Module (Course Syllabus) Catalogue

2022-2023

College/ Institute	**Technology college**	
Department	**Information and Communication Technology Engineering (ICTE)**	
Module Name	**DIGITAL COMMUNICATION**	
Module Code	**DIC404**	
Degree	**Technical Diploma** ✓ **Bachelor** ✓ **High Diploma** **Master** ☐ **PhD** ☐	
Semester	**4th semester**	
Qualification	**Electrical and Electronic Engineering**	
Scientific Title	**Assistant Lecturer**	
ECTS (Credits)	**6**	
Module type	**Prerequisite** ☐ **Core** ✓ **Assist.** ☐	
Weekly hours	**4**	
Weekly hours (Theory)	**(2)hr Class**	**(162)Total hrs Workload**
Weekly hours (Practical)	**(2)hr Class**	**(162) Total hrs Workload**
Number of Weeks	**12**	
Lecturer (Theory)	**Jabbar Majeed Sadeq**	
E-Mail & Mobile NO.	**jabbar.sadeq@epu.edu.iq**	**07504487044**
Lecturer (Practical)	**Jabbar Majeed Sadeq**	
E-Mail & Mobile NO.	**jabbar.sadeq@epu.edu.iq**	**07504487044**
Websites		

Course Book

Course Description	This course is a graduate-level introduction to the basic principles of digital communication systems. A digital communication system is one that transmits a source (voice, video, data, etc.) from one point to another, by first converting it into a stream of bits, and then into symbols that can be transmitted over channels (cable, wireless, storage, etc.). The use of the digital bit-stream as the interface between the source and the channel is universal regardless of what kind of source and channel are involved. Digital communication principle, with "bit" as the most important concept of the information age, and applications in computer science, Internet, wireless, etc., is one of the most successful stories of applying mathematics in engineering designs. Also, this course describes the fundamentals of digital modulation and demodulation, Analog to digital converters, ASK, FSK PSK, and pulse code modulation and demodulation and PAM, PWM, PPM.
Course objectives	**To understand the key modules of digital communication systems with an emphasis on digital modulation techniques**. To get introduced to the concept and basics of information theory and the basics of source and channel coding/decoding.
Student's obligation	The student should be attended to the class every week for four hours and prepare himself for weekly quizzes and do assignments and home works in the theory class and must write a report for every experiment done weekly in the laboratory.
Required Learning Materials	1- Powerpoint presentation 2-white board 3- sheets 3- seminars zoom meeting and Moodle program.

	Task		Weight (Marks)	Due Week	Relevant Learning Outcome
	Paper Review				
	Assignments	Homework	5	3-6-9-12	Telecommunication system outcomes
		Class Activity	2	Overall weeks	Basic of digital to Analog and Analog to digital converters
		Report			
		Seminar	10	6	Seminar on digital communication techniques
		Essay			
		Project		6-11	
	Quiz		8	Every week	Weekly quizzes

	Lab.	10	Overall weeks	Every week report about the experiments done in the laboratory
	Midterm Exam	25	12	
	Final Exam	40	15	All the outcomes
	Total	100		
Specific learning outcome:	On completion of this course the students will be able to: • Analyze digital communications in the time domain and frequency domain. • Distinguish between different Digital modulation techniques. • Understand the importance of error considerations in communication systems. • Understanding the importance of Digital to Analog conversion • Understanding the modulation and demodulation techniques of Digital communication • Understanding the effect of noise on the transmitted signal to the receiver during the medium.			
Course References:	1- Electronic communications by M. LANDA 2- Local area networks by GRED 3- Digital communication by: A.Glover&P.M Grant 4- Modern communication circuits by: J.Smith 5- Electronic communication www.electronic.com 6- Mobile communications www. google			

