ELEC A224: DIGITAL COMMUNICATION SYSTEMS

Item	Value
Curriculum Committee Approval Date	12/02/2020
Top Code	093430 - Telecommunications Technology
Units	3 Total Units
Hours	90 Total Hours (Lecture Hours 36; Lab Hours 54)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Grading Policy	Standard Letter (S)

Course Description

Communications system is a hands-on overview of the numerous electronic means of communication. This course focuses on wireless communications, serial communication, and networked systems. Students will learn how electrical signals are modulated to carry data across a variety of channels. Communication protocols covered include AM, FM, FSK, FHSS, WIFI, xBee, ZWave, Cellular Networks, GNSS, i2c, UART, RS485, USB, Ethernet/IP, DOCSIS, Fiber, ModBus, CAN, and ControlNet to name a few. Students will use these protocols to establish communication links between devices in the lab. ADVISORY: ELEC A111. Transfer Credit: CSU.

Course Level Student Learning Outcome(s)

1. Students will be able to identify various common communication systems and articulate their applications, strengths, and limitations.
2. Students will be able to establish communications between devices using various protocols.
3. Students will gain proficiency using diagnostic equipment to visualize and analyze communication signals.

Course Objectives

- 1. Use oscilloscopes to visualize signals in the time domain.
- 2. Use spectrum analyzers to visualize signals in the frequency domain.
- 3. Understand the fundamental concepts of modulation, encoding, and waves.
- 4. Differentiate between different forms of electronic communication and articulate applications for each.
- 5. Establish connections between microcontrollers.
- 6. Establish connections between microcontrollers and peripheral devices.
- 7. Establish a Local Area Network and connect client devices.
- 8. Terminate Ethernet cables.
- 9. Establish a WIFI Network and connect client devices.
- 10. Tune into a satellite and visualize the signal using a spectrum analyzer.

Lecture Content

Foundations of Communication Technologies Modulation Encoding Techniques Amplification Mediums Time and Frequency Domains Frequency, Amplitude, Period Technologies AM and FM Radio RADAR Microwave Analysis of waveforms and modulation Digital Communications Short Range Device to Device PWM and PPM Serial UART CAN Bus RS485 Intra-Device i2c SPI Network Communication Protocols DOCSIS LAN and WAN Network Topology Network Addressing Physical Infrastructure HTTP SSH High Bandwidth Protocols Fiber Optic MOCA and DOCSIS Microwave Twisted Pair Copper Wireless Communications Mesh Networks WIFI Point to Point Microwave Satellite Communications GNSS Systems Theory of Operation GPS GLONASS Galileo Uplink/Downlink

Lab Content

Safety and Lab Familiarization Lab Procedures Tools Equipment Supplies Communications Test Equipment Signal/Function Generators Oscilloscopes Spectrum Analyzers Analog Communications Project Students will use a microphone or other source to generate a signal. Students will demonstrate proficiency using diagnostic equipment by capturing the signal in the time and frequency domain. Students will produce a report analyzing the signal Graph of signal in Time Domain Graph of signal in Frequency Domain Digital Project Students will connect two microcontrollers together using different communications protocols in order to pass data between the controllers. Students will connect a sensor to a microcontroller in order to obtain data. Students will demonstrate proficiency using diagnostic equipment LAN Network Project Students learn how to terminate ethernet cable and test the quality of their crimp. Students will establish a small Local Area Network and demonstrate proficiency with addressing by creating a custom IP range for devices on the network. Wireless Project Students will establish a wifi network and connect client devices. The network must implement security and use a non-standard IP range. In conjunction, students will establish a mesh network. Students will demonstrate proficiency using diagnostic equipment by manually managing channels to prevent wireless interference. Satellite Project Students will demonstrate basic understanding of satellite communications by tuning in a satellite with a designator provided by the instructor. Students will demonstrate proficiency using diagnostic equipment to visualize the signal from the satellite in the time and frequency domain.

Method(s) of Instruction

- Lecture (02)
- DE Live Online Lecture (02S)
- DE Online Lecture (02X)
- Lab (04)
- DE Live Online Lab (04S)
- DE Online Lab (04X)

Instructional Techniques

Lecture Detailed whiteboard lectures with opportunity for student engagement. Independent in-class problem solving assignments with immediate review. Group based in-class problem solving assignments with immediate review. In-class review of previously assigned homework. Discussion of media provided and assigned via LMS. Review of material prior to exams. Lab Students complete projects individually and as groups. Lab projects reinforce lecture topics and are paced to coincide or lag the lecture content. Lab projects generate content that students use

to generate reports and documentation, enhancing writing and critical thinking skills.

Reading Assignments

Provided via LMS.

Writing Assignments

Keep a journal of chronological notes taken during research, lecture, and laboratory experience. Author a technical report for each project written to industry standards for technical reports.

Out-of-class Assignments

Students will spend approximately 5 hours per week on out-of-class assignments, including: Researching topics as assigned. Researching and reading technical documents prior to laboratory projects. Completing technical reports after each project. Maintaining a portfolio of projects throughout the semester.

Demonstration of Critical Thinking

Students use communications protocols in the lab to establish connections between devices. Students work individually and in groups to solve challenges presented in a project based form. Quizzes administered at the end of each topic to demonstrate mastery of the specific objective. Midterm and final exam administered to test ability to retain problem solving skills.

Required Writing, Problem Solving, Skills Demonstration

Exercises Group and individual Projects Quizzes Midterm Exam Final Exam Keep a journal of chronological notes taken during: a) research b) lecture c) laboratory experience. Maintain a portfolio of technical reports, research and class notes. Submit technical reports for lab projects containing results and analysis.

Eligible Disciplines

Electricity (electrical power distribution): Any bachelors degree and two years of professional experience, or any associate degree and six years of professional experience. Electromechanical technology (industrial mechanical technology): Any bachelors degree and two years of professional experience, or any associate degree and six years of professional experience. Engineering technology: Masters degree in any field of engineering technology or engineering OR bachelors degree in either of the above AND masters degree in physics, mathematics, computer science, biological science, or chemistry, OR bachelors degree in industrial technology, engineering technology or engineering AND a professional engineers license OR the equivalent. Masters degree required.

Other Resources

1. Instructor created handouts provided via LMS.