INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRICAL AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**ELECTRICAL CIRCUIT ANALYSIS LABORATORY**				
Course Code	AEEB06				
Programme	B.Tech				
Semester	II	ECE			
Course Type	Foundation				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	2	1
Chief Coordinator	**Mr. A Srikanth, Assistant Professor, EEE**				
Course Faculty	**Mr. A Srikanth, Assistant Professor, EEE** **Mr. N Shivaprasad, Assistant Professor, EEE** **Mr. K Lingaswamy, Assistant Professor, EEE** **Mr. T Mahesh, Assistant Professor, EEE**				

I. COURSE OVERVIEW:

This course introduces the concepts of basic electrical engineering parameters, quantities, analysis of DC circuits. The course teaches different fundamental laws Ohms laws, Kirchhoff laws ,mesh, nodal analysis, super mesh and super node analysis. Different electrical concepts, network topology in complex circuits and Measuring the impedance of series RL, RC and RLC circuits. Steady state analysis of series and parallel circuits.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHSB02	I	Linear Algebra and Calculus	UG

III. MARKSDISTRIBUTION

Subject	SEE Examination	CIA Examination	Total Marks
Electrical Circuit Analysis Laboratory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✘	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✘	Seminars	✘	Mini Project	✔	Videos
✔	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

20 %	To test the preparedness for the experiment.
20 %	To test the performance in the laboratory.
20 %	To test the calculations and graphs related to the concern experiment.
20 %	To test the results and the error analysis of the experiment.
20 %	To test the subject knowledge through viva – voce.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Table 1: Assessment pattern for CIA

Component	**Laboratory**		**Total Marks**
Type of Assessment	Day to day performance	Final internal lab assessment	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):
One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Preparation	**Performance**	**Calculations and Graph**	**Results and Error Analysis**	**Viva**	**Total**
2	2	2	2	2	10

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Calculations of the observations
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	3	Exercise, Discussion and Seminars
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	3	Seminar
PO5	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3	Term observations

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	**Problem Solving Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	2	Exercise, Discussion and Seminars
PSO2	**Professional Skills:** To explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	--	--
PSO3	**Modern Tools in Electrical Engineering:** To be able to utilize of technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, and maintain power systems and industrial applications.	--	--

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Examine the basic laws and network reduction techniques.
II	Predict the characteristics of sinusoidal function.
III	Calculate and verify the electrical quantities in series RL, RC and RLC circuit.
IV	Discuss the faradays laws of electromagnetic induction and magnetic circuits.
V	Prove the various theorems used to reduce the complexity of electrical network

IX. COURSE OUTCOMES(COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Understand and analyze basic AC and DC electrical circuits.	CLO 1	Understand the characteristics of basic electrical and electronics components.
		CLO 2	Understand the concept of circuit, classification of elements and types of energy sources.
CO 2	Apply mesh analysis and nodal analysis to solve electrical networks.	CLO 3	State different laws associated with electrical circuits and apply source transformation technique to determine equivalent resistance and source current.
		CLO 4	Apply the network reduction techniques directly and indirectly to calculate quantities associated with electrical circuit
		CLO 5	Apply Ohm's law and Kirchhoff's laws to determine equivalent resistance, current and voltage in any branch of a circuit.
CO 3	Illustrate single phase AC circuits and apply steady state analysis to time varying circuits.	CLO 6	Calculate the loop current and node voltages in complex circuits using network topology.
		CLO 7	Identify the alternating quantities with it instantaneous, average and root mean square values.
		CLO 8	Demonstrate the impression of reactance, susceptance, impedance and admittance in estimating power of AC circuits.
CO 4	Discuss the faradays laws of electromagnetic induction and magnetic circuits.	CLO 9	Demonstrate the concept of rectangular and polar form AC circuits.
		CLO 10	Demonstrate the concept of power, real, reactive and complex power, power factor of AC circuits
		CLO 11	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation.
CO 5	Understand the characteristics of complex electrical networks using DC and AC Theorems.	CLO 12	Design the series and parallel RLC for the required bandwidth, resonant frequency and quality factor.
		CLO 13	State the faraday's laws of electromagnetic induction used in construction of magnetic Circuit.
		CLO 14	Summarize the procedure of thevenin's, norton's and milliman's theorems to reduce complex network into simple equivalent network.

X. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes (COs)	Program Outcomes (POs)				Program Specific Outcomes (PSOs)
	PO1	PO2	PO3	PO5	PSO2
CO 1	2		3	3	2
CO 2	3	3	3	3	2
CO 3	2		3	3	2
CO 4	2	3	2	3	2
CO 5	2	2	3	3	2

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XI. COURSE LEARNING OUTCOMES:

Students, who complete the course, will have demonstrated the ability to do the following:

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEEB06.1	CLO 1	Understand the characteristics of basic electrical and electronics components.	PO1, PO5	2
AEEB06.2	CLO 2	Understand the concept of circuit, classification of elements and types of energy sources.	PO1, PO3,PO5	3
AEEB06.3	CLO 3	State different laws associated with electrical circuits and apply source transformation technique to determine equivalent resistance and source current.	PO1, PO3, PO5	3
AEEB06.4	CLO 4	Apply the network reduction techniques directly and indirectly to calculate quantities associated with electrical circuit	PO1, PO5	3
AEEB06.5	CLO 5	Apply Ohm's law and Kirchhoff's laws to determine equivalent resistance, current and voltage in any branch of a circuit.	PO1, PO2	3
AEEB06.6	CLO 6	Calculate the loop current and node voltages in complex circuits using network topology.	PO1,PO3, PO5	3
AEEB06.7	CLO 7	Identify the alternating quantities with it instantaneous, average and root mean square values.	PO1, PO5	3
AEEB06.8	CLO 8	Demonstrate the impression of reactance, susceptance, impedance and admittance in estimating power of AC circuits.	PO1, PO3,PO5	2
AEEB06.9	CLO 9	Demonstrate the concept of rectangular and polar form AC circuits.	PO1,PO5	2
AEEB06.10	CLO 10	Demonstrate the concept of power, real, reactive and complex power, power factor of AC circuits	PO1, PO5	2
AEEB06.11	CLO 11	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation.	PO1, PO2, PO5	2
AEEB06.12	CLO 12	Design the series and parallel RLC for the required bandwidth, resonant frequency and quality factor.	PO1, PO2, PO3, PO5	2
AEEB06.13	CLO 13	State the faraday's laws of electromagnetic induction used in construction of magnetic Circuit.	PO1, PO2, PO3, PO5	2
AEEB06.14	CLO 14	Summarize the procedure of thevenin's, norton's and milliman's theorems to reduce complex network into simple equivalent network.	PO1, PO5	2

XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcome (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2				3								2		
CLO 2	2		3		3								2		
CLO 3	2		3		3								2		

Course Learning Outcome (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 4	3				3								2		
CLO 5	3	3											2		
CLO 6	2		3		3								2		
CLO 7	3				3								2		
CLO 8	1		3		3								2		
CLO 9	2				3								2		
CLO 10	2				3								2		
CLO 11	1	2											2		
CLO 12	2	2	3		3								2		
CLO 13	2	2	3		3								2		
CLO 14	1				3								2		
CLO15	3	3	2		3				2	2	2		2		

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XIII. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2 PO 3, PO 5, PSO2	SEE Exams	PO 1, PO 2 PO 3, PO 5 PSO2	Assignments	PO 1	Seminars	PO 2
Laboratory Practices	PO 1, PO 2 PO 3, PO 5	Student Viva	PO 1, PO 2 PO 3, PO 5	Mini Project	PO 2	Certification	-

XIV. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS:

LIST OF EXERCISES	
Week. 1	**OHM"S LAW, KVL AND KCL**
Verification of Ohm"s law, KVL and KCL using hardware and digital simulation.	
Week. 2	**MESH ANALYSIS**
Determination of mesh currents using hardware and digital simulation	