Course topics (Theory)	Week	Learning Outcome
Principles of digital communication: bit rate, baud rate, signal length	1	Understanding the principles of digital communication
Amplitude, Frequency, phase, and quadrature amplitude modulation	2	Modulation Techniques
Amplitude, Frequency, phase, and quadrature amplitude demodulation	3	Demodulation techniques
Uniform Pulse code modulation, Sampling Theorem.	4	Uniform Pulse code modulation techniques
Uniform Quantization, S/N ratio error power Quantization calculation	5	Understanding how to calculate error power Quantization
Time-division multiplexing signal with Identical sampling rate	6	Understanding principles of time multiplexing
Frequency -division multiplexing and demultiplexing	7	Understanding the frequency multiplexing and demultiplexing techniques
PAM, PWM, PPM Modulation techniques	8	Understanding the PWM, PAM, and PPM techniques
Quadrature amplitude modulation is a combination of ASK and PSK.	9	Understanding the principle of QAM

Constellation Diagrams	10	Students able to sketch constellation diagram
constellation diagrams for an ASK (OOK), BPSK, and QPSK signals	11	constellation diagrams for an ASK (OOK), BPSK, and QPSK signals
Satellite communication	12	To understand the satellite principle
Practical Topics	**Week**	**Learning Outcome**
Amplitude shift keying modulation Experiment	1	Students understand to design an ASK modulation circuit
Amplitude shift keying demodulation Experiment	2	Students understand to design ASK demodulation circuit
Frequency shift keying modulation Experiment	3	Students understand to design FSK modulation circuit
Frequency shift keying demodulation Experiment	4	Students understand to design FSK demodulation circuit
Phase shift keying modulation experiment	5	Students understand to design a PSK modulation circuit
Phase shift keying modulation experiment	6	Students understand to design a PSK demodulation circuit
Pulse code modulation experiment	7	Students understand to design a PCM modulation circuit
Pulse code demodulation experiment	8	Students understand to design a PCM demodulation circuit
Pulse amplitude modulation and demodulation experiment	9	Students understand to design a PAM modulation and demodulation circuit
Pulse width modulation and demodulation experiment	10	Students understand to design a PWM modulation and demodulation circuit
Pulse position modulation and demodulation experiment	11	Students understand to design a PPM modulation and demodulation circuit
Frequency division multiplexing access experiment	12	Students understand to design an FDMA modulation and demodulation circuit

Questions Example Design

19. Examinations:

Q1/ Choose the correct answer for each of the following statements:

1. a) Frequency b) Square of frequency c) Square of amplitude d) Amplitude
2. Pulse width modulation is also called..... modulation.
   a) Pulse position b) Pulse code c) Pulse duration d) Pulse delta
3. The satellite is in orbit somewhere 8000 km and 18000 km above the earth's surface is:
   a) Molniya orbit satellite b) Geostationary earth orbit c) Low earth orbit d) Medium earth orbit
4. Quadrature Amplitude Modulation (QAM) has the same advantages as.....

ASK and FSK b) ASK and PSK c) FSK and PSK d) All the above.

5. ASK, PSK, FSK, and QAM is examples of..... conversion.

Digital to digital b) Analog to digital c) Analog to analog d) Digital to analog.

6. Which of the following techniques uses digital modulation?
   a) PAM b) PWM c) PPM d) PCM
7. What type of modulation the figure below indicates?

Pulse width modulation b) Unipolar PAM c) Bipolar PAM d) Pulse position modulation

8. What type of analog modulation the figure below indicates?

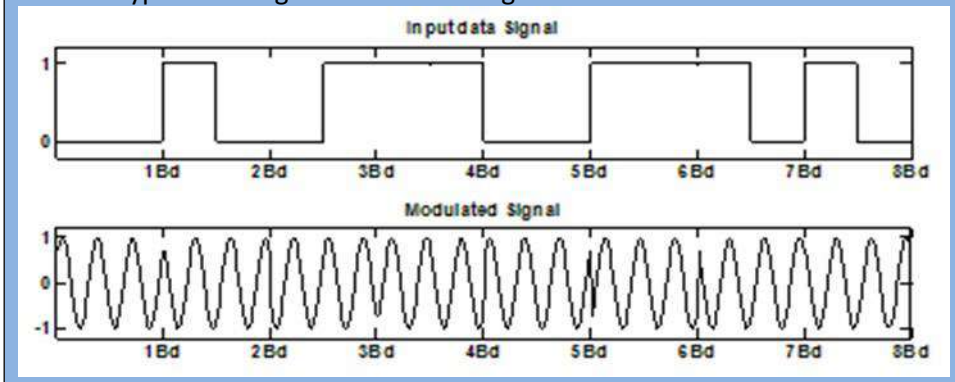
ASK b) PSK c) FSK d) QAM

20. Extra notes:

Q4/A receiver with 300Ω input resistance , operates at temperature of 77Fº, the received signal at 88 MHz with bandwidth of 5.5MHz . The received signal voltage of 8.6µV is applied to an amplifier with noise figure of 2.5 dB calculate:

