ELEC1200 A System View of Communications: From Signals to Packets Fall 2023 Credits: 4

## Course Description

Have you ever wondered what technologies go into your mobile phone or a WiFi hotspot? Through hands on work with a simple but fully functional wireless communication system, you will understand the basic engineering tools used and tradeoffs encountered in the design of these systems. This course is centered on weekly laboratories, each designed to introduce an important concept in the design of these systems. The lab sessions are supported by two one-hour lectures and a tutorial that introduce the concepts for the next laboratory, as well as reviewing and expanding the concepts learned in the previous laboratory.

## List of Topics

### Lecture Outline

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| Week 1 | Course Introduction |
| Week 2 | Signals; Real World Channels |
| Week 3 | Linear Time Invariant Systems; Transmitting Data |
| Week 4 | Channel Equalization; Noise |
| Week 5 | Noise |
| Week 6 | Noise; Error Correcting Codes |
| Week 7 | Error Correcting Codes; The Frequency Domain |
| Week 8 | Midterm exam |
| Week 9 | Filter and Frequency Response; Time-Frequency Analysis/Source Coding |
| Week 10 | Signal Transmission – Multiplexing; De-multiplexing |
| Week 11 | Introduction to Networks; Link Layer |
| Week 12 | Network, Transport & Application Layers |
| Week 13 | Course review |

### Laboratory Outline

1. Introduction to MATLAB
2. Characterizing and Modeling an IR Channel
3. Communication Protocol and Bit Error Rate
4. Eye Diagram and Equalization
5. SNR and Bit Error Rate
6. Time-Frequency Analysis of Signals
7. Signal transmission using Frequency Division Multiplexing

Intended Learning Outcomes:

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| CO1: | Examine a voice communication system to identify the practical context of key theoretical concepts in ECE. |
| CO2: | Identify typical problems and tradeoffs encountered in electronic and computer engineering systems. |
| CO3: | Analyze simple approaches to address a range of problems and tradeoffs. |
| CO4: | Use software tools, such as MATLAB, to investigate potential solutions to problems and tradeoffs in order to validate an analysis, and to handle cases not amenable to simple analysis. |
| CO5: | Work in a cooperative setting on real hardware where the simplifying assumptions used in theoretical analysis may be violated, and assess the benefits and limitations of such analysis. |

**Textbook(s):**

N/A

Reference Book(s)/Materials:

(F) Frenzel, Louis E, "Principles of electronic communication systems." 5th Edition, McGraw-Hill, 2023 (ebook).

(OWN) Alan V. Oppenheim, Alan S. Willsky and S. H. Nawab, Signals and Systems, 2nd Ed., Prentice Hall, 1997

**Relationship of Course to Program Outcomes:**

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| PO1 | An ability to apply knowledge of mathematics, science and Electronic and Computer Engineering. (CO1, CO2, CO3, CO4) |
| PO2 | An ability to design and conduct experiments, as well as to analyze and interpret data. (CO5) |
| PO3 | An ability to design efficient and economical Electronic and Computer Engineering systems, components or process subject to practical constraints. |
| PO4 | An ability to function in a multi-disciplinary environment through teamwork. |
| PO5 | An ability to identify, formulate and solve Electronic and Computer Engineering problems. (CO1, CO2, CO3, CO4) |

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| PO6 | An ability to understand professional practices and ethical responsibilities. |
| PO7 | An ability to communicate effectively. |
| PO8 | An ability to understand contemporary global, regional, economic, environmental, and social issues, and the corresponding role and the impact of Electronic and Computer engineers. |
| PO9 | An ability to recognize the need for, and to engage in life-long learning. |
| PO10 | An ability to use current techniques, skills and engineering tools necessary for solving Electronic and Computer Engineering problems. (CO4) |
| PO11 | An ability to use the computer/IT tools relevant to the Electronic and Computer Engineering along with an understanding of their processes and limitations. (CO4, CO5) |

Grading Scheme:

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| Lab | 25% |
| Homework | 10% |
| Midterm Exam | 25% |
| Final Exam | 40% |