Western Technical College

10662138 Communications Systems

Course Outcome Summary

Course Information

Description	This course introduces the concepts of AM/FM and digital modulations, demodulation, and transmission techniques. Topics include the frequency domain, noise effects, transmission lines, RF propagation, antennas, sampling types, multiplexing, PCM and network protocols.
Career Cluster	Science, Technology, Engineering and Mathematics
Instructional Level	Associate Degree Courses
Total Credits	3
Total Hours	72

Pre/Corequisites

Prerequisite	10660125 Electronic Devices
Prerequisite	10662137 Digital Electronic Concepts

Textbooks

No textbook required.

Success Abilities

1. Cultivate Passion: Enhance Personal Connections
2. Live Responsibly: Foster Accountability
3. Refine Professionalism: Act Ethically
4. Refine Professionalism: Improve Critical Thinking

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. Explain the concepts behind signals and thermal noise in the frequency domain.

Assessment Strategies

1.1. Written Product

Criteria

You will know you are successful when

1.1. you list the common frequency ranges as specified by the FCC.
1.2. you define the term signal.
1.3. you explain the common types of thermal noise.
1.4. you use the FFT function on the oscilloscope to determine the frequency components of common signals.

Learning Objectives

1.a. Describe the radio frequency spectrum
1.b. Define the term signal
1.c. Define the term noise

2. Summarize the effects of electromagnetic and radio frequency interference.

Criteria

You will know you are successful when

2.1. you list the types of external noise.
2.2. you list the types of internal noise.
2.3. you calculate the S/N ratio of a circuit.
2.4. you interpret the NF of a transistor given the spec sheet.
2.5. you explain the significance of the selectivity of a receiver as it relates to RF interference.

Learning Objectives

2.a. List the major types of noise
2.b. Define external noise
2.c. Define internal noise
2.d. Define signal-to-noise ratio
2.e. Define noise figure

3. Demonstrate functional blocks of communications systems.

Assessment Strategies

3.1. Drawing/Illustration

Criteria

You will know you are successful when

3.1. you draw the block diagram of an AM transmitter.
3.2. you draw the block diagram of an FM transmitter.
3.3. you draw the block diagram of an AM receiver.
3.4. you draw the block diagram of an FM receiver.
3.5. you list the four types of transmission mediums.
3.6. you explain the characteristics of the different classes of amplifiers.

Learning Objectives

3.a. Describe a basic transmitter
3.b. Describe a basic receiver
3.c. Describe what is included in the term transmission medium

4. Identify characteristics of transmission lines and systems.

Criteria

You will know you are successful when

4.1. you list the characteristics of an nonresonant transmission line.
4.2. you list the characteristics of a resonant transmission line.
4.3. you calculate the SWR of a system.
4.4. you explain the significance of the skin effect at high frequencies.
4.5. you explain the four basic modes of radio wave propagation.
4.6. you compare and contrast the characteristics of balanced and unbalanced transmission lines.
4.7. you define the term antenna.
4.8. you calculate the electrical length of a half-wave dipole antenna.
4.9. you calculate the physical length of a half-wave dipole antenna.
4.10. you calculate the characteristic impedance of a transmission line.

Learning Objectives

4.a. Identify the characteristics of an nonresonant transmission line
4.b. Identify the characteristics of a resonant transmission line
4.c. Define the term SWR
4.d. Explain what is meant by the term skin effect
4.e. Describe the physical characteristics of a transmission line
4.f. Explain the concept of electromagnetic wave propagation
4.g. Define the term antenna
4.h. Describe the physical characteristics of a half-wave dipole antenna
4.i. Describe the electrical characteristics of a half-wave dipole antenna

5. Apply the amplitude modulation (AM) signal expressions to determine spectrum and waveform components.

Criteria

You will know you are successful when

5.1. you explain the need for modulation to transmit information.
5.2. you draw the AM waveform at various percentages of modulation.
5.3. you draw the frequency spectra of an AM waveform.

Learning Objectives

5.a. Describe the process of modulation
5.b. Draw the AM waveform
5.c. Use the AM equation to determine the spectral components of the AM waveform

6. Examine the operation of AM modulators and envelope detectors.

Criteria

You will know you are successful when

6.1. you draw the block diagram of a high-level modulator.
6.2. you draw the block diagram of a low-level modulator.
6.3. you describe the function of a modulator.
6.4. you distinguish a modulator circuit from an amplifier circuit.
6.5. you draw a basic envelop detector.
6.6. you explain typical AM transmitter specifications.
6.7. you explain typical AM receiver specifications.

