EET-2231: WIRED AND WIRELESS COMMUNICATION

Cuyahoga Community College

Viewing: EET-2231 : Wired and Wireless Communication

Board of Trustees:
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Academic Term:
Fall 2024

Subject Code
EET - Electrical/Electronic Engineer

Course Number:
2231

Title:
Wired and Wireless Communication

Catalog Description:
Final course in electronic communications series. Provides an in-depth study of fiber optic, microwave, broadband, wired ,and cellular communication systems.

Credit Hour(s):
3

Lecture Hour(s):
2

Lab Hour(s):
2

Requisites

Prerequisite and Corequisite
EET-2131 Digital Communication Fundamentals.

Outcomes

Course Outcome(s):
Demonstrate in lab experiments by using instrumentation the principles of Radio Frequency (RF) transmission to measure power, frequency and spectral components.

Objective(s):

1. Use a point source LED (Light Emitting Diode) and a photo transistor to plot the luminous flux in the X and Z planes noting that light is a form of radio wave.
2. Measure and determine fault distance by analyzing reflections in a transmission line.
3. Calculate losses and frequency response characteristics of transmission lines as used in the radio frequency environment.
4. Demonstrate using instrumentation the effects on the frequency response on a transmission line with a proper termination and demonstrated channel or band suck out if improperly terminated.
5. Explain the production of radio frequency (RF) waves by energetic electrons, the associated electrostatic and electromagnetic fields and photons.
6. Use a frequency counter and show that a transmitter is on its assigned frequency.
7. Use an RF power meter or measure the carrier's spectral component to determine the power level in watts and in dBm (decibel relative to 1 milliwatt).
8. Use a spectrum analyzer and determine the power level of the carrier (if present) and the sidebands that associate with the modulation signal.
9. Demonstrate the use and characteristics of radio frequency filters and explain the Federal Communication Commission's (FCC) frequency allocation chart.
10. Explain fading, its causes and its relationship to frequency bands.

11. Discuss and explain antennas, antenna gain, equivalent circuit and propagation characteristics.
12. 12. Use the microwave trainer to measure and plot the radiation pattern of the antenna.

Course Outcome(s):

Show the results of the demodulation process, that is, the intelligence signal, using instrumentation.

Objective(s):

1. Use an eye window to display the effect of bit errors.
2. Explain and compare digital modulation schemes including power per bit and noise immunity.
3. Demonstrate by using instrumentation the detection of amplitude modulated signals.
4. Demonstrate by using instrumentation the detection of frequency modulated signals.
5. Demonstrate using instrumentation various detection methods for digital signals
6. Compare direct detection and superheterodyne receiver design and include pros and cons.

Course Outcome(s):

Demonstrate the operation principles of cellular technology by using mathematics and the results from lab experiments.

Objective(s):

1. Use combinational logic to despread a code division multiplexed signal
2. Use mathematics to demonstrate the meaning of autocorrelation of a code division multiplexed signal.
3. Use mathematics to demonstrate cross correlation of a code division multiplexed signal.
4. Describe how 63 cellular calls can exist in one channel without crosstalk.
5. Explain the difference (pro and cons) of soft and hard handoffs.
6. Explain why spread spectrum technology is highly immune to jamming (frequency hopping and code division multiplexing).
7. Explain spread spectrum technology using frequency hopping and code division multiplexing.
8. Research and write a report on the difference between Time Division Duplexing (TDD) as used in wireless telephones versus time division multiplexing (TDM).

Course Outcome(s):

Demonstrate through in-lab experiments the principles of broadband fiber-based communications systems and maintenance.

Objective(s):

1. Measure the loss in a fiber optic cable and explain the underlying reasons.
2. Explain the difference between photo diodes and avalanche photo diodes (APD), specifically, what are their pros and cons.
3. Explain why chromatic dispersion in a fiber optic cable and why it contributes to the dispersion of a rectangular pulse with time.
4. Use the distance traveled by light rays in a multimode cable to construct a model showing why rectangular pulses are dispersed in time.
5. Demonstrate how a technician can determine if a fiber patch cable is single mode or multimode and explain the differences in propagation.
6. Construct a fiber-base loss budget given launch power with tolerances and the allowable receive power levels.
7. Identify and name the common types of fiber connectors.
8. Use an optical trainer and scope to demonstrate the eye pattern and adjust the data rate until the eye closes. Explain how this relates to bit errors.
9. Clean the end of a fiber optic patch cable using a fiber optic connector cleaner and clean the optical emitter and detector using dry air.
10. Explain safety issues when working with laser emitters and proper methods to eliminate the possibility of handling hot fibers in patch cables or on connector racks.
11. Explain concepts of numerical index, Snell's law, cone of acceptance, reflection, refraction and bend radius.

Course Outcome(s):

Demonstrate the principles of microwave communications systems using instrumentation in lab experiments.

Objective(s):

1. Delineate and explain the categories of spectrum from direct current to gamma rays and the effects of ionizing radiation on human tissue
2. Explain microwave's heating effect of the human body and how relatively small power levels can be dangerous
3. Measure the output power and frequency of a microwave transmitter
4. Explain the significance Fresnel zone and line-of-sight transmission and it's effect on microwave reception. Use satellite-based TV with antennas directed through tree for the example.
5. Adapt the concepts of superheterodyne receiver design to microwave receives and mathematically demonstrate the effect of high side versus low side injection on the polarity of the baseband signal
6. Using a spectrum analyzer, display, measure and explain the microwave transmitter's spectrum with different modulation schemes
7. Demonstrate by measuring microwave receive power level the effects of polarization and be able to explain these effects using Polaroid glasses for an example

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Course Outcome(s):

Demonstrate the proper installation of broadband wired communications networks and explain key concepts.