Week. 3	**NODAL ANALYSIS**
Measurement of nodal voltages using hardware and digital simulation.	
Week. 4	**SINGLE PHASE AC CIRCUITS**
Calculation of average value, RMS value, form factor, peak factor of sinusoidal wave using hardware.	
Week. 5	**IMPEDANCE OF SERIES RL, RC, RLC CIRCUIT**
Examine the impedance of series RL,RC,RLC Circuit	
Week. 6	**SERIES RESONANCE**
Verification of series resonance using hardware and digital simulation	
Week. 7	**PARALLEL RESONANCE**
Verification of parallel resonance using hardware and digital simulation.	
Week. 8	**SUPER POSITION THEOREM**
Verification of super position using hardware and digital simulation.	
Week. 9	**RECIPROCITY THEOREM**
Verification of reciprocity using hardware and digital simulation.	
Week. 10	**MAXIMUM POWER TRANSFER THEOREM**
Verification of maximum power transfer theorem using hardware and digital simulation.	
Week. 11	**THEVENINS THEOREM**
Verification of thevenin's theorem using hardware and digital simulation.	
Week. 12	**NORTONS THEOREM**
Verification of Norton's theorem using hardware and digital simulation.	
Week. 13	**COMPENSATION THEOREM**
Verification of compensation theorem using hardware and digital simulation.	
Week. 14	**MILLIMAN'S THEOREM**
Verification of milliman's theorem using hardware and digital simulation.	

TEXT BOOKS:

1	A Chakrabarti, "Circuit Theory", Dhanpat Rai Publications, 6th Edition, 2006.
2	William Hayt, Jack E Kemmerly S.M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 7th Edition, 2010.
3	K S Suresh Kumar, "Electric Circuit Analysis", Pearson Education, 1st Edition, 2013.

REFERENCES:

1	John Bird, "Electrical Circuit Theory and technology", Newnes, 2nd Edition, 2003.
2	C. L. Wadhwa, "Electrical Circuit Analysis including Passive Network Synthesis", New Age International, 2nd Edition, 2009.
3	David A. Bell, "Electric circuits", Oxford University Press, 7th Edition, 2009.

XVI. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Week No.	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Verification of Ohm‟s law, KVL and KCL using hardware and digital simulation.	CLO 1	T2:1.2 R1:1.4
2	Determination of mesh currents using hardware and digital simulation	CLO 2	T1:1.5 R1:2.4
3	Measurement of nodal voltages using hardware and digital simulation.	CLO 3	T1:2.5 R1:2.5
4	Calculation of average value, RMS value, form factor, peak factor of sinusoidal wave using hardware.	CLO 4	T1:2.5 R1:2.6
5	Examine the impedance of series RL,RC,RLC Circuit	CLO 5	T2:1.5
6	Verification of series resonance using hardware and digital simulation	CLO 6	T1:6.3 R1:5.3
7	Verification of parallel resonance using hardware and digital simulation.	CLO 7	T2:4.2 R1:6.3
8	Verification of super position using hardware and digital simulation.	CLO 8	T1:8.5 R1:6.8
9	Verification of reciprocity using hardware and digital simulation.	CLO 9	T1:12.2 R1:13.1
10	Verification of maximum power transfer theorem using hardware and digital simulation.	CLO 10	T2:9.3 R1:13.2
11	Verification of thevenin’s theorem using hardware and digital simulation.	CLO 11	T2:9.5 R1:13.7
12	Verification of Norton’s theorem using hardware and digital simulation.	CLO 12	T1:11.2 R1:10.2
13	Verification of compensation theorem using hardware and digital simulation.	CLO 13	T3:10.13 R1:10.2
14	Verification of milliman’s theorem using hardware and digital simulation	CLO 14	T3:10.14 R1:10.4

XVII. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S NO	Description	Proposed Actions	Relevance With POS	Relevance With PSOS
1	Analysis of electrical circuits using MATLAB	Seminars and Laboratory Practice	PO2	---
2	Design of electrical circuit using graph theory in PC	Seminars and Laboratory Practice	PO3	PSO1

Prepared by:
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HOD, ECE