INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTION

Course Title	**ELECTRIC CIRCUITS**			
Course Code	**R15-A30204**			
Course Structure	Lectures	Tutorials	Practicals	Credits
	4	1	-	4
Course Coordinator	Mr K. Sudhakar Reddy, Assistant Professor			
Team of Instructors	Ms. Kalyani, Assistant Professor			

I. COURSE OVERVIEW:

This course introduces the basic concepts of circuit analysis which is the foundation for all subjects ofthe Electrical Engineering discipline. The emphasis of this course if laid on the basic analysis of circuitswhich includessinglephasecircuits,magneticcircuits,theoremsandnetworktopology.

II. PREREQUISITE(S):

Level	Credits	periods	Prerequisite
UG	**4**	**4**	**Understand basic concepts of Electrical Engineering**

III. MARKS DISTRIBUTION:

Sessional Marks	University End Exam Marks	Total Marks
There shall be 2 midterm examinations. Each midterm examination consists of subjective test. The subjective test is for 20 marks, with duration of 2 hours. Subjective test of each semester shall contain 5 one mark compulsory questions in part-A and part-B contains 5 questions, the student has to answer 3 questions, each carrying 5 marks. First midterm examination shall be conducted for the first two and half units of syllabus and second midterm examination shall be conducted for the remaining portion. Five marks are earmarked for assignments. There shall be two assignments in every theory course. Marks shall be awarded considering the average of two assignments in each course.	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 OBJECTIVES:

I. Describe basic fundamentals of Electric Circuits, their components and the mathematical tools used to represent and analyze Electrical circuits.

II. Develop fundamentals, including Ohm's law, Kirchoff's laws and be able to solve for currents, voltages and power in complex circuits.

III. Demonstrate to write and solve loop current and node voltage equations for arbitrary DC, AC networks including resistors, capacitors, inductors, dependent and independent sources.

IV. Extrapolate the concept of magnetic circuit, Faraday's laws and analyze the series and parallel magnetic circuits.

V. Summarize various two port network parameters and their relations and develop the design and analysis of basic DC and AC circuits with network topologies.

VI. COURSE OUTCOMES:

After completing this course the student must demonstrate the knowledge and ability to:

1. **Define** basic electrical concepts, including electric charge, current, electrical potential, electrical Power and energy.
2. **Distinguish** the relationship of voltage and current in resistors, capacitors, inductors, and mutual Inductors.
3. **Differentiate** circuits with ideal, independent, and controlled voltage and current sources and able to apply Kirchhoff's voltage and current laws to the analysis of electric circuits.
4. **Illustrate** to apply concepts of electric network topology, nodes, branches, and loops to solve circuit problems, including the use of computer simulation.
5. **Emphasize** on basic laws and techniques to develop a working knowledge of the methods of analysis used.
6. **Interpret** to solve series and parallel magnetic circuits
7. **Design** various two port network parameters and relations between them

VII. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program outcomes		Level	Proficiency assessed by
PO1	**General knowledge:**An ability to apply the knowledge of mathematics, science and Engineering for solving multifaceted issues of Electrical Engineering	S	Assignments
PO2	**Problem Analysis:**An ability to communicate effectively and to prepare formal technical plans leading to solutions and detailed reports for electrical systems	N	Exercise
PO3	**Design/Development of solutions:**To develop Broad theoretical knowledge in Electrical Engineering and learn the methods of applying them to identify, formulate and solve practical problems involving electrical power	H	Assignments, Discussion
PO4	**Conduct investigations of complex problems**: An ability to apply the techniques of using appropriate technologies to investigate, analyze, design, simulate and/or fabricate/commission complete systems involving generation, transmission and distribution of electrical energy	H	Exercise
PO5	**Modern tool usage:**An ability to model real life problems using different hardware and software platforms, both offline and real-time with the help of various tools along with upgraded versions.	N	------
PO6	**The engineer and society**: An Ability to design and fabricate modules, control systems and relevant processes to meet desired performance needs, within realistic constraints for social needs	S	Exercise
PO7	**Environment and sustainability:**An ability To estimate the feasibility, applicability, optimality and future scope of power networks and apparatus for design of eco-friendly with sustainability	S	Discussion,Seminars
PO8	**Ethics:**ToPossess an appreciation of professional, societal, environmental and ethical issues and proper use of renewable resources	N	Discussion, Seminars
PO9	**Individual and team work:** An Ability to design schemes involving signal sensing and processing leading to decision making for real time electrical engineering systems and processes at individual and team levels	S	Discussions
PO10	**Communication:**an Ability to work in a team and comprehend his/her scope of work, deliverables , issues and be able to communicate both in verbal ,written for effective technical presentation	S	Discussion,Seminars
PO11	**Life-long learning**:An ability to align with and upgrade to higher learning and research activities along with engaging in life-long learning.	N	-----
PO12	**Project management and finance**: To be familiar with project management problems and basic financial principles for a multi-disciplinary work	S	Prototype, Discussions

