INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTION

Course Title	**Electrical Circuits**			
Course Code	**A30204**			
Regulation	**R15**			
Course Structure	**Lectures**	**Tutorials**	**Practical's**	**Credits**
	4	**1**	**-**	**4**
Course Coordinator	Mr. T. Anil Kumar, Associate Professor			
Team of Instructors	Mr. T. Anil Kumar, Associate Professor			

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. PREREQUISITES:

Level	Credits	Periods	Prerequisite
UG	4	4	Knowledge of basic mathematics and physics is required

III. COURSE ASSESSMENT METHODS:

a) Marks distribution:

Session Marks	University End Exam Marks	Total Marks
There shall be two mid tem examinations. Each mid term exam consists of subjective type and objective type test. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each semester shall contain four questions; the student has to answer two out of them. Each carrying 5 marks The objective test paper Is prepared by JNTUH, which consists of 20 questions each carrying 0.5 marks and total of 10 marks. The student is assessed by giving two assignments, one, after completion of 1 to 2 1/2 units and the second, after the completion of 2 1/2 to 5 units each carrying 5 marks. On the total the internal marks are 25. The average of two internal tests is the final internal marks. The external question paper is set by JNTUH consisting of part –A and part-B. Where part consists of short answer questions carrying total marks of 25 and part part-B consists of 5 essay type questions consists of internal choice each carrying 10 marks and the total of 50. The total external marks are 75.	75	100

IV. EVALUATION SCHEME:

S. No	Component	Duration	Marks
1	I Mid Examination	90 minutes	20
2	I Assignment	--	05
3	II Mid Examination	90 minutes	20
4	II Assignment	--	05
5	External Examination	3 hours	75

V. COURSE OBJECTIVE:

i. To attain the knowledge of basic parameters, formation of circuit and network.
ii. To attain the knowledge of different network reduction techniques.
iii. To attain the knowledge of single phase AC circuits and their behavior.
iv. To attain the knowledge of locus diagram, electrical resonance and behavior of circuit under resonance.
v. To attain the knowledge of magnetic circuits, its representation and importance in electrical engineering.
vi. To attain the knowledge of network topology and its application to electrical circuits
vii. To attain the knowledge of network theorems to analyze the complex networks.

VI. COURSE OUTCOMES:

i. Attains the knowledge of basic definitions and basic electrical parameters.
ii. Attains the knowledge of nature of supply and types of supply.
iii. Can form the circuit and network with basic parameters.
iv. Able to use the necessary network reduction technique for simplifying network.
v. Understands the concept of AC circuits and their behavior.
vi. Gets the knowledge of locus diagram, electrical resonance and its importance in electrical engineering
vii. Can be able to form the magnetic circuit along with its characteristics giving its importance in electrical engineering
viii. Able to use the graph theory technique to solve the complex networks.
ix. Able to use the required network theorem to solve the complex networks.

VII. HOW PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

S. No	Program Outcomes	Level	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.	H	Assignments, exercise
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.	H	Excercise
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.	H	Assignments, exercise
PO4	**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.	S	Exercises

PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	N	------
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	S	Exercise
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	S	Discussion, seminars
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	N	-----
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	H	Assignments, exercise
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	S	Discussion, assignments, exercise
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	S	Discussions, seminars
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	N	----

N= None S=Supportive H=Highly related

Program Specific outcomes		Level	Proficiency Assessed By
PSO1	**Professional 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.	H	Assignments, exercise
PSO2	**Problem-Solving Skills:** Can 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.	S	Discussion
PSO3	**Successful Career and Entrepreneurship:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.	S	Assignments, exercise

VIII. SYLLABUS:

UNIT - I **Single Stage Amplifier Design and Analysis**: Circuit concepts, RLC parameters, voltage and current sources, independent and dependent sources, source transformation, voltage-current relations for passive elements, kirchoff's laws, network reduction techniques, nodal analysis, mesh analysis, super nodal and super mesh analysis.
UNIT - II **BJT & FET Frequency Response:** RMS, average ,peak and form factor of sinusoidal wave form, steady state analysis of R,L,C in series and parallel combinations with sinusoidal excitation, concept of reactance , impedance, admittance and susceptance, real ,reactive and apparent powers and complex power.

