

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية			
Module Title	Digital Communications		Module Delivery
Module Type	Core		☒ Theory ☐ Lecture ☒ Lab ☐ Tutorial ☐ Practical ☐ Seminar
Module Code	ATU11504		
ECTS Credits	6		
SWL (hr/sem)	150		
Module Level	UGIII	Semester of Delivery	1
Administering Department	Communications Techniques Department	College	Technical College of Najaf
Module Leader		e-mail	
Module Leader's Acad. Title		Module Leader's Qualification	
Module Tutor	Name (if available)	e-mail	
Peer Reviewer Name	Nasir Hussein Selman	e-mail	Coj.nas@atu.edu.iq
Scientific Committee Approval Date	01/05/2025	Version Number	1.0

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	Semester	
Co-requisites module	None	Semester	

Module Aims, Learning Outcomes and Indicative Contents	
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	1- To provide students with a foundational understanding of digital communication systems. 2- To introduce the principles of signal representation, sampling, quantization, and modulation. 3- To develop students' ability to analyze and compare various digital modulation techniques. 4- To expose students to practical applications of digital communication, such as OFDM and spread spectrum.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	Upon successful completion of this course, students will be able to: 1. Explain the differences between analog and digital communication. 2. Apply the sampling theorem and understand the phenomenon of aliasing. 3. Describe & analysis the process of Pulse Code Modulation (PCM) and its variations. 4. Understand and mitigate the effects of inter-symbol interference (ISI). 5. Describe and compare various digital modulation tech. (ASK, FSK, PSK, QAM, etc.). 6. Analyze the error performance of binary and multilevel modulation systems. 7. Explain the principles of OFDM and spread spectrum techniques.
Indicative Contents	1. Introduction to digital communication systems and its elements.

المحتويات الإرشادية	2. (PCM), variations (delta modulation, DPCM), ISI, equalization, matched filter. 3. Binary digital modulation, coherent and non-coherent detection, error performance. 4. Multilevel modulation (QAM, QPSK, OQPSK, MSK, MFSK, M-ary PSK/QAM),
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering types of simple experiments involving some sampling activities that are interesting to the students.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ أسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	78	Structured SWL (h/w) الحمل الدراسي المنتظم للطالب أسبوعيا	
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	72	Unstructured SWL (h/w) الحمل الدراسي غير المنتظم للطالب أسبوعيا	
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation تقييم المادة الدراسية					
		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	2	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Projects / Lab.	1	10% (10)	Continuous	All
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	Midterm Exam	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	Introduction to Digital Communications: Overview, Analog vs. digital communications, and Elements of a digital communication system.
Week 2	Signal Representation & Sampling: Baseband signal representation, Sampling theorem, and, Aliasing, and practical sampling considerations.
Week 3	Quantization & Pulse Code Modulation (PCM): Pulse Code Modulation (PCM) and Quantization process.
Week 4	PCM System Analysis: Representation of binary data, Noise consideration in PCM system, and SNR performance of PCM.
Week 5	Modifications of PCM: Limitations and modifications of PCM, Delta modulation, Delta-Sigma modulation, Adaptive delta modulation, and Differential PCM (DPCM).
Week 6	Inter-Symbol Interference (ISI) and Equalization: ISI, Pulse shaping, Equalization techniques, and adaptive equalization.
Week 7	Matched Filter and Optimal Reception: The matched filter receiver and optimal receiver design.
Week 8	Digital Modulation: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), and Phase Shift Keying (PSK).
Week 9	Digital Modulation: Differential PSK (DPSK), Coherent and non-coherent detection, and Error performance analysis of binary systems.

Week 10	Mid-Term Exam
Week 11	Digital Modulation: Quadrate Amplitude Modulation (QAM), Quadrate Phase Shift Keying (QPSK), Offset-QPSK (OQPSK), Minimum Shift Keying (MSK).
Week 12	Digital Modulation: Multilevel modulation techniques (MFSK, M-ray PSK & M-ray QAM), Error performance of M-ray systems.
Week 13	Digital Modulation: Comparison between performance of digital modulation types, and Modulation trade-offs (Bandwidth, Power, Complexity)
Week 14	Applications I: Orthogonal Frequency Division Multiplexing (OFDM)
Week 15	Applications II: Spread spectrum (Direct sequence and Frequency hopping spread spectrum), and Multiple access (CDMA, TDMA, FDMA).
Week 16	Final Exam

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	Pulse generation circuit
Week 2	Sampling Theorem
Week 3	Quantization: Sample and hold circuit
Week 4	PAM modulation and demodulation
Week 5	PPM modulation and demodulation
Week 6	PCM modulation
Week 7	PCM demodulation
Week 8	ASK modulation and demodulation
Week 9	FSK modulation and demodulation
Week 10	Mid-Term Exam
Week 11	PSK modulation and demodulation
Week 12	PFM modulation and demodulation
Week 13	PWM modulation and demodulation
Week 14	DPCM modulator
Week 15	DOCM demodulator
Week 16	Final Exam

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	Available in the Library?
Required Texts	1- Digital Communications, by John G. Proakis and Masoud Salehi.	No
Recommended Texts	2- Analog communication textbook by sanjay sharma. 3- Modern digital and analog communication systems by B. P. Lathi & Zhi Ding	No
Websites		

Grading Scheme

مخطط الدرجات

Group	Grade	التقدير	Marks %	Definition
Success Group (50 - 100)	A - Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	FX – Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.