NSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTION

Course Title	**NETWORK THEORY**			
Course Code	A40213			
Regulation	**R15**			
Course Structure	Lectures	Tutorials	Practical	Credits
	4	-	-	4
Course Coordinator	Ms. Lekha Chandran, Associate Professor			
Team of Instructors	Ms. Lekha Chandran			

I. COURSE OVERVIEW:

This course introduces the basic concepts of network theory which is the foundation for all subjects of the electrical engineering discipline. The emphasis of this course is laid on the basic analysis of circuits which includes three phase circuits, transient analysis of DC and AC circuits, network functions, and two port network parameters, Fourier analysis of ac circuits, design and analysis of filters.

II. PREREQUISITE(S):

Level	Credits	Periods / Week	Prerequisites
UG	**4**	**4**	Knowledge of electrical circuits

III. MARKS DISTRIBUTION:

Session 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:

At the end of the course, the students will be able to

i. **Calculate** currents and voltages in three phase circuit arrangements and compute the real, reactive and apparent power in three phase systems.
ii. A**nalyse** the transient response of RL, RC and RLC circuits for DC and AC excitation using differential equation and Laplace transform methods.
iii. **Describe** network functions for one port and two port networks.
iv. **Discuss** two port network parameters.
v. **Demonstrate** the various types of filters and their design aspects to implement for the given requirements.
vi. **Develop** an understanding of the mathematical basis for Fourier transforms and Fourier series and their application in circuit analysis.

VI. COURSE OUTCOMES:

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

After completing this course the student must demonstrate the knowledge and an ability to apply above concepts to real world electrical and Electronics problems and applications.

1. **Analyze** three phase circuits and their interconnections and able to design practical circuits that perform the desired operations.
2. **Analyze** first and second order AC and DC circuits for steady-state and transient response using differential equations and Laplace transform techniques.
3. **Apply** the knowledge of network functions and two port network parameters in circuit analysis.
4. **Design** filters of specific characteristics.
5. **Able** to analyse AC circuits through Fourier transforms.

HOW PROGRAM OUTCOMES ARE ASSESSED:

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	Lectures
PO2	**Problem Analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	H	Assignments
PO3	**Design / Development of Solutions**: Design solutions for complex engineering problems and design system components or	H	Project Work

	processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.		
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	Project Work
PO5	**Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	S	Project Work
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	Presentations
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	-
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	S	-
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	S	Project Work
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	Seminars
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	Project Work
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.	S	Lectures

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

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

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.	S	Seminars
PSO2	**Problem-Solving Skills:** Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in	H	Assignments

	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	**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	Project Work

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

VIII. SYLLABUS:

UNIT – I

Three Phase AC Circuits

Three phase circuits: Phase sequence – Star and delta connection – Relation between line and phase voltages and currents in balanced systems – Analysis of balanced and Unbalanced 3 phase circuits – Measurement of active and reactive power.

UNIT – II

D.C and A.C Transient Analysis

Transient response of R-L, R-C, R-L-C circuits (Series and Parallel combinations) for D.C and A.C excitation– Initial conditions –Solutions using differential equation and laplace transforms

UNIT – III

Networks Functions

The concept of Complex Frequency, Physical Interpretation of Complex Frequency, Transform Impedance and Transform Circuits, Series and parallel combination of Elecments, Terminal pairs or ports, Network functions for the One port and two port, Poles and zeros of network Functions, Significance of poles and zeros, properties of driving point functions, properties of Transfer functions, Necessary conditions for driving point functions, Necessary conditions for transfer functions, time domain response from pole zero plot.

UNIT – IV

Network Parameters

Two port network parameters – Z, Y, ABCD and hybrid parameters and their relations. Cascaded networks, concept of transformed network – 2-port network parameters using transformed variables

UNIT – V

Filters and Fourier analysis of A.C. Circuits

Low pass, High pass, Band pass, Band elimination, Prototype filter design. The Fourier theorem, consideration of symmetry, exponential form of Fourier series, line spectra and phase angle spectra, Fourier integrals and Fourier transforms, Properties of Fourier transforms

IX. LIST OF TEXT BOOKS / REFERENCES / WEBSITES / JOURNALS / OTHERS

Text Books:

1. Electric Circuits. Chakrabarthi, Dhanpat Rai& Sons
2. Network Analysis N.C. Jagan& C. Lakshminarayana, B.S Publications

References:

1. Engineering Circuit Analysis William Hay and Jack E. Kimberley, McGraw Hill,
2. Electrical Circuits, David A. Bell, Oxford University Press.
3. Electric circuit Analysis ,K.S. Suresh Kumar, Pearson Education
4. Circuits, A. Bruce Carlson, engage Learning
5. Network Analysis and Circuits ,M. Arshad ,Infinity Science Press
6. Electrical Circuits an Introduction, KCA Smith & RE Alley, Cambridge University Press