N - None **S - Supportive** **H – Highly Related**

VIII HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

PROGRAM SPECIFIC OUTCOMES		LEVEL	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.	H	Lectures and Assignments
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.	S	Tutorials
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.	S	Seminars and Projects

VIII SYLLABUS:

UNIT – I

Introduction to Electrical Circuits: Circuit Concept, R-L-C Parameters, Voltage and Current Sources, Independent and Dependent Sources, Source Transformation, Voltage – Current relationship forPassive Elements (for different input signals –Square, Ramp, Saw toot hand Triangular). Kirchhoff's Laws,Network ReductionTechniques–Series,Parallel,SeriesParallel,Star–to-DeltaorDelta-to-StarTransformations,Nodal Analysis, Mesh Analysis, Super node and Super mesh for DCExcitations.

UNIT – II`

Single Phase A.C. Circuits: R.M.S. and Average values and form factor for different periodic wave forms, Steady State Analysis of R, L and C (in Series, Parallel and Series Parallel Combinations) withSinusoidal Excitation, Concept of Reactance, Impedance, SusceptanceandAdmittance, Phase and Phasedifference, Concept of Power Factor, Real and Reactive powers, J-notation, Complex and Polar forms ofrepresentation, Complexpower.

UNIT – III

Locusdiagrams,ResonanceandMagneticcircuits: Locusdiagrams-seriesR-L,R-C,R-L-Candparallel combination with variation of various parameters - Resonance-series, parallel circuits, concept of band widthand Q factor. Magnetic circuits-Faraday's laws of electromagnetic induction-concept of self and mutualinductance-dot convention-coefficientofcoupling-compositemagneticcircuit-analysisofseriesandparallelmagneticcircuits.

UNIT – IV

Network Topology: Definitions, Graph, Tree, Basic cutsetandBasic Tie set Matrices for Planar Networks,Loop and Nodal methods for analysis of Networks with Dependent &Independent Voltage and Current Sources, Duality & DualNetworks

UNIT – V

Network Theorems (With A.C. & D.C): Tellegen's, Superposition, Reciprocity, Thevinin's, Norton's, Maximum Power Transfer, Milliman's and Compensation theorems for D.C excitations.

Textbooks:

1. Electric Circuits - A.Chakrabarhty, DhanipatRai& Sons.
2. Network analysis - N.C Jagan and C. Lakhminarayana, BSpublications.

Referencebooks:

1. Engineering Circuit Analysis - William Hayt ,Jack E. Kemmerly, S M Durbin, McGraw Hill Companies.
2. Electric Circuit Analysis - K.S.Suresh Kumar, PearsonEducation.
3. Electrical Circuits - David A.Bell, Oxford UniversityPress.
4. Network Analysis and Circuits - M.Arshad, Infinity SciencePress.
5. Circuits - A.Bruce Carlson, CengageLearning.
6. Electrical Circuits: An Introduction - KCA Smith & RE Alley, Cambridge UniversityPress.

VIII. COURSE PLAN:

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

Lecture No.	Course Learning Outcomes	Topics to be covered	Reference
1	Introduction of Electrical Circuits	**Explain** the basics of electrical Circuits Introduction of Electrical Circuits	T1:1.1
2	Circuit Concept, R-L-C Parameters	**Knowing**Circuit Concept, R-L-C Parameters	T1:1.1
3	Voltage and current sources - Independent and dependent sources	**Differentiate** the dependent and independent sources voltage and current sources – Independent and dependent sources	T1:1.1-1.5
4	Source transformation Technique	**Transform** the voltage sources to current sources and vice versa	T1:1.6
5-6	Voltage – current relationship for passive elements	**Discuss** the relation between voltage and current across passive elements	T1:1.1
7	Kirchhoff's Laws	**Apply** the Kirchhoff's Laws Kirchhoff's laws	T1:2.1
8-10	Network reduction techniques-Series, Parallel, Series and Parallel, Delta to Star and Vice versa	**Measure** the equivalent resistance of a circuit.	T1:1.2-1.4
11	Mesh equations by inspection method	**Explain** how to apply the mesh analysis for various electrical circuits	T1:2.5
12	Concept of super mesh analysis	**Solve** the networks using Super-mesh analysis	T1:2.5-2.6
13	Examples on super mesh analysis	**Apply** the super-mesh method for electrical circuits	T1:2.6
14	Concept of Super-node analysis	**Solve** the networks using Super- node analysis	T1:2.5-2.6

