MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Digital Technologies**			**Module Delivery**	
Module Type	**C**			☒**Theory** ☒**Lecture** ☒**Lab** ☐**Tutorial** ☐**Practical** ☐**Seminar**	
Module Code					
ECTS Credits	**4**				
SWL (hr/sem)	**50**				
Module Level	1		**Semester of Delivery**	1	
Administering Department	Type Dept. Code		**College**	Type College Code	
Module Leader	Husham hadi nghaimesh		**e-mail**	E-mail	
Module Leader's Acad. Title	Professor		**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	28/10/2024		**Version Number**	1.0	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	Digital Technologies	**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. Understand and apply the principles of Karnaugh Maps (K-Maps) and optimization techniques in digital circuit design. 2. Analyze and design arithmetic circuits, including binary adders and subtractors, for combinational logic systems. 3. Explore the functionality and applications of decoders, encoders, multiplexers, and de-multiplexers in digital systems. 4. Comprehend the operation and classification of flip-flops, latches, and their role in sequential digital circuits. 5. Design and analyze different types of counters, including synchronous and asynchronous counters, with timing diagrams. 6. . Develop practical skills in digital circuit implementation and conversion between different flip-flop types.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1- Identify and interpret fundamental concepts in digital circuit design, including combinational and sequential circuits. 2- Apply Karnaugh Maps (K-Maps) to simplify Boolean functions and optimize logic circuits. 3- Demonstrate the ability to design arithmetic circuits such as binary adders, subtractors, and multiplexers. 4- Analyze the functionality and applications of decoders, encoders, and demultiplexers in digital systems. 5- Differentiate between various types of combinational and sequential digital circuits. 6- Explain the operation of flip-flops, including SR, JK, D, and T flip-flops, and their role in circuit design. 7- Utilize timing diagrams to analyze the behavior and performance of digital circuits. 8- Design and analyze different types of counters, including synchronous and asynchronous counters. 9- Develop the ability to perform conversions between different flip-flop types for specific circuit applications. 10- Construct and simulate digital circuits using theoretical knowledge and practical tools. 11- Evaluate the performance of digital systems and recommend improvements for optimization. 12- Collaborate in group projects to solve practical problems related to digital circuit design.
Indicative Contents المحتويات الإرشادية	Indicative Content for Digital Techniques 1. Introduction to Digital Systems • Basic concepts of digital logic. • Differences between analog and digital systems. 2. Boolean Algebra and Logic Simplification • Boolean expressions and truth tables.

	• Simplification techniques using Karnaugh Maps (K-Maps). • "Don't Care" conditions in K-Maps. 3. Combinational Circuits • Introduction to combinational logic. • Design and analysis of arithmetic circuits: binary adders and subtractors. • Decoders, encoders, multiplexers, and demultiplexers. • Comparator circuits. 4. Sequential Circuits • Basic concepts of sequential logic. • Latches and flip-flops (SR, D, JK, T). • Flip-flop conversions. • Timing diagrams for sequential circuits. 5. Counters and Registers • Synchronous and asynchronous counters. • Types of counters: up, down, and up/down counters. • Applications of counters in digital systems. 6. Arithmetic Logic Design • Parallel binary adders and subtractors. • Arithmetic logic units (ALUs). 7. Timing Analysis and Circuit Simulation • Timing parameters and clocking considerations. • Circuit simulation tools and testing. 8. Applications of Digital Techniques • Real-world applications of digital circuits. • Problem-solving and practical implementation of digital systems.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The objectives of this course are to provide students with a comprehensive understanding of key concepts in digital technologies. The students will learn to simplify Boolean expressions using Karnaugh maps and apply this knowledge to design efficient logic circuits. The course covers the design and implementation of combinational and arithmetic circuits, as well as the principles behind different types of flip-flops and sequential circuits. Additionally, students will explore the operation of various counters and their applications in real-world systems. By the end of the course, students should be capable of designing and analyzing both combinational and sequential digital systems. For the teaching and learning strategy, the course will be delivered using a combination of lectures and practical lab sessions. Theoretical concepts will be explained during lectures, while students will have the opportunity to apply these concepts in a hands-on environment through circuit design and simulation exercises.

