Fox Valley Technical College

10660128 Semiconductors 1

Course Outcome Summary

Course Information

Description	Introduces semiconductor materials, the operation of diodes, Zener diodes and the construction of rectifier and filter circuits. Fundamental transistor construction and operation is also introduced. Laboratory experiments are performed to verify the theory.
Career Cluster	Science, Technology, Engineering and Mathematics
Instructional Level	Associate Degree
Total Credits	1.00
Total Hours	27.00

Types of Instruction

Instruction Type	Credits/Hours
Lab	1 Credit/27 Hours

Course History

Revised By	Kaye Krueger (kruegek)
Last Approval Date	9/11/2014

Pre/Corequisites

Prerequisite AC Circuits 1 (10-660-114)

Textbooks

Electronics Fundamentals: Circuits, Devices, and Applications
Floyd, Thomas L.; Buchla, David
Prentice-Hall
ISBN: 9780135072950
8th Edition

Employability Essentials

1. **Act Responsibly - Apply ethical standards in both personal and professional behavior.**
   Status *Active*

2. Adapt to Change - Anticipate changes and positively respond to them.
Status *Active*

3. Communicate Effectively and Respectfully - Apply appropriate writing, speaking, and listening skills across various settings to engage diverse audiences.
Status *Active*

4. Think Critically and Creatively - Apply independent and rigorous reasoning that leads to informed decisions, innovation and personal empowerment.
Status *Active*

5. Work Collaboratively - Work collaboratively with others to complete tasks, solve problems, resolve conflicts, provide information, and offer support.
Status *Active*

Program Outcomes

1. Apply electronic theory to practice.
Type *TSA* ***Status*** *Active*

Criteria

1.1. You mathematically analyze a circuit or system.
1.2. You simulate a circuit or system.
1.3. You construct a circuit or system according to schematics or other documentation.
1.4. You perform circuit or system measurements to collect data.
1.5. You analyze data to validate predicted outcome.

2. Operate test equipment.
Type *TSA* ***Status*** *Active*

Criteria

2.1. You demonstrate measurement of electrical and/or electronic signals.
2.2. You demonstrate measurement of electrical and/or electronic quantities.
2.3. You demonstrate measurement of electrical and/or electronic components.
2.4. You use test equipment to generate electrical and/or electronic signals.
2.5. You apply appropriate safety precautions.

3. Build electronic circuits and systems.
Type *TSA* ***Status*** *Active*

Criteria

3.1. You assemble a prototype for operation.
3.2. You demonstrate soldering and de-soldering techniques.
3.3. You apply appropriate antistatic precautions.
3.4. You identify appropriate interfaces.
3.5. You set up programmable devices and/or systems.
3.6. You apply appropriate safety precautions.

4. Evaluate the operation of electronic circuits or systems.
Type *TSA* ***Status*** *Active*

Criteria

4.1. You determine the correct operation of circuits or systems.

4.2. You identify incorrect operation of circuits or systems.
4.3. You isolate causes of failures in circuits or systems.
4.4. You correct failures in circuits or systems.

5. Communicate technical information.

Type *TSA* ***Status*** *Active*

Criteria

5.1. You interpret electrical and/or electronic diagrams.
5.2. You create electrical and/or electronic diagrams.
5.3. You interpret technical reports and documents.
5.4. You use appropriate terminology in speaking and writing.
5.5. You interpret documentation of electronic devices and systems.
5.6. You locate necessary resources and pertinent information to perform work functions.

Course Competencies

1. Analyze Semiconductor Diodes

Status *Active*

Assessment Strategies

1.1. Written exam

Criteria

Performance will meet expectations when:

1.1. you achieve a 70% or better.

Learning Objectives

1.a. Define the following terms: Electron, Trivalent Element, Proton, Pentavalent Element, Neutron, Semiconductor Crystal, Valence Shell, Impurities, Negative Ion, Doping, Positive Ion, Intrinsic, PIV (PRV).
1.b. Describe the difference between electron flow and hole flow (minority carriers and majority carriers).
1.c. Describe the properties of conductors, semiconductors, and insulators.
1.d. Describe how P-type and N-Type materials are formed and the difference between them.
1.e. Describe what is meant by barrier voltage, depletion region, and how it is formed.
1.f. Describe how forward, reverse, or no biasing effects the PN junction of a semiconductor, and the resulting current that flows.
1.g. Identify the forward voltage drops across the PN junction of germanium and silicon diodes.
1.h. Describe how to forward and reverse bias semiconductor diodes and what the applied voltages that are required at the anode and cathode for each of these conditions.
1.i. Identify if the condition of a diode is shorted, open, or good by being given test results with an ohmmeter.
1.j. Indicate the voltage drops across each component of a series circuit that has a diode and resistor when forward and reverse biased given the applied voltage.
1.k. Identify which type of voltage (RMS, Peak, Average) is read by a dc voltmeter at the output of a rectifier.
1.l. Draw the waveform and voltages at each peak across each component of a series circuit, consisting of a diode and resistor, when an AC voltage is applied.
1.m. Indicate the minimum PIV rating that is required by the diode in the circuit given the RMS AC voltage applied to a half-wave and full-wave rectifier.
1.n. Identify the secondary voltage of a transformer and a center-tapped transformer when given the value of the applied voltage and its turns ratio.
1.o. Identify the frequency of a half□wave and full-wave rectifier given the frequency of the applied voltage.
1.p. Identify the pulsating frequency the voltage read by a dc voltmeter that is connected across the output of a rectifier given the frequency of the applied AC power, its voltage value, and the turns ratio of a transformer.
1.q. Indicate if the voltage and current at the components of a series circuit, consisting of a diode and resistor, increases, decreases, or stays the same as the applied voltage is varied.
1.r. Identify which types of waveforms are located at various locations of half□wave and full-wave rectifiers.

