Module Information معلومات المادة الدراسية					
Module Title	**AC Electrical Circuits**			**Module Delivery**	
Module Type	**Core**			☒ **Theory** ☐**Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	**HTCMT 107**				
ECTS Credits	**7**				
SWL (hr/sem)	**175**				
Module Level	First		**Semester of Delivery**	two	
Administering Department	Mech. Eng. Tech.		**College**	HTC	
Module Leader	Zaki M. Abdullah		**e-mail**	drzaki_hwj@ntu.edu.iq	
Module Leader's Acad. Title	Assistant Professor		**Module Leader's Qualification**	Ph.D.	
Module Tutor	Name (if available)		**e-mail**	E-mail	
Peer Reviewer Name	Zaki M. Abdullah			drzaki_hwj@ntu.edu.iq	
Scientific Committee Approval Date	01/03/2025		**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	**This module aims to:** 1. **Provide a fundamental understanding of alternating current (AC) principles, waveforms, and their characteristics.** 2. **Develop the ability to analyze and solve AC circuit problems involving resistors, inductors, and capacitors in series, parallel, and combination circuits.** 3. **Introduce the concept of impedance, reactance, and phasor analysis for better comprehension of AC circuit behavior.** 4. **Equip learners with knowledge of power calculations in AC circuits, including real, reactive, and apparent**

	power, as well as power factor correction. **5. Enhance problem-solving skills by applying network theorems (such as Thevenin's and Norton's theorems) to AC circuit analysis.** **6. Explore the practical applications of AC circuits in electrical power systems, transformers, motors, and generators.** 7. **Prepare students for advanced studies and practical applications in electrical engineering, automation, and power electronics.**
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**With the successful completion of this Module, students will be able to:** **1. Explain the principles of alternating current (AC) and differentiate it from direct current (DC).** 2. Describe sinusoidal waveforms, including amplitude, frequency, phase, and RMS values. 3. Calculate inductive and capacitive reactance and understand their impact on circuit 4. Determine impedance (Z) and phase angles in AC circuits. 5. Use Ohm's Law, Kirchhoff's Laws, and phasor diagrams to analyze AC circuits. 6. Apply Thevenin's and Norton's theorems in AC circuit analysis. 7. Solve AC circuit problems using complex numbers and

	phasor representation. 8. Calculate real, reactive, and apparent power in AC circuits. 9. Analyze the behavior of AC circuits in series, parallel, and combination configurations. 10. Predict resonance conditions in RLC circuits and calculate resonance frequency. 11. Study the type of the filters.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following topics: 1. Fundamentals of Alternating Current (AC): [10 hrs] • Definition and characteristics of AC vs. DC • Sinusoidal waveforms: frequency, period, amplitude, and phase • Mathematical representation of AC signals (sine and cosine functions) • RMS, peak, and average values of AC signals 2. AC Circuit Components [10] • Behavior of resistors, inductors, and capacitors in AC circuits • Inductive reactance (X_L) and capacitive reactance (X_C) • Impedance (Z) and phase relationships • Phasor representation of AC quantities 3. Analysis of AC Circuits [20 hrs] • Ohm's Law and Kirchhoff's Laws in AC circuits • Series and parallel AC circuits

	• Power in AC circuits: real, reactive, and apparent power • Power factor and its correction techniques 4. AC Circuit Theorems and Network Analysis [20hrs] • Thevenin's and Norton's Theorems applied to AC circuits • Superposition Theorem • Maximum Power Transfer Theorem • Resonance in RLC circuits (series and parallel resonance) 5. Transformers and Power Distribution [15] • Principles of AC transformers • Efficiency and losses in transformers • Single-phase vs. three-phase AC power systems • Power transmission and distribution concepts 6. Practical Considerations and Safety [60 hrs] • Measuring AC voltage, current, and power using instruments • Electrical safety standards in AC systems • Common faults and troubleshooting techniques in AC circuits

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The strategies needed in this subject are concentrated on enhancing the students thinking horizons so that they get familiar with it and can feel able to manipulate its problems details. This can be achieved by using real life examples, videos, and schemes with many problems to be solved. Also, the student is requested to solve a lot of problems. When this is accompanied by good utilization of the laboratory, students will be able to go through the course successfully.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/Sem) الحمل الدراسي المنتظم للطالب خلال الفصل	78	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5.2
Unstructured SWL (h/Sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	97	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6.4
Total SWL (h/Sem) الحمل الدراسي الكلي للطالب خلال الفصل	170		

