Module Information معلومات المادة الدراسية					
Module Title	**Digital Logic**			**Module Delivery**	
Module Type	**BASIC**			☒ **Theory** ☐ **Lecture** ☒ **Lab** ☐ **Tutorial** ☒ **Practical** ☐ **Seminar**	
Module Code	**HTCMT 104**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	UGII		**Semester of Delivery**	1	
Administering Department	MT		**College**	HTC	
Module Leader	Amer Ahmed Abed		**e-mail**	ameraldery@ntu.edu.iq	
Module Leader's Acad. Title	Lecturer		**Module Leader's Qualification**	M.Sc.	
Module Tutor	Name (if available)		**e-mail**	E-mail	
Peer Reviewer Name	Name		**e-mail**	E-mail	
Scientific Committee Approval Date	01/09/2025		**Version Number**	1.0	

Relation with other Modules العلاقة مع المواد الدراسية الأخرى

Prerequisite module	None	**Semester**	None
Co-requisites module	None	**Semester**	None

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسة ونتائج التعلم والمحتويات الإرادة	
Module Aims أهداف المادة الدراسية	The aim of this module is to provide students with a strong foundatio **design** and its applications in real-world systems. Upon completing th students will be able to: **1. Develop a Deep Understanding of Digital Systems** Introduce students to the fundamental principles of **digital logic**, enab understand how digital systems function and how they are applied in and computer engineering. Provide an understanding of **number systems** (binary, octal, decimal, and the importance of these systems in digital computing and commu **2. Enhance Problem-Solving Skills in Digital Circuit Design** Equip students with the necessary tools and techniques to solve comp involving **logic gates, Boolean algebra**, and **digital arithmetic**. Enable students to **design, simplify**, and **implement** practical **combi** **circuits**, such as adders and subtractors, using Boolean expressions. **3. Build Practical Skills in Simulation and Circuit Design** Provide hands-on experience with industry-standard simulation tools **Logisim**, **Proteus**, or **Multisim** for **digital circuit design** and **testing** Encourage students to develop practical solutions by designing **real-w** **circuits** and analyzing their behavior using simulation software. **4. Foster Teamwork and Communication Skills in Engineering Pr** Encourage collaboration and teamwork through **mini-projects** where will design digital systems as part of a group. Strengthen communication skills by presenting and documenting **circ** and **problem-solving approaches** through clear and concise **technica** and **presentations**.

Module Learning Outcomes مخرجات التعلم للمادة الدراسية	By the end of this module, students will be able to: **1. Knowledge & Understanding** • Explain the **fundamental concepts of digital logic**, including t between **analog and digital systems** • Identify and describe different **number systems** (binary, octal, decimal, hexadecimal) and perform **number conver** • Understand the principles of **Boolean algebra**, including simpli and **De Morgan's theorems**. • Recognize and describe the functions of **logic gates** (AND, OR, NOT, NAND, NOR, XOR, XNOR) and their applic **2. Cognitive & Analytical Skills** • Solve problems involving **binary arithmetic operations**, inclu **subtraction, multiplication, and division**. • Simplify **Boolean expressions** using **Boolean algebra rules** an • Analyze and design **basic combinational logic circuits** using l • Develop logic circuits using **universal gates (NAND, NOR)** an circuit implementations. **3. Practical & Technical Skills** • Design and implement **logic circuits** using simulation tools suc **Logisim, Proteus, or Multisim**. • Construct and test **basic arithmetic circuits** (Half Adder, Full Adder, Half Subtractor, Full Subtractor). • Apply logic gate concepts in **real-world applications** and **digit** **4. Communication & Teamwork Skills** • Work effectively in teams to design and implement **small digita** • Present solutions to **logic circuit problems** clearly using **truth Boolean expressions, and circuit diagrams**. • Document and explain digital logic designs using appropriate **te and presentations**.

