INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**NETWORK ANALYSIS**				
Course Code	**AEE005**				
Programme	B.Tech				
	III	EEE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	**Ms. S Swathi, Assistant Professor, EEE**				
Course Faculty	**Dr. D Shobha Rani, Professor, EEE** **Ms. S Swathi, Assistant Professor, EEE**				

I. COURSE OVERVIEW:

This course introduces the basic concepts of net work 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 net work parameters, Fourier analysis of AC circuits, design and analysis of filters.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS002	I	Linear Algebra and Ordinary Differential Equations	4
UG	AHS011	II	Mathematical Transform Techniques	4
UG	AEE002	II	Electrical Circuits	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Network Analysis	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	Presentation on real-world problems
PO 5	**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.	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	**Problem Solving**: Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	3	Assignment and Seminar
PSO 2	**Professional Skills:** Identify 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.	---	---
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	2	Project Work / Tutorial

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Analyse three phase star and delta connected circuits to calculate the active and reactive power.
II	Understand the transient response of series and parallel RL, RC and RLC circuits for DC and AC excitations.
III	Discuss the concepts of locus diagram, network functions and to calculate the two port network parameters.
IV	Design different types of filters and perform the digital simulation of electric circuits.

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
CAEE005.01	CLO 1	Analyze three phase star and delta circuits with different configuration.	PO1, PO2, PSO1	3
CAEE005.02	CLO 2	Understand the concept of Phasor diagram for three phase systems.	PO1	3
CAEE005.03	CLO 3	Discuss the active, reactive and apparent power and power factor in three phase circuits.	PO1, PO2, PSO1	3
CAEE005.04	CLO 4	Estimate the transient response of series and parallel circuits with AC and DC excitation.	PO1, PO2	3
CAEE005.05	CLO 5	Evaluate the transient response of first and second order electric circuits using differential equation approach.	PO1, PO2	3
CAEE005.06	CLO 6	Determine the transient response of first and second order electric circuits using Laplace transform technique.	PO1, PO2, PSO1	3
CAEE005.07	CLO 7	Explain the concept of locus diagram for series and parallel circuits.	PO1, PO2	3
CAEE005.08	CLO 8	Generalize the concept of network functions for one port and two port networks.	PO1	3
CAEE005.09	CLO 9	Examine the electric networks in time domain and frequency domain.	PO1, PO2	3
CAEE005.10	CLO 10	Calculate Z, Y, ABCD, H and image parameters of two port network.	PO1, PO2, PSO1	3
CAEE005.11	CLO 11	Inter relationships between various two port networks them.	PO1, PO2, PSO1	3
CAEE005.12	CLO 12	Outline the concepts of interconnections of two port networks.	PO1, PSO1	3
CAEE005.13	CLO 13	Design of low pass, high pass, band pass, band elimination, Active filters and their characteristics.	PO1, P02, PO3, PO5, PSO1	3
CAEE005.14	CLO 14	Summarize the characteristics of electric circuit using Matlab.	PO1, P02 , PO5, PSO3	3
CAEE005.15	CLO 15	Use the technique of Fourier transforms to solve the electric circuit problems.	PO1, P02, PSO3	3
CAEE005.16	CLO 16	Apply the concept of network theorems, switching transient to solve real time world applications.	PO1, P02,PO5, PSO1	3
CAEE005.17	CLO 17	Process the knowledge and skills for employability and to succeed national and international level competitive examinations.	PO1, P02,PO5, PSO1, PSO3	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	2	3											2		
CLO 2	3														
CLO 3	2	3											2		
CLO 4	3	3													
CLO 5	3	3													
CLO 6	3	3											2		
CLO 7	3	2													
CLO 8	3														
CLO 9	2	3													
CLO 10	2	3											3		
CLO 11	3	2											3		
CLO 12	3												3		
CLO 13	2	3	2		2								3		
CLO 14	2	3			2										3
CLO 15	3	3													2
CLO 16	2	3			2								2		
CLO 17	2	3			2								3		2

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT:

CIE Exams	PO1, PO2, PO3, PO5, PSO1	SEE Exams	PO1, PO2, PO3, PO5, PSO1	Assignments	PO1	Seminars	PO1
Laboratory Practices	PO1	Student Viva	-	Mini Project	PSO3	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES – INDIRECT:

