Ministry of Higher Education and
Scientific Research - Iraq
University of Technology-Iraq
Department of Computer Science

MODULE DESCRIPTOR FORM
نموذج وصف المادة الدراسية

Module Information
معلومات المادة الدراسية

Module Title	INFORMATION THEORY	**Module Delivery**
Module Type	CORE	
Module Code	INTH114	**Theory**
ECTS Credits	4	**Lecture**
SWL (hr/sem)	100	**Tutorial**

Module Level	1	**Semester of Delivery**	1
Administering Department	Type Dept. Code	**College**	Type College Code
Module Leader	Dr. Abdulamir Abdullah Karim	**e-mail**	110004@uotechnology.edu.iq
Module Leader's Acad. Title	Professor	**Module Leader's Qualification**	Ph.D.
Module Tutor	Dr.nuha jameel ibrahim	**e-mail**	Nuha.j.ibrahim@uotechnology.edu.iq
Peer Reviewer Name		**e-mail**	
Review Committee Approval	01/06/2023	**Version Number**	1.0

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	None	**Semester**	
Co-requisites module	Coding techniques	**Semester**	2

Module Aims, Learning Outcomes and Indicative Contents
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Aims أهداف المادة الدراسية	1. Understanding the fundamental concepts: The module aims to provide students with a solid understanding of the basic concepts and principles of information theory. This includes topics such as entropy, information content, coding theory, and data compression. 2. Mathematical foundations: Information theory is built upon mathematical principles, particularly probability theory and statistics. The module aims to develop students' mathematical skills and provide them with the necessary tools to analyze and solve problems in information theory. 3. Communication systems: Information theory is closely related to the field of communication systems. The module aims to explore how information is transmitted, encoded, and decoded in various communication systems, including digital and analog systems. 4. Applications and practical implications: Information theory has numerous applications in various fields, including telecommunications, computer science, data analysis, and cryptography. The module aims to highlight these applications and help students understand the practical implications of information theory in real-world scenarios. 5. Analytical and critical thinking: Information theory involves analyzing and quantifying information and data. The module aims to enhance students' analytical and critical thinking skills, enabling them to evaluate information sources, make informed decisions, and solve problems effectively.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Understand the fundamental concepts of information theory, including entropy, information content, and channel capacity. 2. Apply mathematical methods to analyze and quantify information in various domains, such as data compression, data transmission, and cryptography. 3. Evaluate and compare different coding schemes and compression algorithms based on their efficiency and performance. 4. Design and implement error-correcting codes for reliable data transmission and storage. 5. Analyze the trade-offs between data compression and data loss, and make informed decisions in practical applications. 6. Apply information theory principles to analyze and optimize communication systems, such as wireless networks or data transmission over noisy channels. 7. Critically assess the impact of information theory on other fields, such as computer science, telecommunications, and data science.

Indicative Contents
المحتويات الإرشادية
	Indicative Contents for a Module on Information Theory:
	
	1. Introduction to Information Theory
	
	    • Definition and basic concepts
	    • Historical overview
	    • Importance and applications

2. Fundamentals of Probability Theory

- Basic probability concepts
- Random variables and probability distributions
- Joint and conditional probability

3. Entropy and Information

- Shannon entropy and its properties
- Entropy of discrete and continuous random variables
- Joint and conditional entropy
- Mutual information

4. Data Compression

- Source coding and entropy coding
- Huffman coding
- Arithmetic coding
- Lossless and lossy compression techniques

5. Channel Capacity and Coding

- Channel models and capacity
- Channel coding theorem
- Error-correcting codes
- Reed-Solomon codes
- Convolutional codes
- Turbo codes

6. Source Coding and Rate Distortion Theory

- Rate distortion theory and trade-off
- Optimal quantization
- Transform coding (e.g., Discrete Cosine Transform)
- Vector quantization

7. Information Theory and Communication Systems

- Channel coding and modulation
- Channel capacity and bandwidth efficiency
- Shannon's theorem and channel capacity limits
- Channel coding techniques (e.g., LDPC codes, polar codes)

8. Information Theory and Cryptography

- One-time pad and perfect secrecy
- Shannon's theory of secrecy systems
- Cryptographic primitives based on information theory (e.g., Information-

	theoretic secure multi-party computation, secret sharing)
	9. Advanced Topics in Information Theory • Network information theory • Information theory and machine learning • Quantum information theory • Information theory in biology and genetics
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	1. Lectures: Traditional lectures involve the teacher presenting information to the students in a structured manner. This method is useful for delivering content and introducing new concepts. 2. Discussions: Engaging students in discussions encourages active learning and critical thinking. It allows students to share their perspectives, ask questions, and learn from their peers. 3. Group Work: Collaborative learning through group work promotes teamwork, problem-solving skills, and peer interaction. Students work together on tasks or projects, fostering a sense of shared responsibility and collective learning. 4. Hands-on Activities: Practical or experiential activities provide students with opportunities to apply their knowledge in real-world contexts. This strategy can include experiments, simulations, case studies, or field trips. 5. Technology Integration: Utilizing technology tools such as multimedia presentations, online resources, educational apps, and virtual reality can enhance engagement and interactivity in the learning process.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	63	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	37	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	100		

Module Evaluation
تقييم المـادة الدراسية

		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	15% (15)	5, 10, 12	LO #1, 2, 10 and 11
	Assignments	2	10% (10)	2, 12	LO # 3, 4, 6 and 7
	Projects / Lab.	0	0		
	Report	1	10% (10)	13	LO # 5, 8 and 10
Summative assessment	Midterm Exam	2 hr	15% (10)	7	LO # 1-7
	Final Exam	2hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	Principles of probability theory
Week 2	Introduction to information theory
Week 3	Mode of the signal system
Week 4	Some code: ASCII CODE & MORSE CODE
Week 5	The measure of information
Week 6	Self-information
Week 7	Mid Exam
Week 8	Average information (Entropy)
Week 9	Maximum Entropy for Discrete Source
Week 10	Binary source
Week 11	Ternary Source
Week 12	Information Rate
Week 13	Mutual information
Week 14	Normal noisy channel
Week 15	**Preparatory Week**
Week 16	**Final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	

Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	Information Theory: A Tutorial Introduction by James Stone (Author), 2015, Sebtel Press.	No
Recommended Texts	Information Theory, Inference and Learning Algorithms by David J. C. MacKay, vid J. C. MacKay, David J. C. Mac Kay (Authors), Cambridge University Press, 2003.	Yes
Websites		

APPENDIX:

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**	مقبول بقرار	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required
Note:				

NB 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.