Learning Objectives

6.a. Explain the term high-level modulation
6.b. Explain the term low-level modulation
6.c. Describe the various methods used for AM detection

7. Determine the relationship between an AM signal and its parameters.

Criteria

You will know you are successful when

7.1. you calculate the power distribution in an AM waveform.
7.2. you calculate the bandwidth of an AM signal.
7.3. you calculate the percentage modulation of an AM signal.
7.4. you explain the difference between a side frequency and a side band.

Learning Objectives

7.a. Explain the term percentage modulation
7.b. Explain the relationship between the intelligence frequency and the bandwidth of an AM signal
7.c. Explain the relationship between percent modulation, sideband power, and total power in the AM waveform

8. Apply the frequency modulation (FM) signal expressions to determine spectrum and waveform components.

Criteria

You will know you are successful when

8.1. you draw the FM waveform at various levels of deviation.
8.2. you draw the frequency spectra of an FM waveform.

Learning Objectives

8.a. Draw the FM waveform
8.b. Use the FM equation to determine the spectral components of the FM waveform

9. Determine the relationship between an FM signal and its parameters

Criteria

You will know you are successful when

9.1. you calculate the modulation index.
9.2. you use a Bessel function table to calculate the amplitude of the carrier and sidebands based on the modulation index.
9.3. you use a Bessel function table to calculate the bandwidth of an FM.
9.4. you describe what is meant by a narrowband FM signal.
9.5. you describe what is meant by a wideband FM signal.

Learning Objectives

9.a. Explain the term modulation index
9.b. Explain the relationship between the modulation index, sideband amplitude, carrier amplitude and total power in the FM waveform
9.c. Explain the relationship between the modulation index and the number of significant sidebands
9.d. Define frequency deviation

10. Examine the operation of FM modulators and phase-locked loop (PLL) detectors.

Criteria

You will know you are successful when

10.1. you describe three methods of direct FM generation.
10.2. you describe how phase modulation can be used to generate an FM signal.
10.3. you construct a PLL FM transmitter.
10.4. you construct a VCO FM transmitter.
10.5. you construct a PLL FM detector.
10.6. you explain typical FM receiver specifications.
10.7. you explain typical FM transmitter specifications.

Learning Objectives

10.a. Explain the term direct FM generation
10.b. Explain the term indirect FM generation
10.c. Describe the various methods for FM detection

11. Examine phase modulation (PM) and quadrature amplitude modulation (QAM) signals.

Criteria

You will know you are successful when

11.1. you describe the three common types of PSK systems.
11.2. you draw the block diagram of a 16-QAM transmitter.
11.3. you explain the eye pattern used in troubleshooting digital communications.
11.4. you explain the constellation pattern used in troubleshooting digital communications.
11.5. you list the characteristics of QAM systems.
11.6. you describe the two types of spread-spectrum modulation techniques.

Learning Objectives

11.a. Explain how phase modulation can be used in digital communications systems
11.b. Explain the concept of QAM

12. Analyze the characteristics of digital information and signals.

Criteria

You will know you are successful when

12.1. you describe the four common types of alphanumeric codes.
12.2. you describe the the four types of digital encoding formats.
12.3. you describe the quantization process in a PCM system.
12.4. you explain the operation of a A/D convertor.
12.5. you explain the operation of a D/A convertor.
12.6. you define the term codec.
12.7. you explain the effects of noise on a digital signal.
12.8. you describe the various types of pulse modulated signals.
12.9. you define the Nyquist rate.

Learning Objectives

12.a. Explain the various types of encoding formats
12.b. Explain the common types of alphanumeric codes
12.c. Describe the quantization process in a PCM system
12.d. Provide detail on common schemes used to transmit digital signals

13. Apply basic communication and network protocols.

Criteria

You will know you are successful when

13.1. you explain the term simplex transmission of data.
13.2. you explain the term half-duplex transmission of data.
13.3. you explain the term full-duplex transmission of data.
13.4. you explain the term synchronous transmission of data.
13.5. you explain the term asynchronous transmission of data.
13.6. you define the four major protocol functions.
13.7. you describe the various types of modems used to interface to a network.
13.8. you describe the IP addressing scheme.

Learning Objectives

13.a. Explain what is meant by simplex transmission of data
13.b. Explain what is meant by half-duplex transmission of data
13.c. Explain what is meant by full duplex transmission of data
13.d. Explain what is meant by synchronous transmission of data
13.e. Explain what is meant by asynchronous transmission of data
13.f. Describe the various types of modems used to interface to a network
13.g. Describe the IP addressing scheme