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

XIII. SYLLABUS

Unit-I	THREE PHASE CIRCUITS
Three Phase Circuits: Star and delta connections, phase sequence, relation between line and phase voltages and currents in balanced star and delta circuits, three phase three wire and three phase four wire systems, shifting of neutral point, analysis of balanced and unbalanced three phase circuits, measurement of active and reactive power.	
Unit-II	**DC AND AC TRANSIENT ANALYSIS**
Transient response: Initial conditions, transient response of RL, RC and RLC series and parallel circuits with DC and AC excitations, differential equation and Laplace transform approach.	
Unit-III	**LOCUS DIAGRAMS AND NETWORKS FUNCTIONS**
Locus Diagrams: Elementary treatment of locus diagrams of RL, RC and RLC circuits (series and parallel combinations). Network Functions: The concept of complex frequency, physical interpretation, transform impedance, series and parallel combination of elements, terminal ports, network functions for one port and two port networks, poles and zeros of network functions, significance of poles and zeros, properties of driving point functions and transfer functions, necessary conditions for driving point functions and transfer functions, time domain response from pole-zero plot.	
Unit-IV	**TWO PORT NETWORK PARAMETERS**
Two Port Network Parameters: Z, Y, ABCD, hybrid and inverse hybrid parameters, conditions for symmetry and reciprocity, inter relationships of different parameters, interconnection (series, parallel and cascade) of two port networks, image parameters.	
Unit-V	**FILTERS AND DIGITAL SIMULATION OF CIRCUITS**
Filters: Low pass, high pass, band pass, band elimination filters, introduction to active filter, filter design. Digital Simulation: MATLAB simulation and mathematical modeling of R, RL, RC and RLC circuits with DC and AC excitations: steady state and transient analysis, time and frequency domain analysis, frequency and phase spectra by Fourier analysis; basic test signals representation, filter design.	
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	Interpret three phase circuits, its generation and connections.	CLO1	T2:9.3 R1:19.1
2	Discriminate three phase circuits when connected in star and delta.	CLO1	T2: 9.6 R2:19.4
3	Analyze the three phase loads	CLO2	T2: 9.7 R2:19.5
4-5	Discuss voltage and current of three phase unbalanced loads.	CLO2	T2: 9.10 R2:19.6
6-7	Determine the active power in a three phase circuit and the effect of power factor on Wattmeter readings.	CLO3	T2: 9.11 R2:19.8
8-9	Determine the reactive power in a three phase circuit	CLO3	T2: 9.11 R2:19.8
10-12	Tutorial Problems	CLO3	T2, 9.12 R2:19.9
13-14	Observe the Transient behavior of R, L and C elements in a circuit.	CLO5	T2 - 11.1 R2 :17.1
15-16	Compute initial conditions and time response for current and voltage in first order R-L and R-C circuits	CLO4	T2 :11.2 R2 :17.3
17-18	Analyze and solve problems on complicated RC and RL circuits	CLO5	T2 :11.2 R2:17.12
19-20	Describe the AC Transient analysis of a series RC, RL circuits	CLO5	T2:11.5 R2:17.5
21-22	Analyze Transient behavior of a series RLC circuits to AC excitation	CLO5	T2 - 11.7 R2:17.6
23-24	Analyze the Transients using Laplace transform method	CLO6	T2 :11.7 R2:17.10
25-27	Tutorial Problems	CLO6	T1:9.1 R2:17.12
28-29	Discuss the concepts of locus diagram	CLO7	T2 – 8.13 R2:15.12
30	Learn about complex frequency	CLO8	T2 – 15.1 R2:15.1
31-32	Design Transform Impedance and Transform Circuits	CLO8	T2 – 15.3 R2:15.1
33-34	Learn terminal pairs or ports	CLO8	T2 – 15.5 R2:15.1
35	Study the significance of poles and zeros	CLO8	T2 – 15.8 R2:15.1
36	Understand the properties of Transfer functions, Necessary conditions for driving point functions	CLO8	T2 :15.14 R2:15.1
37	Study the Necessary conditions for transfer functions, time domain response from pole zero plot	CLO8	T2 :15.14 R2:15.1
38-41	Tutorial Problems	CLO9	T2:15.15 R2:16.2
42	Discuss about network parameters	CLO10	T1 :13.6 R2:16.3
43-44	Obtain Z parameters and Y parameters	CLO10	T1 :13.6 R2:16.4
45-52	Analyze problems on Z and Y parameters	CLO10	T1 :13.9 R2:16.5
45, 46	Design h parameters and ABCD parameters	CLO10	T1 :13.6

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
			R2:16.6
47	Analyze problems on h and ABCD parameters	CLO10	T1 :13.6 R2:16.7
48	Interrelate Z, Y, H & T parameters	CLO11	T1 :13.7 R2:16.8
49	Study the Cascade, series, parallel connection of Networks	CLO12	T1 :13.14 R2:16.9
50-51	Tutorial Problems	CLO10	T1:14.13R2 :16.12
52	Understand the Low Pass filter characteristics and design	CLO13	T1: 18.6 R2:19.12
53	Design the High Pass filter and study its characteristics	CLO13	T1 :18.8 R2:19.2
54	Analyze and Design Band Pass filter	CLO13	T1 :18.8 R2:19.3
55	Understand the characteristics of Band Elimination filter	CLO13	T1 :18.14 R2:19.4
56	Tutorial Problems	CLO13	T1: 18.16 R2:19.5
57	Design of Active filters	CLO13	T1 :18.17 R2:19.3
58	Observe the simulation of RL,RC,RLC circuits	CLO14	T2 :11.7 R2:14.3
59	Demonstrate different properties of Fourier transforms	CLO15	T2 :12.1 R2:14.5
60	Tutorial Problems	CLO15	T2:12.3 R2:14.6

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

S No	Description	Proposed Actions	Relevance With POs	Relevance With PSOs
1	Designing of Filters	Guest Lectures / NPTEL	PO1,PO2, PO5	PSO 1
2	Digital Simulation of Electric Circuits.	Matlab Demos / NPTEL	PO1, PO3, PO5	PSO 1
3	Significance of Poles and Zeros.	NPTEL / Term Paper	PO1, PO2	PSO 1

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