15	R.M.S. and Average values and form factor for different periodic wave forms	**Knowing** R.M.S. and Average values and form factor for different periodic wave forms	T1:4.1
16-19	Steady State Analysis of R, L and C (in Series, Parallel and Series Parallel Combinations) withSinusoidal Excitation	**Knowing** Steady State Analysis of R, L and C (in Series, Parallel and Series Parallel Combinations) withSinusoidal Excitation	T1:4.2-4.8
20	Concept of Reactance	**Knowing** Concept of Reactance	T1:4.1-4.8
21-22	Impedance, SusceptanceandAdmittance	**Knowing** Impedance, SusceptanceandAdmittance	T1:4.1-4.8
23	Phase and Phasedifference	**Knowing** Phase and Phasedifference	T1:4.1-4.8
24	Concept of Power Factor	**Knowing** Concept of Power Factor	T1:4.1-4.8
25	Real and Reactive powers, J-notation	**Knowing** Real and Reactive powers, J-notation	T1:4.1-4.8
26	Complex and Polar forms ofrepresentation	**Knowing** Complex and Polar forms ofrepresentation	T1: 4.1-4.8
27	Complexpower	**Knowing** Complexpower	T1: 4.1-4.8
28	Problems	exercise	T1:4.10
29-30	LocusdiagramsseriesR-L,R-C,R-L-Candparallel combination with variation of various parameters - Resonance-series	**Knowing** LocusdiagramsseriesR-L,R-C,R-L-Candparallel combination with variation of various parameters - Resonance-series	T1: 4.1-4.8
31-32	Parallel circuits, concept of band widthand Q factor.	**Knowing** Parallel circuits, concept of band widthand Q factor.	T1:4.8
33-34	Magnetic circuits-Faraday's laws of electromagnetic induction	**Knowing** Magnetic circuits-Faraday's laws of electromagnetic induction	T1:11.1
35-36	concept of self and mutualinductance	**Knowing** concept of self and mutualinductance	T1:11.2
37-38	dot convention-coefficientofcoupling	**Knowing** dot convention-coefficientofcoupling	T1:11.7
39-40	Compositemagneticcircuit-analysisofseriesandparallelmagneticcircuits.	**Knowing** Compositemagneticcircuit-analysisofseriesandparallelmagneticcircuits.	T1:11.5
41-43	Definitions, Graph, Tree, Basic cutsetandBasic Tie set Matrices for Planar Networks	**Knowing** Definitions, Graph, Tree, Basic cutsetandBasic Tie set Matrices for Planar Networks	T1:15.1-15.5
44-46	Loop and Nodal methods for analysis of Networks with Dependent &Independent Voltage and Current Sources	**Knowing** Loop and Nodal methods for analysis of Networks with Dependent &Independent Voltage and Current Sources	T1:
47-48	Duality & DualNetworks	**Knowing** Duality & DualNetworks	T1:
49-50	Problems	exercise	T1:11.11,15.18
51-53	Tellegen's, Superposition, Reciprocity theorems	**Knowing**Tellegen's, Superposition, Reciprocity theorems	T1:3.4,3.7,3.10
54-56	Thevinin's, Norton's, theorems	**Knowing**Thevinin's, Norton's, theorems	T1:3.2-3.3
57-58	Maximum Power Transfer, Milliman's	**Knowing** Maximum Power Transfer, Milliman's	T1:3.5-3.6
59-61	Compensation theorems for D.C excitations.	**Knowing** Compensation theorems for D.C excitations.	T1:3.9
62-64	Problems	exercise	T1:3.11

IX. 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
I	S	N	H	S	N	S	S	N	S	S	N	H	H	H	S
II	H	N	H	H	N	H	S	N	S	S	N	H	H	H	S
III	S	N	H	H	N	H	S	N	S	S	N	H	S	S	S
IV	S	N	H	H	N	S	S	N	S	S	N	H	S	H	S
V	H	N	H	S	N	H	S	N	S	S	N	H	S	S	S

N=None **S=Supportive** **H=Highly related**

X MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF TSHE PROGRAM OUTCOMES:

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	S	N	H	S	N	S	S	N	S	S	N	S	S	S	S
2	H	N	H	H	N	H	S	N	S	S	N	S	S	S	S
3	S	N	H	H	N	H	S	N	S	S	N	S	S	H	S
4	S	N	H	H	N	S	S	N	S	S	N	S	S	H	N
5	H	N	H	S	N	H	S	N	S	S	N	S	N	S	N
6	S	N	H	S	N	H	S	N	S	S	N	S	N	S	N
7	S	N	H	S	N	H	S	N	S	S	N	S	N	S	S

N=None **S=Supportive** **H=Highly related**

Prepared by: Mr G Hari Krishna, Assistant Professor

HOD, ELECTRICAL AND ELECTRONICS ENGINEERING