Course Specification
(Bachelor)

Course Title:	Physics of Circuit Analysis
Course Code:	PHYS 0223
Program:	**BSc in Physics and BSc in Physics of Renewable Energy and Environment**
Department: :	**Physics**
College:	**Science**
Institution:	Majmaah University
Version:	**1**
Last Revision Date:	**27/12/2024**

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A. General information about the course:

1. Course Identification

1. Credit hours: 3 (3,0,0)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 4/ Year 2)					
4. Course General Description:					
This course provides a comprehensive introduction to the analysis of electric circuits, focusing on the underlying physical principles. It covers a wide range of topics, from the fundamentals and basic principles of DC and AC circuits to advanced circuit analysis techniques.					
5. Pre-requirements for this course (if any)**:**					
PHYS 0222 Electricity and Magnetism 2					
6. Co-requisites for this course (if any)**:**					
Nill					
7. Course Main Objective(s):					
1-Apply Kirchhoff's Voltage Law (KVL), Kirchhoff's Current Law (KCL), along with component characteristics, and element equations including Ohm's Law. 2-Students will be able to analyze DC circuits by using the laws of electric circuits and employing various techniques such as Mesh analysis, Nodal analysis, and Equivalent Resistance Combinations, along with theorems such as Superposition, Thevenin's, and Norton's theorems. 3-Students will be able to find the parameters of AC sinusoidal waveforms and analyze series resistive-capacitive-inductive circuits with a sinusoidal source.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100 %
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	To know the basic concepts and behavior of DC and AC circuits theorems	K1	Lecture Exercises Quizzes Problem solving	Exams Quizzes Homework Assignments
1.2	To know various methods of circuit/ network analysis using network	K1	Lecture Quizzes Problem-solving	Exams Quizzes Homework Assignments
1.3	To understand the transient and steady state response of the circuits subjected to DC excitations and AC with sinusoidal excitations.	K2	Lecture Exercises Quizzes Problem-solving	Exams Quizzes Homework Assignments
2.0	Skills			
2.1	Provide a correlation between theory and practice and should help explain how scientists arrive at their theories from experimental approaches within the laboratory setting	S1	Oral quizzes Class discussion Exercises Quizzes Problem solving	Homework Oral problems
2.2	To apply the concept of coupling in circuits and topologies.	S2	Lecture	To learn the concept of coupling in

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
				circuits and topologies.
2.3	Collect data and information and perform analysis, interpretation and draw inferences or conclusions.	S4	Oral quizzes Class discussion Exercises Quizzes Problem solving	Homework Oral problems
3.0	Values, autonomy, and responsibility			
3.1	Participate in class discussion and think critically.	V1	2.Group Presentation 3.Group assignments	Observation Group discussion Group Report e-learning quizzes
3.2	Acting responsibly and ethically in carrying out individual as well as group projects.	V2	1.Give time bound task. 2.Group Presentation 3.Group assignments	Observation Group discussion Group Report e-learning quizzes

C. Course Content

No	List of Topics	Contact Hours
1.	Understand Fundamental Concepts: Units, Conversions, Voltage, Current, Resistance, Resistors, Conductors, Insulators, Ohm's Law, Power, Energy, Conductance, Voltmeters, Ammeters, Ohmmeters	4
2.	Advanced Series and Parallel Circuits: Equivalent Resistance, Current, Voltages, Powers, Multiple Sources, Kirchhoff's Voltage Law, Voltage Divider Rule. Advanced Series-Parallel Networks, Open and Short Circuits.	6
3	Current Sources, Superposition with Voltage and Current Sources, Current to Voltage Source Conversions, Mesh (Loop) Analysis, Voltage to Current Source Conversions, Nodal Analysis, Thevenin's and Norton's Theorems, Maximum Power Transfer Theorem.	4
4	Capacitance, Capacitors, Transients in Resistor-Capacitor Circuits,	4

	Capacitor (Average) Current Equation, advanced Capacitors in Series and Parallel.	
5	Inductance, VL (avg), Sinusoidal AC Voltage and Current Waveforms: Peak, Peak-to-Peak values, Period, Frequency, Angular Velocity, Sinusoidal Waveform Math Equation Format, instantaneous values	4
6	AC Phase Angle relationships, Effective (rms) values of Sine Waves, Capacitive and Inductive Reactance, Currents and Voltages in Circuits with one R, L, or C	4
7	Phasor Representations, Impedance and analysis of Series R-L-C circuits with an AC sinusoidal source: Total Impedance, Phasor Current and Voltages, Power	4
	Electronic Lab Course Topics- Tables of Week Numbers and Lab Course Topics	
1	The Oscilloscope and Function Generator	3
2	Verifications of KVL and KCL.	3
3	Verifications Capacitors in Series and Parallel	3
4	Verifications of Thevenin and Norton theorem	3
5	Verification of Superposition Theorem.	3
6	Verification of maximum power transfer Theorem	3
7	Determination of Resonance Frequency of Series and Parallel RLC Circuits.	3
8	Transient analysis of RL and RC circuits.	3
9	Phasor Diagrams, AC Circuit Power Analysis,	3
10	Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power	3
Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	First exam	6th	15%
2.	Second exam	12th	15%
3.	Lab. Exam	12th	20%
4.	Homework	Every week	5%
5	Quiz	8th	5%
6	Final exam	End of the semester	40%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	**Introductory Circuit Analysis,** Robert Boylestad,2015, Pearson pub.
Supportive References	**Lab Manual for Introductory Circuit Analysis, Robert Boylestad & Gabriel Kousourou, 2015, Pearson pub**
Electronic Materials	**• Saudi Digital Library (SDL)** **• Laboratory Requirements:** **• Resistors, Capacitors, Inductors – Sufficient Quantities. Bread** **• Boards – 15 Nos.** **• Oscilloscopes (30Mhz) – 10 Nos.** **• Function Generators (3Mhz) – 10 Nos.** **• Dual Regulated Power Supplies (0 – 30V) – 10 Nos.** **• Computer System with latest specifications connected** **• Simulation software-Multisim or any equivalent simulation software**
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**Classrooms, data show**
Technology equipment (projector, smart board, software)	**Smart Board, software**
Other equipment (depending on the nature of the specialty)	**Library, Seminar Room, and Wi-Fi internet connections**

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students/ internal committee	Direct (Student evaluation electronically organized by Deanship of registration and admission)/ Verification of students' papers
Effectiveness of students' assessment	Staff members (Peer Reviewer)	Indirect (Frequent meetings and consultation among the teaching staff)
Quality of learning resources	Staff members (Peer Reviewer)	Indirect (Frequent meetings

Assessment Areas/Issues	Assessor	Assessment Methods
		and consultation among the teaching staff)
The extent to which CLOs have been achieved	Staff members (Peer Reviewer)	Direct (Meeting between course coordinators and the tutors)

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**DEPARTMENT COUNCIL**
REFERENCE NO.	**16**
DATE	**30/12/2024**