Jordan University of Science and Technology

Faculty of Engineering

Electrical Engineering Department

EE551 Digital Communications - JNQF Level: 7

First Semester 2024-2025

Course Catalog
3 Credit Hours. Digital modulation schemes: signal space representation, baseband and bandpass representation of digitally modulated signals, power spectra of digitally-modulated signals. Optimum receivers for AWGN channels: Detection principles for digital communication signals in noise, correlation and matched filter receivers, maximum a posteriori receivers, maximum likelihood receivers, coherent and non-coherent detection, bit error rate analysis. Baseband and bandpass transmission through band-limited channels: Nyquist's criterion and ISI analysis, system design in the presence of channel distortion and channel equalization. Introduction to information theory and source coding. Introduction to error control coding.
Teaching Method: On Campus

Text Book	
Title	Fundamentals of Communication Systems
Author(s)	Proakis J. and Salehi M.
Edition	2nd Edition
Short Name	Textbook
Other Information	

Course References

Short name	Book name	Author(s)	Edition	Other Information
Reference-1	Digital Communications: Fundamentals and Applications	Sklar B.	2nd Edition	
Reference-2	Communication Systems	Haykin S.	2nd Edition	
Reference-3	Digital Communications	Chitode J. S.	1st Edition	

Reference-4	Modern Digital and Analog Communication Systems	Lathi B. P. and Zhi Ding	4th Edition	
Reference-5	Error Correction Coding: Mathematical Methods and Algorithms	Moon Todd K.	1st Edition	

Instructor	
Name	**Dr. Ibrahim Ghareeb**
Office Location	E1L3
Office Hours	
Email	ghareeb@just.edu.jo

Class Schedule & Room

Section 1:
Lecture Time: Sun, Tue, Thu : 08:30 - 09:30
Room: E2011

Tentative List of Topics Covered

Weeks	Topic	References
Weeks 1, 2, 3, 4, 5, 6	Digital Passband and BandpassTransmission Through AWGN Channel: Digital modulation schemes (ASK, PSK, DPSK, QAM, FSK): signal space representation, baseband and bandpass representation of digitally modulated signals. Optimum receivers for AWGN channels: Detection principles for digital communication signals in noise, correlation and matched filter receivers, signal space concepts, maximum a posteriori receivers, maximum likelihood receivers, coherent and non-coherent detection, bit error rate analysis.	**Chapter 8&9** From **Textbook**
Weeks 7, 8, 9	Digital Transmission Through Bandlimited AWGN Channels: Power spectra of digitally modulated signals. Signal design of bandlimited channels for zero ISI-the Nyquist criterion and controlled ISI-partial response signals. System design in the presence of channel distortion, optimum transmitting and receiving filters and Channel Equalization, ISI analysis.	**Chapter 10** From **Textbook**
Weeks 10, 11, 12	Introduction to Information Theory and Source coding: Modeling of information sources, measure of information, joint and conditional entropy, mutual and average mutual information, source coding theorem, source coding algorithms.	**Chapter 12** From **Textbook**
Weeks 13, 14, 15	Introduction Error Control coding: Linear block codes, decoding and performance of linear block codes, cyclic codes, the structure of cyclic codes, decoding and performance of cyclic codes, convolutional codes.	**Chapter 13** From **Textbook**

Mapping of Course Outcomes to Program Outcomes and NQF Outcomes	Course Outcome Weight (Out of 100%)	Assessment method

The ability to identify different techniques in digital communications, in particular in information theory and source coding, modulation and detection over AWGN channel with baseband and bandpass transmission, transmission in bandlimited channel, and the basic principles of error-control coding techniques and use them in block-diagram level design of communication systems. [1SO1] [1L7K1]	40%	
Describe and motivate the fact that the implementation and development of digital communication technology requires mathematical modeling and problem solving. [1SO1] [1L7S1]	10%	
Apply mathematical modeling to problems in communication systems, and explain how this is used to analyze and synthesize methods and algorithms within the field. [1SO1] [1L7S2]	10%	
Use the knowledge of statistical theory and evaluate the performance of digital communication system in the presence of additive noise and inter-symbol interference. [1SO1] [1L7S3]	20%	
Apply and use the basic tenets of information theory as pertaining to communications, and perform basic calculations of relevant properties [1SO2] [1L7C4]	10%	
Identify and describe different techniques in digital communications, compare different techniques and judge the applicability of different techniques in different situations. Formulate mathematical models which are applicable and relevant in the case of a given problem. When explicit assumptions are missing, the student should be able to judge and compare different possibilities and make own relevant assumptions. Use a mathematical model to solve a given demanding engineering problem in the field, and analyze the result and its validity [1SO2] [1L7C4]	10%	

Relationship to Program Student Outcomes (Out of 100%)						
SO1	SO2	SO3	SO4	SO5	SO6	SO7
80	20					

Relationship to NQF Outcomes (Out of 100%)				
L7K1	L7S1	L7S2	L7S3	L7C4
40	10	10	20	20

Evaluation	
Assessment Tool	**Weight**
First Exam	25%
Second Exam	25%
Participation	10%
Final Exam	40%

Policy

Prerequisites:	Prerequisites by topic: signal and system analysis, probability; random variables and stochastic processes, communication systems. Prerequisites by course: EE 260, EE 360, EE 450
Intended learning outcomes:	The student is required to show the following skills to pass the course: -Identify and describe different techniques in modern digital communications, in particular in source coding, modulation and detection, carrier modulation, and channel coding. -Develop simple software, for example using Matlab, and use this software to simulate and analyze problems within the field, as well as report the development and results. -Describe and motivate the fact that the implementation and development of modern communication technology requires mathematical modeling and problem solving. -Apply mathematical modeling to problems in digital communications, and explain how this is used to analyze and synthesize methods and algorithms within the field. -Formulate a mathematical model which is applicable and relevant in the case of a given problem. -Use a mathematical model to solve a given engineering problem in the field, and analyze the result and its validity To acquire a higher grade, the student is in addition required to show the following skills: -Identify and describe different techniques in modern digital communications, compare different techniques and judge the applicability of different techniques in different situations. -Formulate mathematical models which are applicable and relevant in the case of a given problem. When explicit assumptions are missing, the student should be able to judge and compare different possibilities and make own relevant assumptions. -Use a mathematical model to solve a given demanding engineering problem in the field, and analyze the result and its validity.

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