INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**ELECTRICAL CIRCUITS**				
Course Code	AEEB03				
Programme	B.Tech				
Semester	II	ECE			
Course Type	Foundation				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	1.5
Chief Coordinator	Mr. A Srikanth, Assistant Professor, EEE				
Course Faculty	Mr. K Lingaswamy, Assistant Professor, EEE Mr. A Naresh Kumar, Assistant Professor, EEE Mr. T Mahesh , Assistant Professor, EEE				

I. COURSE OVERVIEW:

This course deals with fundamentals of electrical circuit, 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, two port network parameters, single phase AC circuits and their analysis and for easy simplifications. The emphasis of this course is laid on the basic analysis of circuits which includes, transient analysis of DC and AC circuits Faraday's laws of electromagnetic induction, network theorems for reducing complexity of networks.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	-

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 modules and each module 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 module. 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 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**			**Total Marks**
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	20	05	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 20 marks of 2 hours duration consisting of five descriptive type questions out of which four 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 - Online Examination
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning center. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc.

The AAT chosen for this course is given in section XI.

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.	2	Five Minutes Video
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	2	Seminar
PO 4	**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.	2	Term paper

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.	-	-
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.	2	Discussion of real-time applications
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 :

The course should enable the students to:	
I	Classify circuit parameters and apply Kirchhoff‘s laws for network reduction.
II	Apply mesh analysis and nodal analysis to solve electrical networks.
III	Illustrate single phase AC circuits and apply steady state analysis to time varying circuits.
IV	Analyze electrical circuits with the help of network theorems.

IX. COURSE OUTCOMES(COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Understand and analyze basic AC and DC electrical circuits.	CLO 1	Define the various nomenclature used to study the characteristics of DC networks.
		CLO 2	Understand the concept of circuit, classification of elements and types of energy sources.
		CLO 3	State different laws associated with electrical circuits and apply source transformation technique to determine equivalent resistance and source current.
CO 2	Apply mesh analysis and nodal analysis to solve electrical networks. Calculate the two port network parameters	CLO 4	Apply the network reduction techniques directly and indirectly to calculate quantities associated with electrical circuit
		CLO 5	Calculate Z, Y, ABCD, H and image parameters of two port network.
		CLO 6	Relate various two port parameters and inter relationships between them.
CO 3	Illustrate single phase AC circuits and apply steady state analysis to time varying circuits.	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.
		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.
CO 4	Understand the transient response of series and parallel RL, RC and RLC circuits for DC excitations.	CLO 11	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation.
		CLO 12	Design the series and parallel RLC for the required bandwidth, resonant frequency and quality factor.

COs	Course Outcome	CLOs	Course Learning Outcome
		CLO 13	State the faraday's laws of electromagnetic induction used in construction of magnetic Circuit.
CO 5	Understand the characteristics of complex electrical networks using DC and AC Theorems.	CLO 14	Summarize the procedure of thevenin's, norton's and milliman's theorems to reduce complex network into simple equivalent network.
		CLO 15	Prove the law of conservation of energy, superposition principle, reciprocity and maximum power transfer condition for the electrical network with DC and AC excitation.

X. 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
AEEB03.01	CLO 1	Define the various nomenclature used to study the characteristics of DC networks.	PO1	3
AEEB03.02	CLO 2	Understand the concept of circuit, classification of elements and types of energy sources.	PO1	3
AEEB03.03	CLO 3	State different laws associated with electrical circuits and apply source transformation technique to determine equivalent resistance and source current.	PO1, PO2	2
AEEB03.04	CLO 4	Apply the network reduction techniques directly and indirectly to calculate quantities associated with electrical circuit	PO2	1
AEEB03.05	CLO 5	Calculate Z, Y, ABCD, H and image parameters of two port network.	PO3	1
AEEB03.06	CLO 6	Relate various two port parameters and inter relationships between them.	PO3	2
AEEB03.07	CLO 7	Identify the alternating quantities with it instantaneous, average and root mean square values.	PO2	1
AEEB03.08	CLO 8	Demonstrate the impression of reactance, susceptance, impedance and admittance in estimating power of AC circuits.	PO3	3
AEEB03.09	CLO 9	Demonstrate the concept of rectangular and polar form AC circuits.	PO3	1
AEEB03.10	CLO10	Demonstrate the concept of power, real, reactive and complex power, power factor of AC circuits.	PO3	1

