristics, operation, testing and troubleshooting are investigated. Diode applications including rectification and DC power supplies are covered along with Zener diodes and packaged linear regulators. The transistor is introduced as a switch and basic biasing is presented. Basic power field effect transistor function is introduced. Power control components are introduced, including the SCR, Triac, solid state relays and insulated gate bipolar transistors.
Career Cluster	Manufacturing
Instructional Level	Associate Degree Courses
Total Credits	2
Total Hours	54

Pre/Corequisites

Prerequisite	10804113 College Technical Math (CTM) 1A
Prerequisite	10660118 AC Circuits Analysis

Textbooks

No textbook required.

Learner Supplies

Safety glasses with side eye protection that meet Z87 OSHA guidelines. **Vendor:** Campus Shop. Required.

Scientific calculator (recommend T1-36x Solar). **Vendor:** Campus Shop. Required.

Success Abilities

1. Cultivate Passion: Enhance Personal Connections
2. Cultivate Passion: Expand a Growth-Mindset

3. Cultivate Passion: Increase Self-Awareness
4. Live Responsibly: Develop Resilience
5. Live Responsibly: Embrace Sustainability
6. Live Responsibly: Foster Accountability
7. Refine Professionalism: Act Ethically
8. Refine Professionalism: Improve Critical Thinking
9. Refine Professionalism: Participate Collaboratively
10. Refine Professionalism: Practice Effective Communication

Program Outcomes

1. Perform work safely.
2. Troubleshoot electrical and mechanical systems and devices.
3. Repair electrical and mechanical systems.
4. Communicate technical information.

Course Competencies

1. Explore diode operations with AC circuits.

Assessment Strategies

1.1. Skill Demonstration
1.2. Written Product

Criteria

You will know you are successful when

1.1. you explain the forward and reverse bias condition of a diode in an AC circuit.
1.2. you build a circuit with diodes and an AC power supply.
1.3. you connect the appropriate meters to an AC diode circuits and take measurements.

Learning Objectives

1.a. Explore the forward and reverse bias condition of a diode in an AC circuit.
1.b. Build a circuit with diodes and an AC power supply.
1.c. Connect the appropriate meters to an AC diode circuits and take measurements.

2. Evaluate rectifier circuits.

Assessment Strategies

2.1. Skill demonstration
2.2. Written product

Criteria

You will know you are successful when

2.1. you calculate and verify the operation of a capacitor filtered half-wave rectifier circuit.
2.2. you calculate and verify the operation of a capacitor filtered full-wave rectifier circuit.
2.3. you identify practical applications for full and half wave rectifier circuits.
2.4. you measure the effects of a changing load resistance on filtered rectifier circuits.
2.5. You build and test a bridge circuit with and without filtering.

Learning Objectives

2.a. Explain and analyze the operation and characteristics of power supply filters.
2.b. Calculate circuit values for a filtered half-wave rectifier.
2.c. Identify circuit values for filtered half-wave rectifier.
2.d. Calculate circuit values for a filtered full-wave rectifier.

2.e. Identify circuit values for a filtered full-wave rectifier.
2.f. Insert problems in a rectifier circuit to simulate troubleshooting failed components.
2.g. Measure the effects of a changing load resistance on a filtered rectifier circuit.
2.h. Calculate the effects of a changing load resistance on a filtered rectifier circuit.

3. Evaluate Metal-Oxide Semiconductor Field-Effect Transistor (MOSFET) operations and circuits.

Assessment Strategies

3.1. written product
3.2. skill demonstration

Criteria

You will know you are successful when

3.1. you identify a MOSFET schematic symbol.
3.2. you build an MOSFET circuit and test for operation.
3.3. you test an MOSFET for functionality.
3.4. you explain the function of an MOSFET in a DC circuit.

Learning Objectives

3.a. Explain the operation characteristics of MOSFETs.
3.b. Define, discuss and apply important MOSFET parameters.
3.c. Analyze MOSFET bias circuits.
3.d. Calculate expected circuit voltage and current values in various MOSFET bias circuits.
3.e. Determine the operating characteristics of a power E-MOSFET used in switching and amplifier circuits.
3.f. Construct a circuit used to find the values of IDSS and VGS(off) for a D-MOSFET.
3.g. Construct and calibrate E-MOSFET application circuits.
3.h. Verify operation of MOSFET circuits.
3.i. Fix any problems in MOSFET circuits.

4. Evaluate op-amp operations and circuits.

Assessment Strategies

4.1. written product
4.2. skill demonstration

Criteria

You will know you are successful when

4.1. you explain the function of an Op-Amp as an inverting and non inverting amplifier.
4.2. you calculate the gain of an inverting Op-Amp circuit.
4.3. you calculate the gain of an non-inverting Op-Amp circuit.
4.4. you explore the function of an Op-Amp
4.5. you build op-amp circuits.
4.6. you test Op-Amp circuits for functionality.

Learning Objectives

4.a. Analyze op-amp inverting and noninverting circuit configurations.
4.b. Analyze the operation of summing amplifiers.
4.c. Analyze the operation of basic comparator circuits.
4.d. Explain the impact of various component faults on basic op-amp circuit configurations.
4.e. Explain the relationship between output saturation voltages and a defective op-amp.
4.f. Determine failed components in a malfunctioning op-amp circuit.
4.g. Fix any failed components in a malfunctioning op-amp circuit.

