Western Technical College

10662157 Integrated Circuits Applications

Course Outcome Summary

Course Information

Description	This course will concentrate on the use of integrated circuits and their applications. The student will use operational amplifiers (op amps) to construct basic amplifiers, active filters, comparators, Schmitt triggers, integrators and differentiators. Special function ICs, such as instrumentation amplifiers and monolithic switching regulators will be used to construct typical circuits used in modern electronic equipment. The use of data and specification sheets, along with internet searches and electronic simulation software, will be emphasized throughout the course.
Career Cluster	Science, Technology, Engineering and Mathematics
Instructional Level	Associate Degree Courses
Total Credits	3
Total Hours	90

Textbooks

Electronic Principles. 9th Edition. Copyright 2021. Malvino, Albert and David Bates. Publisher: McGraw-Hill Publishing Company. **ISBN-13**: 978-1-26-436006-2. Required.

Program Outcomes

1. Apply electronic theory to practice.
2. Operate test equipment.
3. Build electronic circuits and systems.
4. Evaluate the operation of electronic circuits or systems.
5. Communicate technical information.

Course Competencies

1. Verify the operation of first-order low-pass and high-pass active filters.

Criteria

You will know you are successful when

1.1. you measure the output frequency response using an oscilloscope.
1.2. you measure the output frequency response using a Bode plotter.
1.3. you make circuit modifications to an existing circuit to meet given performance expectations.
1.4. you evaluate the stated performance specifications of op amp devices using the internet.

Learning Objectives

1.a. Construct low-pass and high-pass active filters using Multisim and actual circuit components.
1.b. Measure the output frequency response of first-order low-pass and high-pass filters.
1.c. Modify filter circuit components to meet design specifications.

2. Design second-order and higher-order op amp active filters.

Criteria

You will know you are successful when

2.1. you design a second-order low-pass active filter to meet performance expectations.
2.2. you design a third-order high-pass filter to meet performance expectations.
2.3. you construct higher-order active filters and verify their operation.

Learning Objectives

2.a. Design higher-order active filters.
2.b. Construct higher-order active filters using Multisim and actual components.
2.c. Evaluate the circuit performance of higher-order active filters to meet given specifications.

3. Analyze the operation of active filters using electronics design software.

Criteria

You will know you are successful when

3.1. you design active filter circuits using National Semiconductor's WEBENCH software tools located on the internet.
3.2. you evaluate the performance of an active filter circuit using National Semiconductor's WEBENCH software tools.

Learning Objectives

3.a. Construct active filter circuits using electronic design software.
3.b. Test active filter circuits using electronic design software.
3.c. Evaluate active filter circuit performance to specified performance levels.

4. Document the performance of an active filter circuit.

Criteria

You will know you are successful when

4.1. you provide written documentation of the circuit's performance using an engineering notebook format.

Learning Objectives

4.a. Write lab reports using an engineering notebook format.

5. Verify the operation of differential amplifiers.

Criteria

You will know you are successful when

5.1. you calculate the proper resistor values needed to construct a differential circuit design.
5.2. you measure the output voltage of an instrumentation amplifier built with Multisim precision op amps.
5.3. you measure the output voltage of an instrumentation amplifier built with LM318 precision op amps.

Learning Objectives

5.a. Calculate the output voltage of a differential amplifier with given input voltages.
5.b. Construct a differential amplifer using Multisim and actual components.
5.c. Test a differential amplifier for proper operation.

6. Design a Wheatstone bridge differential amplifier circuit.

Criteria

You will know you are successful when

6.1. you calculate the resistor values need when using a thermistor.
6.2. you calculate the resistor values needed when using a solid state temperature transducer.
6.3. you test the Wheatstone bridge constructed circuit for proper output voltage values.

Learning Objectives

6.a. Design a Wheatstone bridge circuit used to measure an output temperature level.
6.b. Construct a Wheatstone bridge circuit using actual components.
6.c. Evaluate the Wheatstome bridge circuit for proper output voltage range.

7. Verify the operation of an instrumentation amplifier.

Criteria

You will know you are successful when

7.1. you construct and test the instrumentation amplifier using Multisim.
7.2. you construct and test the instrumentation amplifier using actual components.
7.3. you evaluate the output voltage values of a Wheatstone bridge/instrumentation amplifier combination circuit.