UNIT - III **Multivibrators:** Locus diagrams for all series and paralle combinations of RLC parameters, resonance of series and parallel circuits, concept of bandwidth and q factor. Magnetic circuit, faradays laws of electro-magnetic induction, concept of self and mutual induction, dot convention, co-efficient of coupling, composite magnetic circuit, analysis of series and parallel magnetic circuits.
UNIT - IV **Large Single Amplifiers:** Definitions, graph, tree, co-tree, cutest, tie-set, matrices for planar networks, loop and nodal methods for analysis of networks with dependent and independent voltage and current sources, duality and dual networks.
UNIT - V **Swicthing Charateristics of Device:** Network theorems with DC and AC excitations, tellegen's ,compensation, thevenin's, nortan's, milliman's, reciprocity and super-position theorems.

TEXT BOOKS:

1. Electrical circuits – A. Chakrabarthy, Dhanpat Rai & Sons.
2. Network Analysis – NC Jagan and C. Lakshminarayana, BS Publications.

REFERENCES:

1. Engineering circuit analysis—William Hayt, Jack E Kemmerly, SM Durbin, Mc GrawHill

IX. COURSE PLAN:

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

Lecture No.	Mapping	Learning objectives	Topic To Be Covered	Reference
1	a, b, i, ii	Gets the knowledge of what is voltage, current, power and energy.	Introduction, basic definitions, circuit concepts.	T1T2
2	a, b, i, ii	Can identify the what is resistance, inductance and capacitance and their V-I characteristics.	R-L-C parameters and their V-I relations	T1T2
3	a, b, i, ii	Gets the knowledge of different elements in power systems and sources to drive the network.	Types of elements, types of sources	T1T2
4	a, b, i, ii	One can understand the behavior of RLC for different input signals.	V-I relations for RLC parameters for different input signals.	T1T2
5	a, b, iii, iv	One can understand application of kirchoff's laws for electrical networks.	Kirchoff's voltage and current law in detail.	T1T2
6	a, b, iii ,iv	One can arrange the RLC parameters in series and parallel combinations to form electrical network.	formation of series and parallel circuits and their simplifying the circuits for different results.	T1T2
7	a, b, iii ,iv	Can easily determine the solution for the network using these techniques.	Source transformation and star-delta transformation.	T1T2
8	a, b, iii, iv	Can solve the electrical networks using mesh analysis to determine current, voltage and power in each and every element and of the network.	Mesh and super mesh analysis	T1T2
9	a, b, iii, iv	Can solve the electrical networks using nodal analysis to determine current, voltage and power in each and every element and of the network.	Nodal and super nodal analysis	T1T2

10	a, b, iii, iv	Can solve the different types of power systems networks using above reduction techniques.	Exercise problems	T1T2
11	a, b, iii, iv		Exercise problems	T1T2
12	a, b, iii, iv		Exercise problems	T1T2
13	a, b, iii, iv		Exercise problems	T1T2
14	c, v	One can get the knowledge of representing alternating quantity with sine wave	Introduction to alternating quantity using sinusodial	T1T2
15	c, v	Able to determine the characteristics of sine wave	Definitions related to sine wave.	T1T2
166	c, v	Behavior of series circuits with sine input can be understand.	Steady state response of RLC parameters with sinusoidal input for series circuits	T1T2
17	c,v c, v	Behavior of parallel circuits with sine input can be understand.	Steady state response of RLC parameters with sinusoidal input for parallel circuits	T1T2
18	c, v	Can determine the impedance offered by RLC parameters.	Concept of reactance and impedance.	T1T2
19	c, v	Can determine the admittance offered by RLC parameters.	Concept of admittance and susceptance.	T1T2
20	c, v	Power absorbed in Ac circuits can be determined.	Active, reactive and apparent powers in AC circuits and then power triangle	T1T2
21	c, v	Can be able to Represent Ac circuit in terms of complex power .	Complex power	T1T2
22	c, v	Can be able to determine behavior of different AC circuits that come across in power systems(finding alternating current, alternating voltage, complex power)	Exercise problems	T1T2
23	c, v		Exercise problems	T1T2
24	c, v		Exercise problems	T1T2
25	c, v		Exercise problems	T1T2
26	c, v		Exercise problems	T1T2
27	c, v		Exercise problems	T1T2
28	d, vi	One can represent electrical circuit in the form of locus diagram.	Introduction to locus diagram.	T1T2
29	d, vi	One can study behavior of series RLC circuits in the form of locus diagram	Locus diagram of series circuits	T1T2
30	d, vi		Locus diagram of series circuits	T1T2
31	d, vi	One can study behavior of parallel RLC circuits in the form of locus diagram	Locus diagram of parallel circuits	T1T2
32	d, vi		Locus diagram of parallel circuits	T1T2
33	d, vi	One can understand what is electrical resonance and How it is usefull in electrical wold	Resonance, series resonance	T1T2
34	d, vi	One can understand what is electrical resonance and How it is usefull in electrical wold	Parallel resonance	T1T2
35	d, vi	Can determine the behavior of power systems networks using locus diagram.	Exercise problems	T1T2
36	d, vi		Exercise problems	T1T2
37	d, vi		Exercise problems	T1T2
38	e, vii	Gets the basic formation of magnetic circuit.	Magnetic circuits introduction	T1T2
39	e, vii	Can write the faradays laws and their usage to write self and mutual inductance	Faradays laws, self inductance and mutual inductance	T1T2
40	e, vii	Able to represent the total emf induced in coil using dot convention	Dot convention	T1T2
41	e, vii	Can decide the amount of mutual flux linkage between two coils	Co-efficient of coupling	T1T2