5. Evaluate Silicon-Controlled Rectifier (SCR) operations and circuits.

Assessment Strategies

5.1. written product
5.2. skill demonstration

Criteria

You will know you are successful when

5.1. you explain the function of an SCR in a DC circuit.

5.2. you explain the function of an SCR in a AC circuit.
5.3. you test an SCR for functionality.
5.4. you build an SCR circuit and test for operation.
5.5. you identify a SCR schematic symbol.

Learning Objectives

5.a. Calculate the voltage waveforms for SCR gate control at various conduction angles.
5.b. Construct and measure circuit values for DC gate and AC gate controlled SCR circuits.
5.c. Evaluate SCR switching circuits.
5.d. Test an SCR using a VOM and a DMM.
5.e. Construct a circuit used to test the electrical characteristics of an SCR.
5.f. Explain the testing limitations of DMMs when used on SCR devices.
5.g. Verify the operation of SCR circuits.
5.h. Fix any problems in SCR circuits.

6. Evaluate Insulated-gate Bipolar Transistor (IGBT) operations and circuits.

Assessment Strategies

6.1. skill demonstration
6.2. written product

Criteria

You will know you are successful when

6.1. you explain the function of an IGBT in a DC circuit.
6.2. you test an IGBT for functionality.
6.3. you build an IGBT circuit and test for operation.
6.4. you identify a IGBT schematic symbol.
6.5. you measure IGBT values from a range of operation.

Learning Objectives

6.a. Describe basic structure and operation of IGBT circuits.
6.b. Analyze specific applications of IGBT circuits.
6.c. Investigate IGBT characteristics.
6.d. Calculate necessary component values for IGBT circuit.
6.e. Build IGBT circuits as specified by instructor.
6.f. Verify operation of IGBT circuits.
6.g. Fix any problems with IGBT circuits.

7. Explore the operation of bipolar junction transistors (BJTs).

Assessment Strategies

7.1. Skill demonstration
7.2. Written product

Criteria

You will know you are successful when

7.1. you explain the construction of NPN and PNP transistors.
7.2. you draw the schematic symbol for NPN and PNP transistors including lead identification.
7.3. you explain how a transistor can be used as an amplifier and a switch.
7.4. you construct a test circuit to measure the base, emitter, and collector currents of a transistor.

Learning Objectives

7.a. Describe the basic construction of a bipolar junction transistor (BJT).
7.b. Determine how a transistor is biased and its current relationships.
7.c. Discuss transistor parameters and characteristics.
7.d. Discuss how a BJT is used as an amplifier and as a switch.
7.e. Examine various types of BJT package configurations.
7.f. Compute the effect of how transistor base current controls the collector current.

8. Perform tests on special purpose semiconductor diodes and BJTs.

Assessment Strategies

8.1. Skill demonstration

8.2. Written product

Criteria

You will know you are successful when

8.1. you test the condition of optoisolators, and BJTs with a DMM.
8.2. you construct a circuit to test for a transistor's Beta value.
8.3. you determine the type of BJT by testing with a DMM.

Learning Objectives

8.a. Test a zener diode using a DMM.
8.b. Test LEDs and optoisolators using a DMM.
8.c. Test NPN and PNP transistors using analog and digital meters.
8.d. Find a transistor's Beta value by constructing a transistor test circuit.

9. Design transistor bias circuits.

Assessment Strategies

9.1. Skill demonstration
9.2. Written product

Criteria

You will know you are successful when

9.1. you design a based-bias circuit to meet given specifications.
9.2. you design a voltage-divider biased circuit to meet given specifications.
9.3. you identify applications for biased circuits.
9.4. you explain how a transistor circuit can sink or source current.

Learning Objectives

9.a. Design a base-biased circuit using a known Beta value.
9.b. Design a simple voltage-divider bias circuit.
9.c. Inspect the effectiveness of Q-point stability for the various transistor bias circuits.
9.d. Test transistor bias circuit using simulation software.

10. Evaluate TRIAC and DIAC operations and circuits.

Assessment Strategies

10.1. Skill Demonstration
10.2. Written Product

Criteria

You will know you are successful when

10.1. you explain the function of a DIAC.
10.2. you explain the function of an TRIAC in a AC circuit.
10.3. you test an TRIAC for functionality.
10.4. you build an TRIAC circuit and test for operation.
10.5. you identify a TRIAC and DIAC schematic symbol.
10.6. you measure load values in a TRIAC and DIAC circuit from a range of operation.

Learning Objectives

10.a. Explore the function of a DIAC.
10.b. Explore the function of an TRIAC in a AC circuit.
10.c. Test an TRIAC for functionality.
10.d. Build an TRIAC circuit and test for operation.
10.e. Identify a TRIAC and DIAC schematic symbol.
10.f. Measure load values in a TRIAC and DIAC circuit from a range of operation.

11. Explore analog to digital (ADC) and digital to analog (DAC) conversion.

Assessment Strategies

11.1. Skill Demonstration
11.2. Written Product

Criteria

You will know you are successful when

11.1. you explain the function of a DAC.
11.2. you explain the function of an ADC.
11.3. you build a circuit using a DAC.
11.4. you build a circuit using an ADC.
11.5. you measure the values in a DAC circuit.
11.6. you measure the values in an ADC circuit.

Learning Objectives

11.a. Explore the function of a DAC.
11.b. Explore the function of an ADC.
11.c. Build a circuit using a DAC.
11.d. Build a circuit using an ADC.
11.e. Measure the values in a DAC circuit.
11.f. Measure the values in an ADC circuit.