	Ministry of Higher Education and Scientific Research - Iraq University of Baghdad College of Engineering Department of Computer Engineering	

MODULE DESCRIPTOR FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**ELECTRICAL CIRCUITS AND SYSTEMS**			**Module Delivery**	
Module Type	**CORE**			Class Lecture + Lab.	
Module Code	**COE 109**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	1		**Semester of Delivery**	2	
Administering Department	**computer**		**College**	**Engineering**	
Module Leader	**Hussien Joma Abbas**		**e-mail**	**hussain.joma@alnaji-uni.edu.iq**	
Module Leader's Acad. Title	**Prof.**		**Module Leader's Qualification**	**Ph.D.**	
Module Tutor			**e-mail**		
Peer Reviewer Name			**e-mail**		
Review Committee Approval			**Version Number**	1.0	

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	COE104 Electrical Circuits, COE101 Mathematics 1	**Semester**	1 1
Co-requisites module	-	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Aims
أهداف المادة الدراسية

1. **Understand Signals and Systems**: To provide students with a solid understanding of continuous-time signals, periodic signals, and key signal properties such as power, energy, and waveform characteristics.
2. **Analyze AC Circuits**: Enable students to analyze AC circuits, including understanding resistance, reactance, impedance, conductance, susceptance, and admittance.
3. **Apply Phasor Analysis**: Develop proficiency in using phasor analysis to analyze AC circuits, including the use of phasor diagrams and complex numbers.
4. **Explore Circuit Resonance**: Investigate series and parallel resonance circuits, including quality factor, selectivity, bandwidth, and their practical applications.
5. **Calculate Power in AC Circuits**: Understand and calculate power in AC circuits, including power factor, power factor correction, and related concepts.
6. **Utilize Network Theorems**: Apply network theorems such as superposition, Thevenin's, and Norton's theorems to simplify and analyze AC circuits.
7. **Integrate Practical Applications**: Introduce practical applications of AC circuit analysis and signal processing in computer engineering contexts.
8. **Enhance Problem-Solving Skills**: Develop problem-solving skills through hands-on exercises, simulations, and real-world applications in AC circuit analysis and signal processing.

Module Learning Outcomes

مخرجات التعلم للمادة الدراسية

1. **Understand Signals and Systems**:
   - Explain the characteristics of continuous-time signals, including unit ramp, delta function, and periodic signals.
   - Calculate power, energy, and average values of waveforms.
2. **Analyze AC Circuits**:
   - Analyze the behavior of pure resistor, inductive, and capacitive elements in AC circuits.
   - Calculate impedance, reactance, and admittance using phasor analysis.
3. **Apply Phasor Analysis**:
   - Construct and interpret phasor diagrams for AC circuits.
   - Solve AC circuit problems using complex numbers and phasor techniques.
4. **Explore Circuit Resonance**:

	○ Analyze series and parallel resonance circuits, including quality factor, selectivity, and bandwidth. ○ Determine resonant frequency and half-power frequencies in resonance circuits. 5. **Calculate Power in AC Circuits**: ○ Compute real, reactive, and apparent power in AC circuits. ○ Evaluate power factor and perform power factor correction calculations. 6. **Utilize Network Theorems**: ○ Apply superposition, Thevenin's, and Norton's theorems to simplify and analyze AC circuits. ○ Verify theorems through practical applications and simulations. 7. **Integrate Practical Applications**: ○ Design and simulate AC circuits using software tools. ○ Apply AC circuit analysis principles to practical engineering problems. 8. **Enhance Problem-Solving Skills**: ○ Solve complex problems related to AC circuits and signals. ○ Demonstrate proficiency in analyzing and troubleshooting AC circuits in various applications.
Indicative Contents المحتويات الإرشادية	**Introduction to Signals and Systems** ● Overview of signals: continuous-time signals, unit ramp, delta function, periodic signals. ● Signal properties: power, energy, average, and RMS values of waveforms. **Electrical and Mechanical Angles** ● Representation of waveforms in electrical and mechanical domains. ● Instantaneous and RMS values, form factor, peak factor, and phasor quantities. **Voltage and Current Relationships** ● Analysis of pure resistive, inductive, and capacitive elements in AC circuits. ● Phasor representation of voltages and currents. **AC Circuit Analysis Fundamentals** ● Resistance, reactance, impedance, conductance, susceptance, and admittance in AC circuits. ● Phasor diagram representation of AC circuits. **Series and Parallel AC Circuits** ● Analysis of series and parallel AC circuits using phasor techniques.

