MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Computation Theory**			**Module Delivery**	
Module Type	**Core**			☒**Theory** ☒**Lecture** ☐ **Lab** ☐**Tutorial** ☐**Practical** ☐**Seminar**	
Module Code	**COM-213**				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level	2		**Semester of Delivery**	3	
Administering Department	com		**College**	cos	
Module Leader	*.Jumana Waleed Salih*		**e-mail**	jumanawaleed@uodiyala.edu.iq	
Module Leader's Acad. Title	Assistant Prof.		**Module Leader's Qualification**	Ph.D.	
Module Tutor	Name (if available)		**e-mail**	E-mail	
Peer Reviewer Name	Name		**e-mail**	E-mail	
Scientific Committee Approval Date	04/08/2024		**Version Number**	1.0	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	COM-122	**Semester**	1
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	This course emphasizes computability and computational complexity theory. Topics include regular and context-free languages, decidable and undecidable problems, reducibility, recursive function theory, time and space measures on computation, completeness, hierarchy theorems, inherently complex problems, oracles, probabilistic computation, and interactive proof systems. • Improve their mathematical thinking skill and habits, including thinking precisely about definitions, stating assumptions carefully, critically reading arguments, and being able to write convincingly. • Be able to understand both finite and infinite formal models of computation and to reason about what they can and cannot compute. • Understand both intuitively and formally what makes some problems either impossible or too expensive to solve with a computer, and what can be done in practice when an unsolvable or intractable problem is encountered. • Reason formally about the cost of computation, and be able to prove useful bounds on the costs of solving problems, including showing that certain problems cannot be solved efficiently. • Learn about some interesting aspects of theoretical computer science, and why understanding them matters even if you are only interested in building practical computing systems.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1- Acquisition of the basic concepts of probability and statistical inference. 2- Knowledge and understanding of basic statistical calculations and the software tools used for them. 3- The ability to identify the elements making up a univariate statistical model applied to real situations. 4- The ability to use standard statistical packages and to correctly interpret the lists produced.
Indicative Contents المحتويات الإرشادية	We explore these questions by developing abstract models of computing machines and reasoning about what they can and cannot compute efficiently. A main goal of this course is for you to understand how theoretical computer scientists reason about these questions, and connecting that theory to practical questions about computing. We will also look at some applications in cryptography that take advantage of problems being hard to solve, and what can be done when a problem cannot be solved or is too expensive to solve.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	• Automata and Language Theory (2 weeks) ○ Finite automata, regular expressions, push-down automata, context-free grammars, pumping lemmas.

	• Computability Theory (3 weeks)
	  ○ Turing machines, the Church-Turing thesis, decidability, the halting problem, reducibility, the recursion theorem.
	• Complexity Theory (7 weeks)
	  ○ Time and space measures of complexity, complexity classes P, NP, L, NL, PSPACE, BPP and IP, complete problems, the P versus NP conjecture, quantifiers and games, hierarchy theorems, provably hard problems, relativized computation and oracles, probabilistic computation, interactive proof systems

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	48	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	3.2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	52	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.4
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**100**		

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.				
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	**Midterm Exam**	2hr	20% (20)	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, Finite Automata, Regular Expressions
Week 2	Nondeterminism, Closure Properties, Regular Expressions → Finite Automata
Week 3	The Regular Pumping Lemma, Finite Automata → Regular Expressions, CFGs
Week 4	Pushdown Automata, CFG ↔ PDA
Week 5	The CF Pumping Lemma, Turing Machines
Week 6	TM Variants, the Church-Turing Thesis
Week 7	Decision Problems for Automata and Grammars
Week 8	**Midterm Exam**
Week 9	P and NP, SAT, Poly-time Reducibility
Week 10	NP-Completeness
Week 11	Cook-Levin Theorem
Week 12	Space Complexity, PSPACE, Savitch's Theorem
Week 13	PSPACE-Completeness
Week 14	Games, Generalized Geography
Week 15	L and NL, NL = coNL
Week 16	**Preparatory week before the 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	Sipser, Michael. *Introduction to the Theory of Computation*. 3rd ed. Cengage Learning, 2012. ISBN: 9781133187790.	Yes
Recommended Texts	**Introduction to Probability and Statistics 15th Edition** by William Mendenhall (Author), Robert J. Beaver (Author), Barbara M. Beaver (Author)	no
Websites	https://www.coursera.org/courses?query=theory%20of%20computation	

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.