	The use of digital tools and simulation software will enhance learning by allowing students to visualize circuits and instantly test their designs. Collaborative activities, discussions, and problem-solving will be encouraged to promote critical thinking and deeper understanding. The overall goal is to ensure that students not only grasp the theory but also gain practical skills in designing and analyzing digital systems.

Student Workload (SWL) الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	24	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	20	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	2
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**50**		

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 Technologies and Overview of the Course. • Basic Concepts of Digital Systems. • Introduction to Boolean Algebra and Logic Gates.
Week 2	• Karnaugh Map (K-Map) Introduction.

	• Simplification of Boolean Expressions using K-Map (2-variable). • Practice Problems.
Week 3	• Simplification of Boolean Expressions using K-Map (3-variable). • Don't Cares on Karnaugh Maps. • Practice Problems and Examples.
Week 4	• Arithmetic Circuits: Introduction to Adders. • Half Adder and Full Adder. • Practice Problems on Adders.
Week 5	• Parallel Binary Adders. • Binary Subtractors: Half Subtractor and Full Subtractor. • Practice Problems
Week 6	• Combinational Digital Circuits: Introduction. • Decoder and Encoder. • Practice Problems on Decoders and Encoders.
Week 7	• Multiplexers and De-multiplexers: Basic Concepts. • 2-to-1, 4-to-1, and n-to-1 Multiplexers. • De-multiplexer Designs.
Week 8	• Comparator Circuits: Introduction and Applications. • Practice Problems on Comparators.
Week 9	• Flip-Flops Introduction. • Latches and Flip-Flops: SR Flip-Flop, D Flip-Flop.
Week 10	• Clocked SR Flip-Flop and D Flip-Flop. • Timing Diagrams for Flip-Flops. • Practice Problems on Flip-Flops.
Week 11	• JK Flip-Flop and T Flip-Flop. • Flip-Flop Conversion Techniques. • Practice Problems.
Week 12	• Sequential Digital Circuits: Introduction. • Analysis and Design of Sequential Circuits.
Week 13	• Counters: Introduction and Types. • Asynchronous Counters and their Design. • Practice Problems on Asynchronous Counters
Week 14	• Synchronous Counters and their Design. • Comparison of Asynchronous and Synchronous Counters. • Practice Problems on Synchronous Counters.
Week 15	• Revision of All Topics. • Review of Key Concepts and Problem Solving.

	• Q&A Session.
Week 16	• Midterm Exam (Covering Weeks 1-7). • Final Exam (Covering Weeks 8-16).

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	• Topic: Introduction to Laboratory Tools and Digital Circuit Simulation. • Activities: • Introduction to the simulation environment (e.g., Multisim or Logisim). • Build basic logic gates (AND, OR, NOT) using laboratory tools. • Design simple circuits like Half Adder.
Week 2	• Topic: Simplifying Circuits Using Karnaugh Maps (K-Map). • Activities: • Apply Karnaugh Maps to simplify Boolean expressions. • Design circuits using 2-variable and 3-variable K-Maps. • Test and verify the circuits using simulation.
Week 3	• Topic: Design and Implementation of Binary Adders. • Activities: • Design Half Adder and Full Adder circuits. • Test the circuits using simulation software. • Combine adders to create full binary addition circuits.
Week 4	• Topic: Decoders and Encoders. • Activities: • Design a 3-to-8 Decoder circuit. • Design a 4-to-2 Encoder circuit. • Test and verify the circuits using simulation.
Week 5	• Topic: Multiplexers and De-multiplexers. • Activities: • Design 2-to-1 and 4-to-1 Multiplexer circuits. • Test and verify the circuits using simulation. • Design a 1-to-2 De-multiplexer and test i
Week 6	• Topic: Flip-Flops. • Activities: • Build SR, D, and JK Flip-Flops using circuit simulation. • Test Flip-Flops with timing diagrams. • Perform tests to ensure correct operation of Flip-Flops.

Week 7	• Topic: Counters. • Activities: • Design an Asynchronous Counter circuit. • Design a Synchronous Counter circuit. • Test the counters using simulation and verify their functionality.

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Fundamentals of Electric Circuits* by C.K. Alexander and M.N.O Sadiku, McGraw-Hill Education (Available in the library).	Yes
Recommended Texts	DC Electrical Circuit Analysis: A Practical Approach*, 2020 (Not available in the library).	yes
Websites	(https://www.coursera.org/browse/physical-science-and-engineering/electrical-engineering).	

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.