Module Evaluation تقييم المادة الدراسية					
		Time/Number	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5, 10	LO #1, 2, 3,8,9,10
	Assignments	1	10% (10)	3, 12	LO # 3, 4, 6 and 7
	Projects / Lab.	10	10% (10)	Continuous	1-11
	Report	5	10% (10)	10	LO # 5, 8 and 10
Summative assessment	**Midterm Exam**	2 hr	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 AC Circuits • Difference between AC and DC • Sinusoidal waveforms: amplitude, frequency, period, phase • RMS value and average value of AC signals • Introduction to phasors
Week 2	Phasors and Complex Numbers • Representation of AC quantities using phasors • Complex numbers: rectangular and polar forms • Arithmetic operations with complex numbers • Impedance and admittance concepts
Week 3	Passive Components in AC Circuits • Behavior of resistors, capacitors, and inductors in AC circuits • Reactance (inductive and capacitive) • Impedance of R, L, and C components
Week 4	Series AC Circuits • Analysis of RLC series circuits

	• Impedance triangle and phase relationships • Voltage and current relationships in series circuits
Week 5	Parallel AC Circuits • Analysis of RLC parallel circuits • Admittance triangle and phase relationships • Current and voltage relationships in parallel circuits
Week 6	Network Theorems in AC Circuits • Thevenin's and Norton's theorems for AC circuits
Week 7	Network Theorems in AC Circuits • Superposition theorem • Maximum power transfer theorem
Week 8	Resonance in AC Circuits • Series resonance • Resonant frequency, bandwidth, and quality factor (Q) • Applications of resonant circuits
Week 9	Resonance in AC Circuits • parallel resonance • Resonant frequency, bandwidth, and quality factor (Q) • Applications of resonant circuits •

Week 10	Power in AC Circuits • Instantaneous power, average power, and power factor • Real, reactive, and apparent power • Power triangle and power factor correction •
Week 11	Mutual Inductance and Transformers • Mutual inductance and coupling coefficient • Ideal and real transformers • Transformer equivalent circuits and applications
Week 12	Three-Phase Systems • Introduction to three-phase AC systems • Star (Y) and delta (Δ) configurations • Line and phase voltages/currents in balanced systems •
Week 13	Unbalanced Three-Phase Circuits • Analysis of unbalanced three-phase systems • Neutral currents in unbalanced systems Applications and challenges of unbalanced systems
Week 14	Filters and Frequency Response • Low-pass, high-pass, band-pass, and band-stop filters • Applications of filters in AC circuits
Week 15	Transient Analysis in AC Circuits • Transient response of RLC circuits

	• Time constants and damping in AC circuits • Applications of transient analysis •
Week 16	• Preparatory week before the final Exam

Delivery Plan (Weekly Lab. Syllabus) **المنهاج الاسبوعي للمختبر**	
	Material Covered
Week 1	Introduction to function generators and oscilloscopes; measuring AC waveforms.
Week 2	Phasor analysis of simple AC circuits.
Week 3	Measuring impedance of R, L, and C components.
Week 4	Building and analyzing RLC series circuits.
Week 5	Building and analyzing RLC parallel circuits.
Week 6	Applying network theorems to AC circuits.
Week 7	Applying network theorems to AC circuits.
Week 8	Analyzing resonant circuits and measuring bandwidth in series circuits
Week 9	Analyzing resonant circuits and measuring bandwidth in parallel circuits
Week 10	Measuring power in AC circuits; power factor correction.
Week 11	Testing transformers and measuring turns ratio.
Week 12	Building and analyzing three-phase circuits.
Week 13	Analyzing unbalanced three-phase circuits.
Week 14	Designing and testing basic filters.

Week 15	Observing transient responses in AC circuits.

Learning and Teaching Resources **مصادر التعلم والتدريس**		
	Text	**Available in the Library?**
Required Texts	Fundamentals of Electric Circuits, C.K. Alexander and M.N.O Sadiku, McGraw-Hill Education	Yes
Recommended Texts	DC Electrical Circuit Analysis: A Practical Approach Copyright Year: 2020, dissidents.	No
Websites	https://www.coursera.org/browse/physical-science-and-engineering/electricalengineering	

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 -	متوسط	60 - 69	Fair but with major shortcomings

	Satisfactory			
	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	راس ب	(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