Learning Objectives

7.a. Construct an integrated circuit instrumentation amplifier circuit.
7.b. Test an instrumentation amplifier circuit for proper output voltage levels.
7.c. Combine a Wheatstone bridge circuit and an instrumentation amplier to operate as a temperature-to-voltage converter.

8. Design a wideband variable gain amplifier using electronic design software.

Criteria

You will know you are successful when

8.1. you calculate the resistor values needed for a wideband variable gain amplifier using National Semiconductor's WEBENCH design software.
8.2. you measure the output response of a wideband variable gain amplifier using WEBENCH.

Learning Objectives

8.a. Design a wideband variable gain amplifier using design software.
8.b. Evaluate the output performance of an instrumentation amplifier using design software.

9. Verify the operation of basic op amp comparator circuits.

Criteria

You will know you are successful when

9.1. you calculate the output voltage of a comparator circuit with a fixed reference and varying input voltage.
9.2. you construct an IC comparator circuit using a LM339 open collector IC.
9.3. you design and construct a window comparator circuit using Multisim.

Learning Objectives

9.a. Design a basic op amp comparator.
9.b. Construct an open collector op amp comparator circuit.
9.c. Design an op amp window comparator.

10. Generate low-frequency linear and nonlinear waveforms with op amp circuits.

Criteria

You will know you are successful when

10.1. you calculate the output frequency of a low-frequency RC oscillator circuit.
10.2. you construct a low-frequency RC oscillator circuit and measures its output frequency.
10.3. you modify an existing RC oscillator circuit to provide a specified output frequency.

Learning Objectives

10.a. Evaluate the operation of low frequency RC oscillator circuits.

10.b. Modify critical RC components to set an oscillator frequency to a specified value.

11. Design integrator and differentiator op amp circuits using electronic design software.

Criteria

You will know you are successful when

11.1. you design an integrator circuit using National Semiconductor's WEBENCH software.
11.2. you design a differentiator circuit using National Semiconductor's WEBENCH software.
11.3. you measure the output voltage of integrator and differentiator circuits using National Semiconductor's WEBENCH design software.

Learning Objectives

11.a. Design an IC integrator circuit to meet stated specifiecations.
11.b. Design an IC differentiator circuit to meet stated specifications.
11.c. Evaluated the operation of integrator and differentiator circuits.

12. Design linear voltage regulator circuits with monolithic integrated circuits.

Criteria

You will know you are successful when

12.1. you calculate the component values necessary to produce a specified fixed output voltage value.
12.2. you calculate the component values necessary to produce a range of variable output voltage values.
12.3. you verify the proper output voltage values of fixed and variable voltage regulator circuits.

Learning Objectives

12.a. Design IC voltage regulator circuits to meet specified output voltage levels.
12.b. Construct IC voltage regulator circuits.
12.c. Evaluate the output voltage and current levels of IC voltage regulators.

13. Verify the operation of DC-to-DC converters.

Criteria

You will know you are successful when

13.1. you build a switching regulator circuit using actual components.
13.2. you build a switching regulator circuit using Multisim.
13.3. you determine if the output levels of a switching voltage regulator circuit meets stated specifications.

Learning Objectives

13.a. Construct an unregulated DC-to-DC voltage regulator circuit.
13.b. Measure the output voltage levels of a DC-to-DC voltage regulator circuit.
13.c. Evaluate the operation of a DC-to-DC voltage regulator circuit.

14. Verify the operation of buck/boost switching voltage regulators.

Criteria

You will know you are successful when

14.1. you build a buck/boost switching regulator circuit using Multisim.
14.2. you measure the output voltage of a buck/boost switching regulator circuit using Multisim.

Learning Objectives

14.a. Construct a buck/boost switching voltage regulator.
14.b. Measure the output voltage levels of a buck/boost switching voltage regulator.
14.c. Describe the circuit operatiion of a buck/boost switching voltage regulator.

15. Evaluate the circuit performance of industry built switching power supply circuits.

Criteria

You will know you are successful when

15.1. you measure the output dc and ripple voltage of an industrial switching power supply.
15.2. you verifiy the output levels of a switching power supply meet stated ratings.

Learning Objectives

15.a. Measure the output voltage of an industrial switching power supply circuit.
15.b. Determine if a prebuild switching power supply meets listed specifications.