	• Calculation of total impedance and admittance. **Power in AC Circuits** • Real, reactive, and apparent power calculations. • Power factor and power factor correction in AC circuits. **AC Circuit Analysis and Network Theorems** • Application of network theorems (superposition, Thevenin's, and Norton's theorems) to AC circuits. • Practical applications and problem-solving exercises. **Series and Parallel Resonance Circuits** • Characteristics of series and parallel resonance circuits. • Quality factor (Q), selectivity, half-power frequencies, and bandwidth calculations. **Practical Applications of AC Circuits** • Design and simulation of AC circuits using software tools (e.g., SPICE). • Case studies and real-world examples of AC circuit applications. **Practical Exercises and Applications** • Hands-on lab sessions: construction, measurement, and analysis of AC circuits. • Integration of theoretical knowledge with practical skills. **Final Project and Presentation** • Design and implementation of a comprehensive AC circuit project. • Presentation of project results, including analysis, simulation, and practical outcomes.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	1. Lectures: The module may include traditional lectures where the instructor presents the theoretical concepts, principles, and mathematical techniques related to mathematical modeling and electrical circuits. The lectures can provide a foundation for understanding the subject matter. 2. Interactive Discussions: Interactive discussions can be incorporated to encourage student participation and engagement. This can involve questioning and problem-solving activities related to mathematical modeling and electrical circuits. Discussions can help clarify concepts and stimulate critical thinking. 3. LAB Experiment. Sessions: Hands-on LAB.sessions can allow students to apply the theoretical knowledge to real-world scenarios. Students may work with electrical circuit components, measurement devices, and software tools for

	circuit simulation and analysis. LAB Experiment provide valuable experiential learning opportunities. 4. Computer-based Learning: Computer-based learning resources, such as online tutorials, interactive simulations, and educational software, can be used to supplement the learning process. These resources can assist students in visualizing electrical circuits, simulating their behavior, and exploring mathematical modeling concepts. 6. Group Projects: Collaborative group projects can encourage teamwork and the application of mathematical modeling principles to solve complex electrical circuit problems. Students can work together to design and analyze circuits, formulate mathematical models, and present their findings to the class. 7. Assessment Methods: Various assessment methods can be employed, including quizzes, tests, assignments, and project reports. These assessments can evaluate students' understanding of mathematical modeling and electrical circuits, their ability to apply the learned concepts, and their problem-solving skills. 8. Self-directed Learning: Encouraging students to engage in self-directed learning by exploring additional resources, conducting research, and practicing problems independently can further enhance their understanding and mastery of the subject matter.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	79	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5.267
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	71	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.733
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation
تقييم المادة الدراسية

		Time/ Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	3	10% (10)	3,7,11	LO #1, 2 and 3
	Assignments	2	5% (5)	8,14	LO # 1, 2,3, 7 and 8
	Lab.	7	20%(20)	1-15	LO #3,4 ,5 and 6
Summative assessment	**Projects**	1	5% (5)	12	LO #3, 4, 5, 6 and 7
	Mid Exam	1	10% (10)	15	LO # 1-4
	Final Exam	4 hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	Introduction to Signals and Systems ● Overview of signals: continuous-time signals, unit ramp, delta function, periodic signals.
Week 2	● Signal properties: power, energy, average and RMS values of waveforms.
Week 3	Electrical and Mechanical Angles
Week 4	Voltage and Current Relationships ● Analysis of pure resistive, inductive, and capacitive elements in AC circuits.
Week 5	● Phasor representation of voltages and currents.
Week 6	AC Circuit Analysis Fundamentals ● Resistance, reactance, impedance, conductance, susceptance, and admittance in AC circuits.
Week 7	● Phasor diagram representation of AC circuits.
Week 8	Series and Parallel AC Circuits ● Analysis of series and parallel AC circuits using phasor techniques.
Week 9	● Calculation of total impedance and admittance.
Week 10	Power in AC Circuits ● Real, reactive, and apparent power calculations.
Week 11	AC Circuit Analysis and Network Theorems ● Application of network theorems Thevenin's, and Norton's
Week 12	● superposition
Week 13	Series and Parallel Resonance Circuits
Week 14	Practical Applications of AC Circuits ● Design and simulation of AC circuits using software tools (e.g., SPICE).
Week 15	● Case studies and real-world examples of AC circuit applications.
Week 16	Review and revision and Final examination preparation

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	Introduction to Lab Equipment and Basic Measurements
Week 2	EXP 1: **Introduction to Signals and Waveforms**

	● **Objective**: Familiarize students with different types of signals and their properties. ● **Activities**: ○ Generate and observe continuous-time signals such as sinusoidal, square, and triangular waves using function generators. ○ Measure and calculate the average and RMS values of waveforms. ○ Introduce oscilloscope operation for waveform visualization.
Week 3	cont.
Week 4	EXP 2: **Phasor Analysis and AC Circuit Basics** ● **Objective**: Understand phasor representation and basic AC circuit analysis techniques. ● **Activities**: ○ Construct phasor diagrams for resistive, inductive, and capacitive AC circuits. ○ Measure and calculate impedance, reactance, and admittance using phasor techniques. ○ Verify calculations through experimental measurements using AC signal sources.
Week 5	EXP 3: **Series and Parallel AC Circuits** ● **Objective**: Analyze series and parallel AC circuits using phasor methods. ● **Activities**: ○ Construct series and parallel AC circuits with resistors, capacitors, and inductors. ○ Measure total impedance and current distribution in these circuits. ○ Compare theoretical predictions with experimental results and discuss discrepancies.
Week 7	cont.
Week 8	EXP 4: **Power in AC Circuits** ● **Objective**: Calculate real, reactive, and apparent power in AC circuits. ● **Activities**: ○ Measure voltage and current waveforms in AC circuits.