42	e, vii	Behavior of different types magnetic circuits can be analyze	Composite magnetic circuits	T1T2
43	e, vii	Can determine the behavior of magnetic circuits in power systems	Exercise problems	T1T2
44	f, viii	Fundamentals of network topology can be understand	Definitions of network topolgy	T1T2
45	f, viii	One can form incident matrix from which characteristics of electrical circuits can be studied	Basic incident matrix	T1T2
46	f, viii	One can form incident matrix from which current flowing through each element can be determined	Formation of tie-set matrix	T1T2
47	f, viii	One can form incident matrix from which voltage across each element can be determined	Formation of cut-set matrix	T1T2
48	f, viii	Importance of these matrices can be known	Applications of above matrix	T1T2
49	f, viii	Can transform complex network into simple network without changing results	Introduction to dual and duality	T1T2
50	f, viii	Able to graw the dual network.	Procedure to form dual network for original one	T1T2
51	f, viii	Can form the matrices representing behavior of network and their by can go coding for complex networks.	Exercise problems	T1T2
52	f, viii		Exercise problems	T1T2
53	f, viii		Exercise problems	T1T2
54	f, viii		Exercise problems	T1T2
55	g, ix	One can simply, design, analyze any complex networks using given theorems	Tellegen's theorem	T1T2
56	g, ix		Thevenin's theorem	T1T2
57	g, ix		Nortan's theorem	T1T2
58	g, ix		Superposition theorem	T1T2
59	g, ix		Reciprocity theorem	T1T2
60	g, ix		Compensation theorem	T1T2
61	g, ix		Milliman's theorem	T1T2
62	g, ix	One can simply, design, analyze any complex networks using given theorems	Exercise problems	T1T2
63	g, ix		Exercise problems	T1T2
64	g, ix		Exercise problems	T1T2
65	g, ix		Exercise problems	T1T2
66	g, ix		Exercise problems	T1T2
67	g, ix		Exercise problems	T1T2
68	g, ix		Exercise problems	T1T2
69	***	Previous papers discussion		

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

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
a	h	h	s										x	x	
b	h	s	s	h									x	x	
c	s	s	h						s				x	x	
d	s	h	h						s				x	x	
e	s	h	h										x	x	
f	h	h	h										x	x	
g	h	h	h										x	x	

S=Supportive H=Highly related

XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES:

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	H		H										X	X	
II	S		H										X	X	
III	S	H	H										X	X	
IV	H	H	S										X	X	
V	S	S	H						S				X	X	
vi	S	H	H						S				X	X	
vii	S	H	H										X	X	
viii	H	H	H										X	X	
ix	H	H	H										X	X	

S=Supportive H= Highly related

Prepared by: Mr. T. Anil Kumar, Associate Professor

HOD, ELECTRICAL AND ELECTRONICS ENGINEERING