INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**ELECTRICAL CIRCUITS**				
Course Code	**AEE002**				
Programme	B.Tech				
	II	ECE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	**Mr. T. Vignyesh, Assistant Professor.EEE**				
Course Faculty	**Mr. T Anil Kumar, Assistant Professor, EEE** **Mr. K Raju, Associate Professor, EEE** **Mr. T Vigneysh, Assistant Professor, EEE** **Mr. G Hari krishna, Assistant Professor, EEE**				

I. COURSE OVERVIEW:

This course deals with fundamentals of electrical circuit analysis, basic parameters like resistor, inductor and capacitor, formation of circuit and network, nature of sources to feed the networks, different network reduction techniques to study behavior of networks, single phase AC circuits and their analysis and network theorems for reducing complexity of networks and for easy simplifications.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS002	I	Linear Algebra and Ordinary Differential Equations	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Electrical Circuits	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:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either‟ or ‟choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 2	**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	Seminar
PO 3	**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.	2	Project Work / Tutorial

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.	2	Assignment and Seminar
PSO 2	**Problem-Solving Skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.	--	--
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	--	--

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand the basic parameters, formation of circuit and network.
II	Apply different network reduction techniques to solve complex electrical networks..
III	Use network topology technique to solve complex electrical networks.
IV	Analyze single phase AC circuits and their behavior.
V	Summarize the conditions for electrical resonance.
VI	Explain the importance of magnetic circuits and their behavior in electrical engineering.
VII	Examine complex electrical networks using network theorems.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
CAEE002.01	CLO 1	Define the various nomenclature used to study the characteristics of DC networks.	PO1	3
CAEE002.02	CLO 2	Understand the concept of circuit, classification of elements and types of energy sources.	PO1	3
CAEE002.03	CLO 3	State different laws associated with electrical circuits and apply source transformation technique to determine equivalent resistance and source current.	PO1, PO2, PSO1	3
CAEE002.04	CLO 4	Apply the network reduction techniques directly and indirectly to calculate quantities associated with electrical circuit	PO1, PO2, PSO1	3
CAEE002.05	CLO 5	Define the various nomenclature related with network topology and give the importance of dual network.	PO1, PO2	3
CAEE002.06	CLO 6	Formulate incidence, tie-set and cut-set matrix which are used to solve the behavior of complex electrical circuits.	PO1, PO2, PSO1	3
CAEE002.07	CLO 7	Identify the alternating quantities with it instantaneous, average and root mean square values.	PO1, PO2	3
CAEE002.08	CLO 8	Demonstrate the impression of reactance, susceptance, impedance and admittance in estimating power of AC circuits.	PO1, PO2	3
CAEE002.09	CLO 9	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation.	PO1, PO2,PSO1	3
CAEE002.10	CLO 10	Design the series and parallel RLC for the required bandwidth, resonant frequency and quality factor.	PO1, PO2, PSO1	3
CAEE002.11	CLO 11	State the faraday‟s laws of electromagnetic induction used in construction of magnetic circuit.	PO1, PO2, PSO1	3
CAEE002.12	CLO 12	Determine magnetic flux, reluctance, self and mutual inductance in the single coil and coupled coils magnetic circuits.	PO1, PO2 PSO1	3
CAEE002.13	CLO 13	Prove the law of conservation of energy, superposition principle, reciprocity and maximum power transfer condition for the electrical network with DC and AC excitations.	PO1, P02,PO3 PSO1	3
CAEE002.14	CLO 14	Summarize the procedure of thevenin‟s, norton‟s and milliman‟s theorems to reduce complex network into simple equivalent network.	PO1, P02,PO3, PSO1	3
CAEE002.15	CLO 15	Explain the steps of compensation, zero current and voltage shift theorem to predict constraints of electrical networks.	PO1, P02, PSO1	3
CAEE002.16	CLO 16	Apply the network reduction techniques , concept of graph theory, resonance and faraday‟s laws to solve real constraints of electrical and magnetic circuits.	PO1, P02,PSO1	3
CAEE002.17	CLO 17	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.	PO1, P02 PSO1	3