Indicative Contents المحتويات الإرشادية	1. Introduction to Digital Logic • Difference between Analog & Digital Signals • Introduction to Binary Logic • Applications of Digital Systems in real-world electronics 2. Number Systems & Conversions • Decimal (Base 10), Binary (Base 2), Octal (Base 8), Hexadecimal (Base 16) • Conversion between different number systems • Binary Addition, Subtraction, Multiplication, and Division • 1's & 2's Complement Representation (for negative numbers) 3. Boolean Algebra & Simplification • Basic Boolean Operations (AND, OR, NOT) • Boolean Theorems and simplification techniques • De Morgan's Theorems • Truth Tables for Boolean expressions 4. Logic Gates & Their Applications • Basic Logic Gates: AND, OR, NOT • Universal Gates: NAND, NOR • Exclusive Gates: XOR, XNOR • Gate-Level Implementation of Boolean Functions 5. Logic Circuit Design & Simplification • Karnaugh Maps (K-Maps) for 2, 3, and 4 variables • Using NAND & NOR Gates for circuit simplifications • Sum of Products (SOP) & Product of Sums (POS) representations 6. Arithmetic Circuits • Half Adder & Full Adder • Half Subtractor & Full Subtractor • Binary Adder/Subtractor Circuits 7. Combinational Circuits *(Brief Overview – Optional)* • Multiplexers (MUX) & Demultiplexers (DEMUX) • Encoders & Decoders 8. Introduction to Sequential Circuits *(Basic Concept Only)* • Difference between Combinational & Sequential Circuits

	• Introduction to Flip-Flops (SR, JK, D, T) – Conceptual Only 9. Practical Applications & Review • Practical Examples of Logic Gates in Electronics • Simple Digital Logic Projects • Review & Exam Preparation

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 discussions, while at the same time refining and expanding their critical thinking skills. This will be achieved through; 1- Lectures - aim to deliver fundamental knowledge in relation to dynamic analysis and the application to practical examples. 2- Tutorial sessions - are deployed to illustrate the application of fundamental knowledge of dynamic analysis to different practical exercises. 3- Assignments - are arranged to provide the opportunity for students to search for information, analyze machines with knowledge obtained, and present the completed tasks.

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	87	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	5.44
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluationتقييم المادة الدراسية					
		Time/Number	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	3, 12	LO #1, 2, 9-11
	Assignments	2	10% (10)	7, 13	LO # 1-6, 9-12
	Projects / Lab.	1	10% (10)	14	LO # 1-7, 9-13
	Reports	2	10% (10)	7,13	LO # 3, 4 and 5
Summative assessment	**Midterm Exam**	2 hr	10% (10)	8	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 Logic: Digital vs. analog signals, number systems, Overview lecture, real-life examples discussion.
Week 2	Number Systems (1): Decimal and binary systems, conversions, Exercises on decimal-to-binary conversion.
Week 3	Number Systems (2): Octal and hexadecimal, interconversion, Practical problems on number conversions.
Week 4	Binary Representation: 1's and 2's complement, binary arithmetic, Solving binary arithmetic problems.
Week 5	Introduction to Boolean Algebra: Fundamental laws, basic operations, Boolean expressions simplification exercises.
Week 6	Basic Logic Gates: AND, OR, NOT – Truth tables and circuits.
Week 7	Compound Logic Gates: NAND, NOR, XOR, XNOR, Practical circuit design using logic gates.
Week 8	**Midterm Exam**
Week 9	Logic Circuit Simplification: De Morgan's Theorems, Karnaugh Maps (K-Maps), Hands-on practice with Boolean simplifications.
Week 10	Expressions & Circuit Implementation: Converting Boolean expressions to circuits, Circuit design based on Boolean equations.
Week 11	Simplification using NAND & NOR: Implement circuits using only NAND/NOR gates, designing practical circuits.
Week 12	Applications of Logic Gates: Half Adder & Full Adder circuits, Mini project on arithmetic circuits.

Week 13	Introduction to Sequential Circuits: Basics of Flip-Flops, combinational vs. sequential logic.
Week 14	General Review: Solving comprehensive problems on numbers and gates.
Week 15	Group review session and exam preparation.

Delivery Plan (Weekly Lab. Syllabus) **المنهاج الاسبوعي للمختبر**	
	Material Covered
Week 1-2	Introduction to Basic Logic Gates
Week 3-4	Boolean Algebra & Karnaugh Map Simplification
Week 5-6	Half Adder & Full Adder Circuits
Week 7	Half Subtractor & Full Subtractor Circuits
Week 8	Mid Exam
Week 9-10	Sequential Logic – Flip-Flops
Week 11	Design of Counters
Week 12	Shift Registers
Week 13-14	Mini Project – Applied Digital Logic
Week 15	Final Review & Assessment

Learning and Teaching Resources **مصادر التعلم والتدريس**		
	Text	**Available in the Library?**
Required Texts	"Digital Design" – M. Morris Mano & Michael D. Ciletti	No
Recommended Texts	Introduction to Logic Circuits & Logic Design" – Brock J. LaMeres	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 with 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.

MODULE DESCRIPTION FORM

نموذج وصف المادة

الدراسية