COURSE DESCRIPTIONS

Faculty	Faculty of Engineering				
Department	Communication and Computer Engineering			**NQF level**	7
Course Title	Digital Communication	**Code**	**701452**	**Prerequisite**	**701451**
Credit Hours	3	**Theory**	3	**Practical**	0
Course Leader	Prof. Dr. Igried Khawaldeh	**email**	igried.a@jadara.edu.jo		
Lecturers	Dr. Amer Al-Canaan	**emails**	a.alcanaan@jadara.edu.jo		
Lecture time	13:00_14:30 (Sunday-Wednesday)	**Classroom**	D 310		
Semester	First 2022/2023	**Production**	2017	**Updated**	October 2022

Short Description
▪ This course is an introduction to the basic principles of digital communication systems. The topics in this course include the mathematical foundation of decomposing the systems into separately designed source encoding (such as PAM, ASK, FSK, QPSK, QAM, BPSK, and BFSK) and channel encoding (for error detection/correction). We also introduce the principles and some commonly used algorithms to convert continuous-time waveforms into bits, and vice versa. We give a comprehensive introduction to the basics of information theory, a rather basic treatment of Fourier transforms and the sampling theorem.
Course Objectives
▪ An ability to convert analog signals to digital signals (sampling, quantization, and encoding) and study the different encoding techniques (PCM, DM, D-EM, DPCM). ▪ An ability to analyze the effect of noise and inter-symbol interference on data transmission and the techniques to minimize them (matched filter, correlation receiver, and maximum likelihood decoder, and equalizers). ▪ An ability to compute the bandwidth and the probability of error for different digital modulation techniques (ASK, FSK, PSK, QPSK, QAM) assuming AWGN. ▪ An ability to evaluate, compare the performance of different communication systems according to transmission bandwidth, transmitted power (noise performance) and system complexity.

Learning Outcomes
A. Knowledge - Theoretical Understanding
a1. **Understand** the building block diagram of digital communication system. Digital Signals mathematically and understand how to perform mathematical operations to convert analogue signals to digital signals. (K1)
B. Knowledge - Practical Application
a2. **Understand** different encoding techniques including PCM, DM, D-EM and DPCM. (K2)

C. Skills - Generic Problem Solving and Analytical Skills
b1. **Analyse** communication signals mathematically and **calculate** the effect of noise and Inter-Symbol Interference (ISI) on data transmission and the techniques to minimise them (matched filter, correlation receiver, and maximum likelihood decoder, and equalizers). (S1)
D. Skills - Communication, ICT, and Numeracy
E. Competence: Autonomy, Responsibility, and Context
Teaching and Learning Methods
• Lecture, lab and discussion
Assessment Methods
• Lecture, lab and discussion • Midterm exam, Final exam, Class Assignment and Project • Observation of student contribution in team work and project presentation

Course Contents					
Week	**Hours**	**CILOs**	**Topics**	**Teaching & Learning Methods**	**Assessment Methods**
1 16-19 Oct.	12	a1, a2, b1	Syllabus, Course Schedule; Introduction to communication systems	Lectures and discussion	
2 23-26 Oct.	12	a1, a2, b1	**Chapter 6:** 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.	Lectures and discussion	
3 30 Oct.-2 Nov.	1.5		**Chapter 6 (cont.):** Introduction to Information Theory and Source coding:	Lectures and discussion	
4 6-9 Nov.	12	a1, a2, b1	**Chapter 6 (cont.):** Modeling of information sources, measure of information, joint and conditional entropy,	Lectures and discussion	
5 13-16 Nov.	6	a1, a2, b1	**Chapter 6 (cont.):** mutual and average mutual information, source coding theorem, source coding algorithms. Quantization, direct quantization, companded quantization.	Lectures and discussion	Assignment #1, Quiz #1
6 20-23 Nov.			**Chapter 6 (cont.):** Waveform coding, pulse code modulation, delta modulation, noise analysis in PCM and DM systems.	Lectures and discussion	Assignment #2, Quiz #2
7 27-30 Nov.			**Chapter 7:** Digital Passband and Bandpass Transmission Through AWGN Channel. **Midterm Exam (30 % of assessment)**	Lectures and discussion	**Midterm exam**
8 4-7 Dec.			**Chapter 7 (cont.):** Digital modulation schemes (ASK, PSK, DPSK, QAM, FSK): signal space	Lectures and discussion	

			representation, baseband and bandpass representation of digitally modulated signals.		
9 11-14 Dec.			**Chapter 7 (cont.):** Optimum receivers for AWGN channels: Detection principles for digital communication signals in noise,	Lectures and discussion	Assignment #3
10 18-21 Dec.			**Chapter 7 (cont.):** correlation and matched filter receivers, signal space concepts, maximum a posteriori receiver, maximum likelihood receivers, coherent and non-coherent detection, bit error rate analysis.	Lectures and discussion	Quiz #3
11 25-28 Dec.			**Chapter 8:** Digital Transmission Through Bandlimited AWGN Channels: Power spectra of digitally modulated signals.	Lectures and discussion	
12 1-4 Jan.			**Chapter 8 (cont.):** 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.	Lectures and discussion	Assignment #4
13 8-11 Jan.			**Chapter 9:** 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.	Lectures and discussion	Quiz #4
14 15-18 Jan.			**Chapter 9 (cont.):** 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.	Lectures and discussion	
15, 16 21 Jan.- 02 Feb.			**Final Exam (50 % of assessment)**		

Infrastructure	
Textbook	1- Digital & Analog Communication Systems, by Couch, Leon, Publisher: Pearson, 2016.
References	1. Communicaiton Systems Engineering, John Proakis and ‘asoud Salehi, 2nd Ed., 2002. 2. Alan V. OPPenheim, A. S. Wlisky, Signals and Systems, 2nd Edition, Prentice Hall
Required reading	
Electronic materials	PDF, Power Point Lectures
Other	

Assessment Method	**Grade**	**a1**	**a2**	**b1**
First (Midterm)	**30**	10	10	10

Second (if applicable)					
Final Exam		**50**	10	20	20
Coursework					
Coursework assessment methods	Assignments	**10**		5	5
	Case study				
	Discussion and interaction				
	Group work activities				
	Lab tests and assignments				
	Presentations				
	Quizzes	**10**		5	5
Total		**100**	**20**	**40**	**40**

Plagiarism
Plagiarism is claiming that someone else's work is your own. The department has a strict policy regarding plagiarism and, if plagiarism is indeed discovered, this policy will be applied. Note that punishments apply also to anyone assisting another to commit plagiarism (for example by knowingly allowing someone to copy your code). Plagiarism is different from group work in which a number of individuals share ideas on how to carry out the coursework. You are strongly encouraged to work in small groups, and you will certainly not be penalized for doing so. This means that you may work together on the program. What is important is that you have a full understanding of all aspects of the completed program. In order to allow proper assessment that this is indeed the case, you must adhere strictly to the course work requirements as outlined above and detailed in the coursework problem description. These requirements are in place to encourage individual understanding, facilitate individual assessment, and deter plagiarism.