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

(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	3												1		
CLO 2	3												2		
CLO 3	3	3											3		
CLO 4	3	3											3		
CLO 5	3	2											1		
CLO 6	3	2											1		
CLO 7	3	2											2		
CLO 8	3	2											2		
CLO 9	3	3											2		
CLO 10	3	3											3		
CLO 11	3	3											3		
CLO 12	3	2											2		
CLO 13	3	3	3										2		
CLO 14	3	3	3										2		
CLO 15	3	3											2		
CLO 16	3	3											2		
CLO 17	3	3											2		

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XI. ASSESSMENT METHODOLOGIES – DIRECT:

CIE Exams	PO1, PO2, PO3, PSO1	SEE Exams	PO1, PO2, PO3, PSO1	Assignments	PO1	Seminars	PO1
Laboratory Practices	PO1	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES – INDIRECT:

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

XIII. SYLLABUS

Unit-I	INTRODUCTION OF ELECTRICAL CIRCUITS
Circuit concept: Basic definitions, Ohm"s law at constant temperature, classifications of elements, R, L, C parameters, independent and dependent sources, voltage and current relationships for passive elements (for different input signals like square, ramp, saw tooth, triangular and complex), temperature dependence of resistance, tolerance, source transformation, Kirchhoff"s laws, equivalent resistance of series, parallel and series parallel networks.	
Unit-II	**ANALYSIS OF ELECTRICAL CIRCUITS**
Circuit analysis: Star to delta and delta to star transformation, mesh analysis and nodal analysis by Kirchhoff"s laws, inspection method, super mesh, super node analysis; Network topology: definitions, incidence matrix, basic tie set and basic cut set matrices for planar networks, duality and dual networks.	
Unit-III	**SINGLE PHASE AC CIRCUITS**
Single phase AC circuits: Representation of alternating quantities, instantaneous, peak, RMS, average, form factor and peak factor for different periodic wave forms, phase and phase difference, „j" notation, concept of reactance, impedance, susceptance and admittance, rectangular and polar form, concept of power, real, reactive and complex power, power factor. Steady state analysis: steady state analysis of RL, RC and RLC circuits (in series, parallel and series parallel combinations) sinusoidal excitation.	
Unit-IV	**RESONANCE AND MAGNETIC CIRCUITS**
Resonance: Series and parallel resonance, concept of band width and Q factor. Magnetic circuits: Faraday"s laws of electromagnetic induction, analysis of series and parallel magnetic circuits, composite magnetic circuits, coupled coils, concept of self and mutual inductance, dot convention, coefficient of coupling, multi winding analysis.	
Unit-V	**NETWORK THEOREMS (DC and AC)**
Theorems: Zero current theorem, Tellegen"s, superposition, reciprocity, voltage shift theorem, Thevinin"s, Norton"s, maximum power transfer, Milliman"s and compensation theorems for DC and AC excitations.	
Text Books:	
1. A Chakrabarthy, "Electric Circuits", Dhanpat Rai & Sons, 6th Edition, 2010. 2. A Sudhakar, Shyammohan S Palli, "Circuits and Networks", Tata McGraw-Hill, 4th Edition, 2010 3. M E Van Valkenberg, "Network Analysis", PHI, 3rd Edition, 2014. 4. Rudrapratap, "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers", Oxford University Press, 1st Edition, 1999.	
Reference Books:	
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.	

XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Define the voltage, current, power and energy.	CLO1	T1:1.1-1.5
2	Define resistance, inductance and capacitance and their V-I characteristics.	CLO1	T1:1.1-1.5
3	Understand different elements in power systems and sources to drive the network.	CLO2	T1:1.6-1.8
4	Understand the behavior of RLC for different input signals.	CLO2	T2:1.7
5	Understand application of kirchoff‟s laws for electrical networks.	CLO3	T1:1.9-1.13
6	Apply the RLC parameters in series and parallel combinations to form electrical network.	CLO3	T1:1.9-1.13
7	Apply the solution for the network using network reduction technique.	CLO3	T1:2.15
8	Apply the network reduction techniques using mesh analysis to determine current, voltage and power in each and every element and of the network.	CLO4	T1:2.9-2.11
9	Apply the network reduction techniques using using nodal analysis to determine current, voltage and power in each and every element and of the network.	CLO4	T1:2.12 2.14
10	Apply the network reduction techniques using of power systems networks using above reduction techniques.	CLO4	T1:2.12-2.14
11-13	Apply the network reduction techniques for different complex problems.	CLO4	T1:2.12-2.14
14	Define the various nomenclature related with network topology.	CLO5	T1:2.1-2.3
15	Formulate incident matrix from which characteristics of electrical circuits can be studied.	CLO6	T1:2.4-2.5
16	Formulate incident matrix from which current flowing through each element can be determined.	CLO6	T1:2.7
17	Formulate incident matrix from which voltage across each element can be determined.	CLO6	T1:2.8
18	Formulate incident matrix from which voltage across each element can be determined.	CLO6	T1:2.7-2.8
19	Formulate complex network into simple network without changing results.	CLO6	T1:3.8
20	Define the various nomenclature related with network topology and give the importance of dual network.	CLO7	T1:3.8
21-23	Define the various nomenclature related with network topology and give the importance of dual network	CLO7	T1:3.9-315
24	Identify the representing alternating quantity with sine wave.	CLO7	T1:4.1
25	Understand the characteristics of sine wave in alternating quantity	CLO7	T1:4.2-4.4
26	Understand behavior of series circuits with sine input	CLO7	T1:12.5-12.7
27	Understand behavior of parallel circuits with sine input	CLO7	T1:12.5-12.7
28	Demonstrate the impression of reactance, susceptance, impedance and admittance in estimating power of AC circuit.	CLO8	T1:5.1-5.4
29	Demonstrate the impression of reactance, susceptance, impedance and admittance in estimating power of AC circuit	CLO8	T1:5.1-5.4
30	Demonstrate the impression of reactance, susceptance, impedance and admittance in estimating power of AC circuit	CLO8	T1:6.1-6.5
31	Demonstrate the impression of reactance, susceptance, impedance and admittance in estimating power of AC circuit	CLO8	T1:6.1-6.5

33	Understand behavior of different AC circuits that come across in power systems(finding alternating current, alternating Voltage, complex power).	CLO8	T1T2
34	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation	CLO9	T2:4.5
35	Steady state analysis: steady state analysis C circuits with sinusoidal excitation.	CLO9	T2:4.5
36	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation.	CLO9	T2:4.6
37	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation.	CLO9	T2:4.7
38	Design Series and parallel resonance, concept of band width and Q factor	CLO10	T1:8.7-8.12
39	Design Series and parallel resonance, concept of band width and Q factor	CLO10	T1:8.7-8.12
40 - 42	Design Series and parallel resonance, concept of band width and Q factor	CLO10	T1:8.7-8.12
43	Understand the basic formation of magnetic circuit.	CLO10	T1:10.11
44	State the faraday"s laws of electromagnetic induction used in construction of magnetic circuit	CLO11	T1:10.11
45 - 47	Determine magnetic flux, reluctance, self and mutual inductance in the single coil and coupled coils magnetic circuits.	CLO12	T1:10.4-10.5
48	Remember different types magnetic circuits	CLO11	T1:10.15
49 -55	Prove the law of conservation of energy, superposition principle, reciprocity and maximum power transfer condition for the electrical network with DC and AC excitations.	CLO13	T1:3.9-3.10
56 - 60	Summarize the procedure of thevenin"s, norton"s and milliman"s theorems to reduce complex network into simple equivalent network.	CLO14	T1:3.9-3.10

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

S No	Description	Proposed Actions	Relevance With POs	Relevance With PSOs
1	Mathematical modelling of electrical network using MATLAB.	Guest Lectures / NPTEL	PO1, PO2,PO5	PSO3
2	Design of electrical circuit using graph theory in PC.	Matlab Demos / NPTEL	PO1, PO2,PO5	PSO3

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