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEEB03.11	CLO11	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation.	PO4	2
AEEB03.12	CLO12	Design the series and parallel RLC for the required bandwidth, resonant frequency and quality factor.	PO4	3
AEEB03.13	CLO13	State the faraday's laws of electromagnetic induction used in construction of magnetic Circuit.	PO1	1
AEEB03.14	CLO14	Summarize the procedure of thevenin's, norton's and milliman's theorems to reduce complex network into simple equivalent network.	PO4	2
AEEB03.15	CLO15	Prove the law of conservation of energy, superposition principle, reciprocity and maximum power transfer condition for the electrical network with DC and AC excitation.	PO4	3

3 = High; 2 = Medium; 1 = Low

XI. 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														
CLO 2	3												1		
CLO 3	2	2													
CLO 4		1											1		
CLO 5		1													
CLO 6				2									1		
CLO 7				2									1		
CLO 8				1									3		
CLO 9	1												1		
CLO 10				3									2		
CLO 11				1									2		
CLO 12		1											3		
CLO 13		2											3		
CLO 14				3									2		
CLO 15				1									2		

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XII. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO4, PSO2	SEE Exams	PO1, PO2, PO4, PSO2	Assignments	PO4	Seminars	PO 2
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XIII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIV. SYLLABUS

Module-I	**INTRODUCTION TO 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.	
Module -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.	
Module-III	**SINGLE PHASE AC CIRCUITS AND RESONANCE**
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) with sinusoidal excitation; Resonance: Series and parallel resonance, concept of band width and Q factor.	
Module-IV	**MAGNETIC CIRCUITS**
Magnetic circuits: Faraday's laws of electromagnetic induction, concept of self and mutual inductance, dot convention, coefficient of coupling, composite magnetic circuit, analysis of series and parallel magnetic circuits	
Module-V	**NETWORK THEOREMS (DC AND AC)**
Network Theorems: Tellegen‟s, superposition, reciprocity, Thevenin‟s, Norton‟s, maximum power transfer, Milliman‟s and compensation theorems for DC and AC excitations, numerical problems.	
Text Books:	
1. A Sudhakar, Shyammohan S Palli, "Circuits and Networks", Tata McGraw-Hill, 4th Edition, 2010.	
Reference Books:	
1. John Bird, "Electrical Circuit Theory and technology", Newnes, 2nd Edition, 200 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.	

COURSE PLAN:

