EC525- Information Theory and Coding

CREDIT HOURS

3 Hours

CONTACT HOURS (Hours/week)

Lecture: 2; Tutorial: 2

COURSE COORDINATOR

Dr. Ashraf Mamdouh

TEXT BOOK

T. M. Cover, "Elements of Information Theory", 2nd Ed, Wiley-Interscience, 2nd edition

COURSE DESCRIPTION

Review of probability theory - Concept of information theory and coding - Average information & Entropy – Mutual information - Channel capacity - Bandwidth and S/N of a channel - Source Coding - Channel Coding Theorem - Linear block codes - Convolutional codes - Viterbi decoding - Turbo Codes - Iterative decoding - Performance of different coded modulation in AWGN channels.

PREREQUISITE:

EC 523

RELATION OF COURSE TO PROGRAM

Required

COURSE INSTRUCTION OUTCOMES

The student will be able to:

- Understand the key modules of digital communication system.
- Understand the meaning of entropy, Self and mutual Information.
- Understand and practice the design of source encoding and decoding.
- Understand and practice the design of the channel encoding and decoding.

TOPICS COVERED

- Review of probability theory - Concept of information theory and coding
- Average information & Entropy – Joint Entropy and Conditional Entropy –Self and Mutual information
- Channel capacity - Time rate of information - Capacity of the Binary Symmetric Channel - More Examples on capacity of Discrete channels.
- Continuous channels - Entropy of continuous sources - Entropy maximization - Gaussian sources - Shannon's formula for capacity.
- Bandwidth and S/N of a channel -- Shannon- Hartely theorem of the capacity of AWGN channels.

- Source Coding: Universal Codes and Arithmetic Coding - Lossy and Lossless coding - Run Length Coding (RLC).
- Variable Length Coding- Huffman coding.
- Channel Coding Theorem: Preview, Definitions, and Jointly typical sequences.
- Linear block codes (Definition of subspace –Standard array- Generator matrix – parity check matrix- systematic form of codes - Hamming distance – etc..) – Syndrom decoding. Maximum likelihood decoding.
- Hamming codes and Cyclic codes. Binary Galois Fields. Maximum-length codes – BCH codes.
- Convolutional codes- State diagram-Terrllis diagram.
- Viterbi decoding
- MAP decoding of Convolutional Codes.
- Turbo Codes. Iterative decoding.
- Performance of different coded modulation in AWGN channels.

CONTRIBUTION OF COURSE TO MEET THE REQUIREMENTS OF CRITERION 5:

Professional component Content			
Math and Basic Sciences	**Engineering Topics**	**General Education**	**Other**
	✓		

RELATIONSHIP OF COURSE TO STUDENT OUTCOMES:

Student Outcomes		Course aspects
A	An ability to apply knowledge of mathematics, science, and engineering	a_1 a_2
B	An ability to design and conduct experiments, analyze and interpret data.	
C	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economics, environmental, social, political, ethical, health, and safety, manufacturability, and sustainability	c_3
D	An ability to function on multi-disciplinary teams.	
E	An ability to identify, formulate, and solve engineering problems	e_3
F	An understanding of professional and ethical responsibility	
G	An ability to communicate effectively	
H	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social content	
I	A recognition of the need for, and an ability to engage in life-long learning.	
J	A knowledge of contemporary issues within and outside the electrical engineering profession.	
k	An ability to use the techniques, skills, and modern engineering tools necessary for electrical engineering practice.	