- The input noise power (5M)
- The input signal power (5M)
- The S/N in decibels . (5M)
- The noise factor and S/N of the amplifier (5M)
- The noise temperature of amplifier (5M)

8. What type of analog modulation the figure below indicates?



ASK b) PSK c) FSK d) QAM

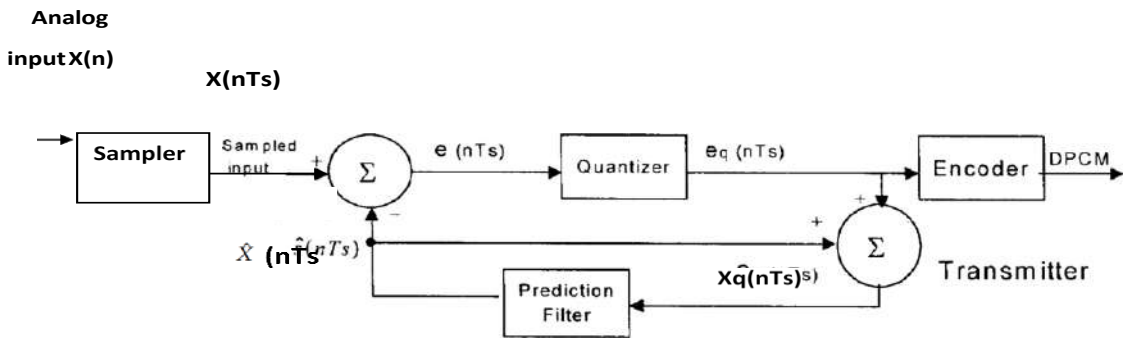
Q2/ If $V_m(t) = 5\cos(2\pi\ 4.2\times10^6{}_{(t)})V$, is pulse code modulated **(PCM)** with quantizing level **(M = 6)**

1- Calculate Code word length.

2-Calculate bit rate.

3-Output signal to quantization noise ratio in decibels. If the signal power=0.05

Example: Consider the input samples $X_{(n)} = \{3.1,3.2,3.3,3.5,3.6,3.7,3.8\}$. Explain how encoding and decoding is done on DPCM, Assume the first order filter $\hat{X}(nTs)=X_q(n-1)$



Encoder:

e(nTS)= X(nTs) - $\hat{X}$ (nTs)

Xq(nTs) = $\hat{X}$ (nTs)+e_q(nTs)

X(n)	$\hat{X}$ (nTs)=Xq(n-1)	e(nTs) X(n) - $\hat{X}$ (nTs)	eq(nTs)	Xq(nTs)= $\hat{X}$ (nTs)+eq(nTs)
4.1	0 initially	4.1-0=4.1	4	0+4=4
4.2	4	4.2-4=0.2	0	4+0=4
4.3	4	4.3-4=0.3	0	4+0=4
4.4	4	4.4-4=0.4	0	4+0=4
4.5	4	4.5-4= 0.5	1	4+1=5
4.6	5	4.6-5=-0.4	0	5+0=5
4.7	5	4.7-5=-0.3	0	5+0=5
4.8	5	4.8-5=-0.2	0	5+0=5

Transmitter sequences

4	0	0	0	1	0	0	0
100	000	000	000	001	000	000	000

20. Extra notes:

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External Evaluator

1- The course book of Digital communication is completely related to the syllabus of Digital communication, the practical syllabus satisfies the goal of digital communication subjects.

2- The practical course is completely defined the theoretically lectures.

Brzo Aziz Qader: Lecturer at oil technology department