Ministry of Higher Education and Scientific Research - Iraq
Al-Nahrain University
College of Science
Computer Science Department

MODULE DESCRIPTION FORM
نموذج وصف المادة الدراسية

Module Information
معلومات المادة الدراسية

Module Title	Computation Theory	**Module Delivery**	
Module Type	C	☒ **Theory** ☐ **Lecture** ☐ **Lab** ☒ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	COMP2109		
ECTS Credits	6.0		
SWL (hr/sem)	150		
Module Level	3	**Semester of Delivery**	1
Administering Department	Computer Science	**College**	Science
Module Leader	Dr.Suhad A. Yousif	**e-mail**	
Module Leader's Acad. Title	Assistant Professor	**Module Leader's Qualification**	Ph.D. in Computer Science
Module Tutor		**e-mail**	Suhad.a.yousif@nahrainuniv.edu.iq
Peer Reviewer Name	Dr. Tiba Zaki	**e-mail**	
Scientific Committee Approval Date		**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 Aims أهداف المادة الدراسية	• Familiarize students with fundamental concepts in automata theory, formal languages, and Turing machines. • Investigate deterministic and non-deterministic finite automata, and their computational functions. • Grasp the essence of context-free grammars and their connection to computational models. • Examine pushdown automata and their use in parsing and recognizing languages. • Acquire knowledge about Turing machines and their importance in computability and complexity theory. • Offer a blend of theoretical knowledge and practical applications in computational theory. • Equip students to analyze computational problems and evaluate algorithmic procedures.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	By the end of this module, students will be able to: • Understand and explain the fundamental concepts of automata theory, formal languages, and computation models. • Differentiate between deterministic and non-deterministic finite automata and their practical applications. • Design and analyze regular expressions and finite automata for recognizing patterns and languages. • Define and work with context-free grammars (CFGs) and demonstrate their equivalence with pushdown automata. • Simplify context-free grammars and convert them to Chomsky Normal Form (CNF). • Analyze the computational power of Turing machines and understand their significance in computability theory. • Apply theoretical knowledge to solve computational problems and evaluate the complexity of algorithms. • Demonstrate an understanding of the limitations of various computational models, including regular and context-free languages.
Indicative Contents المحتويات الإرشادية	**Introduction to Computation Theory** • Overview of computation theory and its significance **Mathematical Foundations** • Sets, relations, and functions • Logic and proof techniques (induction, contradiction) **Finite Automata** • Definition and types (deterministic vs. nondeterministic) • Transition diagrams and state tables • Minimization of finite automata • Applications of finite automata **Regular Languages** • Definition and properties of regular languages • Regular expressions and their equivalence to finite automata • Closure properties of regular languages • Pumping lemma for regular languages

	Context-Free Languages • Definition and context-free grammars (CFGs) • Parse trees and derivations • Chomsky normal form and other forms of CFGs • Closure properties and pumping lemma for context-free languages **Pushdown Automata**

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	

Strategies	• **Lectures:**
	  • Delivered to explain key theoretical concepts and their applications in automata theory, formal languages, and computation models.
	• **Interactive Discussions:**
	  • Engage students in discussions to deepen their understanding of complex topics such as non-deterministic finite automata, context-free grammars, and Turing machines.
	• **Problem-solving Sessions:**
	  • Students will participate in problem-solving exercises during class to apply theoretical concepts to practical computation problems.
	• **Assignments and Quizzes:**
	  • Regular assignments and quizzes will be provided to reinforce understanding and ensure continuous assessment of the learning outcomes.
	• **Group Projects:**
	  • Students will collaborate on group projects to explore real-world applications of automata theory and computational models, fostering teamwork and deeper understanding.
	• **Exams:**
	  • Midterm and final exams will assess students' grasp of theoretical concepts and their ability to apply them to solve computational problems.

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	77	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	5.1
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation تقييم المادة الدراسية					
		Time/Number	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	1	10% (10)	10	All
	Assignments	1	10% (10)	10	All
	Projects / Lab.	1	10% (10)	Continuous	All
	Report	1	10% (10)	10	All
Summative assessment	**Midterm Exam**	2 hr	10% (10)		All
	Final Exam	3 hr	50% (50)		All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Introduction to Automata, Computability, and Complexity (Sipser - Chapter 1)
Week 1	Basic Mathematical Notation and Techniques (Sipser - Chapter 1)
Week 2	Finite Automata - Definitions and Examples (Sipser - Chapter 1)
Week 3	Deterministic Finite Automata (DFA) (Sipser - Chapter 1) - Extended to Week 4
Week 4	Deterministic Finite Automata (DFA) (Sipser - Chapter 1)
Week 5	Nondeterministic Finite Automata (NFA) (Sipser - Chapter 1)
Week 6	Equivalence of DFA and NFA (Sipser - Chapter 1)
Week 7	Regular Expressions (Sipser - Chapter 1)
Week 8	Equivalence of Regular Expressions and Finite Automata (Sipser - Chapter 1) - Extended to Week 8
Week 9	Midterm Exam
Week 10	Context-Free Grammars (CFG) - Definitions and Examples (Sipser - Chapter 2)
Week 11	Simplification of Context-Free Grammars (Sipser - Chapter 2)
Week 12	Pushdown Automata (PDA) - Introduction and Definitions (Sipser - Chapter 2)
Week 13	Equivalence of Pushdown Automata and Context-Free Grammars (Sipser - Chapter 2)
Week 14	Equivalence of Pushdown Automata and Context-Free Grammars (Sipser - Chapter 2)
Week 15	Turing Machines - Introduction and Basic Definitions (Sipser - Chapter 2)

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	
Week 8	
Week 9	
Week 10	
Week 11	
Week 12	
Week 13	
Week 14	
Week 15	

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	Introduction To The Theory Of Computation - Michael Sipser	
Recommended Texts	https://cglab.ca/~michiel/TheoryOfComputation/TheoryOfComputation.pdf	
Websites	https://mog.dog/files/SP2019/Sipser_Introduction.to.the.Theory.of.Computation.3E.pdf	

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.