2. Analyze DC Power Supplies

Status *Active*

Assessment Strategies

2.1. Written exam

Criteria

Performance will meet expectations when:

2.1. you achieve a 70% or better.

Learning Objectives

2.a. Describe the operation of each section in the DC Power Supply block diagram shown in Figure 16-39 of the text, and identify which components are used for each block.
2.b. List the ripple frequency of a half□wave and full□wave rectifier given the frequency of the applied AC supply voltage.
2.c. Describe the difference between voltage regulation and filtering, and explain in detail how the components for each circuit function to perform their operation.
2.d. Describe in detail when the diode is forward-biased and reverse-biased in Figure 16-40 of the text and when the filter capacitor charges and discharges.
2.e. Describe how changing the values of the filter capacitor and load resistor of a DC power supply improves the ripple.
2.f. Identify the ripple factor given the average dc voltage and ripple voltage of a filter circuit.
2.g. List the three factors that cause the output voltage of an unregulated filter rectifier to vary.
2.h. Identify the required minimum PIV value of the rectifier diode in the circuit given the peak-to-peak value of an AC voltage applied to the rectifier.
2.i. Calculate line regulation and load regulation problems.
2.j. Describe what happens to the zener diode current, the voltage and current of the load resistor, and the voltage and current at the series resistor of the regulator circuit in the lab manual when the load resistor value changes.
2.k. Identify how much the DC supply voltage can be varied, when given the values of the series resistor, the breakdown voltage, and minimum and maximum current values for the zener diode for a zener diode voltage regulator circuit (Figure 16-51 of the textbook).
2.l. Distinguish if the ripple voltage of a filtered full-wave rectifier will increase or decrease when the value of the filter capacitor, load resistor, or input frequency are changed.
2.m. Identify the secondary voltage of the transformer, the pulsating DC output voltage of the rectifier, and the dc output of the filter given the input voltage of a filtered full-wave rectifier.
2.n. Given various symptoms of a defective filtered rectifier circuit, determine the cause of the fault.

3. Analyze Transistors

Status *Active*

Assessment Strategies

3.1. Written exam

Criteria

Performance will meet expectations when:

3.1. you achieve a 70% or better.

Learning Objectives

3.a. State the basic construction of a bipolar junction transistor (BJT).
3.b. State the two types of bipolar junction transistors.
3.c. List the three terminals of the bipolar junction transistor, and identify their location from the top or bottom of the case by using a data manual.
3.d. Draw the schematic symbol for each type of bipolar junction transistor.
3.e. Describe how emitter, base, and collector currents are related.
3.f. Identify the following points on a transistor characteristic curve chart: saturation point, cutoff point, IC, VCE, load line, Q point, IB.
3.g. Describe how the emitter-base and collector-base junctions are biased, and the type of resistance readings (low or high) that will be measured across these terminals of a PNP and NPN transistor that is defective, or is not defective, with an ohmmeter.
3.h. Define alpha and beta of a transistor. Calculate beta.
3.i. Identify the following abbreviations that pertain to a transistor: VE, VB, VC, IB, IC, IE, VCE.
3.j. Identify the following values: VB, VRE, VC, VCE, IE, IC, IB, given the resistor values and the VCC value for a common-emitter NPN transistor amplifier.
3.k. Identify the gain of the circuit given the values of the emitter resistor and the collector resistor in an NPN

transistor amplifier.

3.l. Describe how the following values are affected in terms of when a transistor is in the saturation and cutoff modes: VE, VCE, VC, IB, IE, IC.

3.m. Describe if the following values are increased or decreased when either VB, IB, or base-emitter voltage is varied: VE, VCE, VC, IB, IE, IC.

3.n. Explain how the common-emitter amplifier will become saturated or go into cutoff when an AC waveform is applied if one of the two biasing resistor values is too high or too low. Given the VCC value of a common-emitter transistor, indicate the ideal Q point voltage.

Grant Award

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Course Learning Plans and Performance Assessment Tasks

Type	Title	Source	Status
PAT	Semiconductor Diode Exam	Course	Active
PAT	DC Power Supplies Exam	Course	Active
PAT	Transistors Exam	Course	Active
LP	Semiconductor Diodes	Course	Active
LP	DC Power Supplies	Course	Active
LP	Transistors	Course	Active