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

Lecture No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
1	Understand the concept of electrical circuits	CLO 1	T1:1.1
2	Understand the concept of circuit concept.	CLO 1	T1:1.1
3	Describe the voltage, current, power and energy.	CLO 2	T1:1.1
4	Understand ohm's law and its applicability, limitations	CLO 3	T1:1.1
5-6	Identify the resistance, inductance and capacitance and their V-I characteristics.	CLO 2	T1:1.1
7-8	Understand application of Kirchhoff's voltage law for electrical networks and evaluate the equivalent circuit parameters	CLO 3	T1:2.1-2.2
9-10	Understand application of Kirchhoff's current laws for electrical networks also find out the equivalent circuit parameters	CLO 3	T1:2.3-2.4
11	Determine the solution for the network using these techniques.	CLO 4	T1:1.9
12	Solve the electrical networks using mesh analysis to determine current, voltage and power in each and every element and of the network.	CLO 4	T1:2.5
13	Solve the electrical networks using mesh analysis to determine current, voltage and power in each and every element and of the network.	CLO 4	T1:2.5
14	Solve the electrical networks using nodal analysis to determine current, voltage and power in each and every element and of the network.	CLO 4	T1:2.5
15	Solve the electrical networks using nodal analysis to determine current, voltage and power in each and every element and of the network.	CLO 4	T1:2.5
16	Interpret how can parameters useful for computing different Networks	CLO 14	T1:4.1
17-18	Compute Impedance parameters	CLO 14	T1:4.1
19	Compute Admittance parameters for two port networks	CLO 14	T1:4.1
20	Compute ABCD Parameters for two port networks	CLO 14	T1:4.1
21	Compute Hybrid parameters for two port networks	CLO 14	T1:4.1
22	Formulate the conditions for Reciprocity and Symmetry	CLO 15	T1:4.2
23-24	Deduce the interrelations of different parameters.	CLO 15	T1:4.2,7.1
25-26	Analyze the two port network when connected in series	CLO 15	T1:4.3, 7.1-7.6
27-28	Analyze the two port network when connected in parallel	CLO 15	T1:4.4, 7.1-7.6
29-31	Analyze the two port network when connected in cascade	CLO 15	T1:11.1
32	Understand the image parameters to analyze filters for a two port network.	CLO 14	T1:11.7

Lecture No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
33	Interpret alternating quantity in terms of mathematical equation.	CLO 5	T1:11.6
34	Understand the concept of AC quantities	CLO 5	T1:11.8
35	Understand the concept of phase and phase difference.	CLO 6	T1:11.5- 11.6
36	Determine the impedance offered by RLC parameters.	CLO 6	T1:3.1
37	Represent any alternating quantity in terms of rectangular and polar form.	CLO 5	T1:3.4
38	Understand the behavior of series RL circuits with sine input	CLO 7	T1:3.7
39-40	Understand the behavior of series RC circuits with sine input.	CLO 7	T1:3.2
40-41	Understand the behavior of series RLC circuits with sine input.	CLO 7	T1:3.3
42	Estimate the power absorbed in AC circuits.	CLO 7	T1:3.5
43-44	Write the faradays laws and their usage to write self and mutual inductance.	CLO 9	T1:3.6,3.9
45	represent the total EMF induced in coil using dot convention.	CLO 9	T1:8.1
46	Analyze the behavior of different types magnetic circuits	CLO 9	T1:8.2
47-48	Analyze the behavior of different types magnetic circuits.	CLO 9	T1:8.3
49	Understand what electrical resonance is and How it is useful in electrical world.	CLO 8	T1:8.4
50-51	Understand the Transient behavior of R, L and C elements in a circuit.	CLO 12	T1:8.6
52	Compute initial conditions for R, L, C elements.	CLO 12	T1:9.10- 9.11
53	Compute and analyze Time response for current and voltage in first order R-L circuits using differential equation approach.	CLO 12	T1: 9.10-9.11
54-55	Compute and analyze Time response for current and voltage in first order RC circuits using differential equation approach.	CLO 12	T1: 9.16
56	Compute and analyze Time response for current and voltage in first order RLC circuits using differential equation.	CLO 12	T1:12.1
57	Design and analyze any complex networks using zero current theorem	CLO 13	T1:12.6
58	Design, analyze any complex networks using superposition theorem	CLO 13	T1:12.7
59	Design, analyze any complex networks using maximum power transfer theorems	CLO 13	T1:12.9
60	Design, analyze any complex networks using Thevenin's theorems.	CLO 10	T1:12.8
61	Design, analyze any complex networks using Norton's theorems.	CLO 10	T1:12.10
62-63	Design, analyze any complex networks using reciprocity theorems.	CLO 10	T1:12.11
64	Design, analyze any complex networks using compensation and milliman's theorem.	CLO 11	T1:12.13

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.	Seminars /NPTEL	PO1, PO2, PO4	PSO1
2	Interpretation and analyzing of an electrical circuit using graph theory in PC.	Term Paper / NPTEL	PO1, PO2, PO4	PSO1

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