	○ Calculate power using oscilloscope measurements and power analyzers.
Week 9	EXP 5: **Network Theorems in AC Circuits** ● **Objective**: Apply network theorems to simplify and analyze AC circuits. ● **Activities**: ○ Implement superposition, Thevenin's, and Norton's theorems in practical AC circuit configurations. ○ Verify theorem applications through experimental circuit measurements. ○ Discuss the advantages and limitations of each theorem in circuit analysis.
Week 10	cont.
Week 11	EXP 6: **Resonance in AC Circuits** ● **Objective**: Investigate series and parallel resonance phenomena. ● **Activities**: ○ Construct series and parallel resonance circuits with adjustable parameters. ○ Measure resonant frequency, quality factor (Q), and bandwidth. ○ Analyze frequency response and selectivity characteristics using frequency sweeps and measurements.
Week 12	cont.
Week 13	**Simulation and Design Project** ● **Objective**: Apply knowledge gained to design and simulate a comprehensive AC circuit project. ● **Activities**: ○ Select a project topic related to AC circuits and signals. ○ Design the circuit using simulation software (e.g., SPICE). ○ Simulate and analyze circuit performance, including frequency response and power characteristics. ○ Present findings and conclusions from the project in a final report or presentation.

Week 14	cont.
Week 15	Final Exam

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	1-Fundamentals of Modern Electric Circuit Analysis and Filter Synthesis A Transfer Function Approach Second Edition© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2023 2-Fundamentals of Electric Circuits Charles K. Alexander Professor Emeritus of Electrical Engineering and Computer Science Cleveland State University ,Matthew N. O. Sadiku Department of Electrical and Computer Engineering Prairie View A&M University Published by McGraw-Hill Education, 2 Penn Plaza, New York, NY 10121. Copyright © 2021 by McGraw-Hill Education. 3."Engineering Circuit Analysis" by William H. Hayt Jr. and Jack E. Kemmerly: This textbook provides a comprehensive introduction to electrical circuits, covering topics such as circuit analysis techniques, network theorems, and AC circuit analysis. 5."Introduction to Electric Circuits" by Richard C. Dorf and James A. Svoboda: This textbook offers a practical approach to understanding electric circuits. It covers topics such as circuit analysis techniques, network theorems, AC circuit analysis, and introduces mathematical modeling principles. 4."Mathematical Modeling and Simulation: Introduction for Scientists and Engineers" by Kai Velten: This textbook focuses specifically on mathematical modeling techniques and their application in various scientific and engineering fields. It covers topics such as modeling principles, differential equations, simulation methods, and includes examples relevant to electrical circuits.	Yes Soft copy
Recommended Texts	1. "Electric Circuits" by James W. Nilsson and Susan A. Riedel: This textbook offers a clear and concise introduction to electrical circuits and circuit analysis. It covers topics such as Kirchhoff's laws, network theorems, AC circuit analysis, and introduces mathematical modeling techniques. 2. "Mathematical Modeling and Simulation: Introduction for Scientists and Engineers" by Kai Velten: This textbook focuses specifically on mathematical modeling techniques and their application in various scientific and engineering fields. It covers topics such as modeling principles, differential equations, simulation methods, and includes examples relevant to electrical circuits. 3. Basic Engineering Circuit Analysis J. DAVID IRWIN Auburn University R. MARK NELMS Auburn University 2021 12th Edition	Yes pdf

	4-Fundamentals of Modern Electric Circuit Analysis and Filter Synthesis A Transfer Function Approach Second Edition© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2023 5-Fundamentals of Electric Circuits Charles K. Alexander Professor Emeritus of Electrical Engineering and Computer Science Cleveland State University ,Matthew N. O. Sadiku Department of Electrical and Computer Engineering Prairie View A&M University Published by McGraw-Hill Education, 2 Penn Plaza, New York, NY 10121. Copyright © 2021 by McGraw-Hill Education.	
Websites	1. MATLAB(www.mathworks.com/products/matlab.html 2. Simulink (www.mathworks.com/products/simulink.html) 3. CircuitLab (www.circuitlab.com) 4. Multisim Live (www.multisim.com/live/)	

APPENDIX:

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	مقبول بقرار	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required
Note:				

NB 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.