X. COURSE PLAN:

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

Lecture No.	Learning objectives	Topics to be covered	Reference
1	Interpret three phase circuits, its generation and connections.	Introduction to three phase circuits, Generation of three phase voltages and three phase connections, phase sequence	T1,T2,R1
2	Discriminate three phase circuits when connected in star and delta.	Relation between phase and line quantities in a three phase star and delta connected system.	T1,T2,R1
3	Analyze the three phase loads	Inter connection of 3 phase loads. Analysis of 3 phase loads	T1, T2,R1
4,5	Discuss voltage and current of three phase unbalanced loads.	Analysis of 3 phase unbalanced loads, Numerical problems on three phase unbalanced loads	T1, T2,R1
6,7	Determine the active power in a three phase circuit and the effect of power factor on Wattmeter readings.	Measurement of active power in a three phase circuit, Effect of power factor on Wattmeter readings and numerical problems on two wattmeter method	T1, T2,R1
8,9	Determine the reactive power in a three phase circuit	Measurement of reactive power in a three phase circuit	T1, T2,R1
10,11,12	Tutorial		
13,14	Show the Transient behaviour of R, L and C elements in a circuit.	Introduction to transient analysis and initial conditions of the R L & C	T1, T2,R1
15,16	Compute initial conditions and time response for current and voltage in first order R-L and R-C circuits	DC Transient analysis of a series RC and RL Circuit differential equation method	T1, T2,R1
17,18	Analyze and solve problems on complicated RC and RL circuits	Problems on DC Transient analysis of a series RLC Circuit using differential equation method	T1, T2,R1
19,20	Describe the AC Transient analysis of a series RC, RL circuits	AC Transient analysis of a series RC and RL Circuit. Problems on AC Transient analysis of a series RC and RL Circuit	T1, T2,R1
21,22	Transient analysis of a series RLC circuits to AC excitation	Series RLC Circuit and numerical problems AC Transient analysis using differential equation method.	T1, T2,R1
23,24	Transient analysis using Laplace transform method	Transient analysis using Laplace transform method	T1, T2,R1
25,26,27	Tutorial		T1, T2,R1
28,29,30	Learn complex frequency	The concept of Complex	T1, T2,R1

		Frequency, Physical Interpretation of Complex Frequency	
31,32	Learn Transform Impedance and Transform Circuits	Transform Impedance and Transform Circuits, Series and parallel combination of Elements	T1, T2,R1
33,34	Learn terminal pairs or ports	Terminal pairs or ports, Network functions for the One port and two port	T1, T2,R1
35,36	To learn significance of poles and zeros	Poles and zeros of network Functions, Significance of poles and zeros, properties of driving point functions	T1, T2,R1
37	Analyze and solve problems	properties of Transfer functions, Necessary conditions for driving point functions	T1, T2,R1
38	Analyze and solve problems	Necessary conditions for transfer functions, time domain response from pole zero plot	T1, T2,R1
39,40,41	Tutorial		T1, T2,R1
42	To learn network parameters	Introduction to network parameters	T1, T2,R1
43,44	Obtain Z parameters Y - parameters	Z - parameters , Y - parameters	T1, T2,R1
45,46	Analyze and solve problems	H - parameters , T - parameters (A, B, C, D parameters)	T1, T2,R1
47	Analyze and solve problems	Relations between Z, Y, H & T parameters	T1, T2,R1
48	Analyze and solve problems	Cascade Networks	T1, T2,R1
49	Analyze and solve problems	Concept of transformed network	T1, T2,R1
50	Analyze and solve problems	Two port network parameters using transformed variables	T1, T2,R1
51,52	Tutorial		T1
53	Discuss filters concept, filter networks, classification, and its types.	Introduction to filters, Classification of filters, filter networks.	T1, T2,R1
54	Understand Low Pass filter Analysis and Design	Low Pass filter Analysis and Design	T1, T2,R1
55	Understand High Pass filter Analysis and Design	High Pass filter Analysis and Design	T1, T2,R1
56,57	Understand Band Pass filter Analysis and Design	Band Pass filter Analysis and Design	T1, T2,R1
58	Understand Band Elimination filter Analysis and Design	Band Elimination filter Analysis and Design	T1, T2,R1
59	Understand Prototype filter Analysis and Design	Prototype filter Analysis and Design	T1, T2,R1
60	Understand Fourier theorem, different form of Fourier series	Introduction to Fourier theorem, consideration of symmetry. Exponential form of Fourier series	T1, T2,R1
61	Demonstrate different properties of Fourier transforms.	Line spectra and properties of Fourier transforms	T1, T2,R1
62	Demonstrate different properties of Fourier transforms	Phase angle spectra	T1, T2,R1
63	Demonstrate different properties of Fourier transforms	Fourier integrals and Properties of Fourier transforms	T1, T2,R1
4,65	Tutorial	Solve problems	T1, T2,R1

XI. 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	PSO 1	PSO 2	PSO 3
I	H	H	H	S	S	S	S	S	S	S	S	S	S	H	S
II	H	H	H	S	S	S	S	S	S	S	S	S	S	H	S
III	H	H	H	S	S	S	S	S	S	S	S	S	S	H	S
IV	H	H	H	S	S	S	S	S	S	S	S	S	S	H	S
V	H	H	H	S	S	S	S	S	S	S	S	S	S	H	S
VI	H	H	H	S	S	S	S	S	S	S	S	S	S	H	S

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

Course outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	H	H	H	S	S	S	S	S	S	S	S	H	S	H	S
2	H	H	H	S	S	S	S	S	S	S	S	H	S	H	S
3	H	H	H	S	S	S	S	S	S	S	S	H	S	H	S
4	H	H	H		S	S	S	S	S	S	S	H	S	H	S
5	H	H	H	S	S	S	S	S	S	S	S	H	S	H	S

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Prepared By: Lekha Chandran, Associate Professor

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