Objective(s):

1. Terminate a coaxial cable with a Bayonet Neill-Concelman (BNC) connector and explain the difference between 50 ohm and 75 ohm connectors.
2. Terminate an "F" connector.
3. Use instrumentation to measure the velocity of propagation in a coaxial or twisted pair cable and compared measure data to published data.
4. Use circuit simulation software to prove by an analysis plot the benefit(s) of balanced transmissions systems versus unbalanced systems regarding common mode interference.
5. Demonstrate connectorizing a category X cable and explain the effects of distance, pair twist per inch, near and far end crosstalk, and the effect of nearby metal relating to its transmission line characteristics.
6. Terminate a category X Ethernet cable.

Course Outcome(s):

Demonstrate by written and oral reports the possibilities facing mankind by emerging technologies, based upon digital communications, that are not yet discovered or implemented. In addition to completely new technologies, use rate of technological change to predict the future possibilities.

Objective(s):

1. Write a report explaining solitons.
2. Write a report based upon EET formal lab report criteria (located in EET Student Handbook): Predict possible products/services that use the internet that include wireless device-to-internet connectivity. Explain groups of people that will benefit from this emerging technology and the groups of people that will suffer. "Groups of people" are to include those segregated economically, racially, by ethnicity, etc. Include possible impact on under developed and developed countries or
3. Write a report based upon EET formal lab report criteria (located in EET Student Handbook): Predict possible products/services that use cellular technology. Explain if any groups of people will benefit from this emerging technology and if any groups will suffer. "Groups of people" are to include those segregated economically, racially, by ethnicity, etc. Include possible impact on under developed and developed countries or
4. Write a report based upon EET formal lab report criteria (located in EET Student Handbook): Predict possible products/services that use wireless technology that include video surveillance locally (street corners, etc.), by satellite and by drones and others methods. Explain if any groups of people will benefit from this emerging technology and if any groups will suffer. "Groups of people" are to include those segregated economically, racially, by ethnicity, etc. Include possible impact on under developed and developed countries or
5. Write a report based upon EET formal lab report criteria (located in EET Student Handbook): Predict possible products/services that use wireless technology that include Radio Frequency Identification (RFID). Explain if any groups of people will benefit from this emerging technology and if any groups will suffer. "Groups of people" are to include those segregated economically, racially, by ethnicity, etc. Include possible impact on under developed and developed countries or
6. Prepare and present an oral report from your prospective concerning 1). The growth in communications technology on first, second and third world countries. Address the pros and cons of the Internet of Things (IoT) and, 2) The civic responsibilities of technicians, engineers and company managers to use technology in a manner that is in accord with the greater good of human kind. The report must include PowerPoint slides.

Methods of Evaluation:

1. Tests
2. Quizzes
3. Laboratory Assignments/Reports
4. Homework
5. Projects

Course Content Outline:

1. Concepts
   a. Production of Radio Frequency (RF) waves
   b. Properties of RF
   c. Modulation schemes
   d. Bit Errors
   e. Instrumentation to measure the frequency of RF
   f. Instrumentation to measure the power of RF
   g. Instrumentation to measure harmonics and other undesirable components of RF
   h. Frequency allocation
   i. Fading
   j. Antenna gain
   k. Antenna radiation pattern
   l. Smith chart
   m. Microwaves
   n. Light as an extension of RF
   o. Transmission lines
   p. Losses in transmission lines
   q. Terminations
   r. Connectors: BNC, F, N, others
   s. Superheterodyne and direct detection
   t. Cellular
   u. Handoff methods
   v. Generation of light for fiber optic (FO) systems
   w. Single mode FO
   x. Multimode FO
   y. Dispersion
   z. FO connectors
   aa. FO patch cables
   bb. FO loss budget
   cc. FO safety issues
   dd. FO cleaning
   ee. Solitons
   ff. Spectrum
   gg. Microwaves
2. SKills
   a. Spreading a digital signal
   b. Despreading a digital signal
   c. Spreading codes and correlation
   d. Detecting amplitude modulated signals
   e. Detecting of angle modulated signals
   f. Detecting of code division modulated signals
   g. Detecting of other digital signals using different modulation schemes
   h. Measuring the frequency of RF
   i. Measuring the power of RF
   j. Measuring harmonics and other undesirable components of RF
   k. Determining power level in watts and dBm
3. Issues

a. Microwave safety issues
b. Safety issues when working with laser emitters

Resources

Bejarano, Oscar. *Wireless: A Total Beginner's Guide to Modern Wireless Communication Technologies*. 1st ed. Bitflip Media, 2023.

Molisch, Andreas F. *Wireless Communications: From Fundamentals to Beyond 5G*. 3rd ed. Wiley-IEEE Press, 2022.

Raghunandan, Krishnamurthy . *Introduction to Wireless Communications and Networks: A Practical Perspective*. 1st ed,. Springer, 2022.

Sachan, V.K. *Wireless Communications: Principles, Designs and Applications*. 1st ed. Independent, 2020.

Sobot, Robert. *Wireless Communication Electronics by Example* . 2nd ed. Springer, 2022.

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