ECE4606 Course Syllabus

ECE4606

Wireless Communications (3-0-0-3)

CMPE Degree

This course is Elective for the CMPE degree.

EE Degree

This course is Elective for the EE degree.

Lab Hours

0 supervised lab hours and 0 unsupervised lab hours

Course Coordinator

Weitnauer,Mary Ann

Prerequisites

(ECE 2025/2026 [min C]) and (ECE 3020 [min C] or ECE 3040 [min C] or ECE 3084 [min C]) and (CEE/ISYE/MATH 3770 or ISYE 2027 or ECE 3077)

Corequisites

None

Catalog Description

Cellular concept, wireless propagation modeling, types of digital modulation used in wireless systems, diversity combining, performance over fading channels, and multiple access techniques.

Textbook(s)

Zarrinkoub, *Understanding the LTE with MATLAB: From Mathematical Modeling to Simulation and Prototyping*, Wiley & Sons, Ltd., 2014. (required) (comment: Available as an ebook through the GT Library)

Course Outcomes

Upon successful completion of this course, students should be able to:

1. Perform basic link budget analysis.
2. Classify types of channel fading.
3. Analyze flat fading channel effects with spatial diversity combining.
4. Explain the benefits and disadvantages of a minimum shift keying (MSK) signal and how it is modulated and demodulated.
5. Calculate the average power of a signal from its Power Spectral Density.
6. Explain the differences between path loss, multipath fading and shadowing.
7. Estimate the bit error rate of an AWGN link, given the signal space representation of the waveform and the noise spectral height.
8. Estimate the loss from knife edge diffraction.
9. Analyze Orthogonal Frequency Division Multiplexing (OFDM) signals.
10. Analyze the basic Multiple-input-multiple-output (MIMO) configurations for flat-fading channels.

11. Compute the blocking probability, number of channels, or traffic for a Blocked Calls Cleared trunked system.
12. Classify type of multiple access technique.
13. Explain the major distinctions between the current wireless standards.

Student Outcomes

In the parentheses for each Student Outcome:
"P" for primary indicates the outcome is a major focus of the entire course.
“M” for moderate indicates the outcome is the focus of at least one component of the course, but not majority of course material.
“LN” for “little to none” indicates that the course does not contribute significantly to this outcome.

1. (P) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. (LN) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. (LN) An ability to communicate effectively with a range of audiences
4. (LN) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. (LN) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. (LN) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. (M) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Topical Outline

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Quick Overview of Wireless System Design Challenges
Path Loss (free space, two-ray, reference power)
Short review of random variables, including Small-scale Fading Dist
Multipath Fading
Coherence Bandwidth
Power spectral density basics
Coherence time
Diversity
Diffraction
Shadowing
Link Budget
Basic parts of a Digital Transmission Link with BPSK
Effects of noise in a BPSK receiver
Geometry of Signals
Power Spectral Density for Linear Modulation
Nyquist Pulses
Matched Filter
Other Linear Techniques
Frequency Shift Keying
MSK Viewed as OQPSK
Orthogonal Frequency Division Multiplexing (OFDM)
Forward error correction (FEC)
Multiple-input-multiple-output (MIMO)
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Overview of Prevalent standards
Trunking Theory, cellular concept
DSSS and RAKE Receivers
Multiple Access Techniques