Jordan University of Science and Technology

Faculty of Engineering

Electrical Engineering Department

EE751 Digital Data Transmission - JNQF Level: 9

Second Semester 2022-2023

Course Catalog
3 Credit Hours. Elements of communication systems and information theory applied to digital communication systems. Characterization of noise and channel models. Characterization of communication signals and systems, representation of digitally modulated signals and spectral characteristics. Optimum receivers for AWGN channels: evaluation of error rate performance and channel bandwidth requirements. Design of multichannel systems with nonlinear channels and additive noise. Channel capacity and coding theorem.

Text Book	
Title	Digital Communications
Author(s)	J. Proakis and M. Salehi
Edition	5th Edition
Short Name	Required Textbook
Other Information	New York: McGraw-Hill, 2008.

Course References

Short name	Book name	Author(s)	Edition	Other Information
Ref. 1`	Digital transmission Techniques Signal Design and Detection	M. Simon, S. Hinedi and W. Lindsey	1st Edition	Prentice Hall, 1995
Ref. 2	Modern Digital and Analog Communication Systems	B.P. Lathi and Z. Ding	4th Edition	2010
Ref. 3	Digital Communications: Fundamentals & Applications	B. Sklar	2nd Edition	Pearson Education, 2001.
Ref. 4	Principles of Communication Engineering	J. Wozencraft and I. Jacobs	1st Edition	Wiley , 1965.
Ref. 5	Digital transmission theory	S. Benedetto, E. Biglieri and V. Castellani	1st Edition	Prentice-Hall, 1987.

Ref. 6	Principles of Digital Communication and Coding	A. Viterbi and J. Omura	1st Edition	McGraw-Hill, 1979.

Instructor	
Name	**Dr. Ibrahim Ghareeb**
Office Location	E1L3
Office Hours	Sun : 08:00 - 08:30 Sun : 11:00 - 12:30 Tue : 08:00 - 08:30 Tue : 11:00 - 12:30 Wed : 08:00 - 09:00 Thu : 08:00 - 08:30 Thu : 11:00 - 12:30
Email	ghareeb@just.edu.jo

Class Schedule & Room
Section 1: Lecture Time: Sun, Tue, Thu : 09:30 - 10:30 Room: LAB

Tentative List of Topics Covered		
Weeks	**Topic**	**References**
Weeks 1, 2, 3, 4, 5	Characterization of Digital Communication Signals and Systems: Representation of bandpass signals and systems, Signal space representation, Representation of digitally modulated signals; memoryless modulation methods, linear modulation with memory, non-linear modulation with memory, Spectral characterization of digitally modulated signals; power spectra of linear modulated signals, power spectra of non-linear modulated signals, power spectra of modulated signals with memory.	From **Required Textbook**
Weeks 6, 7, 8, 9, 10	Optimum Receivers for Additive Gaussian Noise Channel: Correlation demodulator, matched filter demodulator, the optimum detector, the maximum likelihood sequence detector, a symbol by symbol MAP detector for signals with memory. Performance of optimum receiver for memoryless modulation, the probability of error analysis. Performance of optimum receiver for modulation with memory. Performance of signals with random phase (nocoherent detection), the optimum receiver, the probability of error analysis.	**+ Lecture Notes.** From **Required Textbook**
Weeks 11, 12, 13	Multichannel Digital Communication Systems: multipath and channel parameters for nondispersive channels, the concept of diversity, forms of diversity and diversity combining methods, Optimum Receivers for multipath Additive Gaussian Noise Channels, probability of error analysis for coherent and noncoherent modulations.	**+ Lecture Notes.** From **Required Textbook**
Weeks 14, 15	Information theory, Channel capacity and coding theorem, Block and convolutional codes.	**+ Lecture Notes.** From **Required Textbook**

Week 16	Spread spectrum communications, Direct sequence spread spectrum digital communication systems, Frequency hopped spread spectrum digital communication systems. Class	**+ Lecture Notes.** From **Required Textbook**

Mapping of Course Outcomes to Program Outcomes and NQF Outcomes	**Course Outcome Weight (Out of 100%)**	**Assessment method**
Justify the fact that the implementation and the development of modern communication technology require mathematical modelling and problem solving, such as the knowledge to analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency and perform the time and frequency domain analysis of the signals in a digital communication system. [1ABET1] [1L9K1]	20%	
Describe and analyze the generation and reception of communication signals. Explain basic principles and theoretical concepts behind different technologies in modern digital communications, especially in modulation and detection, channel modeling, carrier modulation, channel coding and error protection. [1ABET1] [1L9K2]	20%	
Formulate a mathematical model that is applicable and relevant for a given problem in the area and use a given or individually formulated mathematical model for solving a given technical problem in the area and analyze the result and its reasonableness. [1ABET1] [1L9S1]	20%	
Analyze the error performance of digital communication techniques and problem solving regarding the bandwidth and power requirements for digital systems. Compare different technologies in modern digital communication techniques, contrast different technologies against one another and assess the suitability of individual technologies in different situations [1ABET2] [1L9S2]	20%	
Designing optimum receiver for digital modulation techniques in a single and multi channel transmission and reception. [1ABET2] [1L9C1]	20%	

Relationship to Program Student Outcomes (Out of 100%)						
ABET1	ABET2	ABET3	ABET4	ABET5	ABET6	ABET7
60	40					

Relationship to NQF Outcomes (Out of 100%)				
L9K1	L9K2	L9S1	L9S2	L9C1
20	20	20	20	20

Policy

Class Project:	Students taking the course for graduate credit are required to complete a project on a topic related to digital communications. The primary intent of the project is to expand the learning beyond the material presented in class in a focused area. Students are strongly encouraged to select projects based on their own research/learning interests. Projects must have a simulation/analysis element and purely literature surveys are not acceptable. Team projects are preferred over individual projects and you may work in groups of up to 2 students. Each group is expected to share their work with the class in a brief seminar and turn in a report. Grading will be based on the project report, presentation, implementation demonstration, and in-class participation during presentations. Project Topic: The project is your opportunity to explore an area of Digital Communications for deeper exploration. It is your job to identify an area that interests you and enough of your peers (in order to form a project team). For this purpose, you may find it helpful to read articles published in IEEE Communications Magazine and IEEE Wireless Communications Magazine. These provide tutorial/review articles covering the significant developments in the field. You may also wish to consult recent issues of IEEE Transactions in the Communications and Wireless Communications areas for ideas. By the project proposal deadline you should have your topic identified and one/two key journal paper references on which you will base your work. These should be included along with your proposal. NOTE: Conference papers will not be acceptable as primary references for your project. Each of student is required to submit an 1-page proposal outlining the project (with some key references), a project report (of about 8-10 pages) and to provide an oral presentation (no more than 20 minutes) at the end of the semester.

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