INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**NETWORK ANALYSIS**				
Course Code	**AEEB09**				
Programme	B.Tech				
Semester	**III**	**EEE**			
Course Type	**Foundation**				
Regulation	**IARE - R18**				
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 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 with network theorems for both DC and AC excitation. The course also includes transient analysis of DC and AC circuits, network functions, and two port net work parameters, locus diagrams, design and analysis of filters.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	AHB02	I	Linear Algebra and Calculus
UG	AHSB11	II	Mathematical Transform Techniques
UG	AEB002	II	Electrical Circuits

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 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 centre. 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.

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	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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

The course should enable the students to:	
I	Apply network theorems to obtain the equivalent circuit of electrical networks.
II	Analyze the transient response of series and parallel RL, RC, RLC circuits for DC and AC excitations.
III	Understand the concept of locus diagram for series and parallel circuits and also network functions for one port and two port networks.
IV	Evaluate the two port network parameters and Discuss their interrelation and interconnection of networks.
V	Design different types of filters and study their characteristics.

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Apply Thevenin and Norton theorems to analyze and design for maximum power transfer and the concept of linearity and the associated technique of superposition to circuits and network.	CLO 1	Verify the law of conservation of energy, superposition principle, reciprocity and maximum power transfer condition for the electrical network with DC excitation.
		CLO 2	Summarize the procedure of Thevenin's, Norton's and Milliman's theorems to reduce complex network into simple equivalent network.
CO 2	Analyze the transient response of series and	CLO 3	Estimate the transient response of series and parallel circuits with DC excitation.

COs	Course Outcome	CLOs	Course Learning Outcome
	parallel circuits with DC and AC excitation using differential approach and laplace transform approch	CLO 4	Analyze the transient response of series and parallel circuits with AC excitation.
		CLO 5	Evaluate the transient response of first and second order electric circuits using differential equation approach.
		CLO 6	Determine the transient response of first and second order electric circuits using Laplace transform technique
CO 3	Understand the locus diagram representation and various functions of network.	CLO 7	Explain the concept of locus diagram for series and parallel circuits.
		CLO 8	Generalize the concept of network functions for one port and two port networks.
		CLO 9	Observe the Time Response From pole - zero plots.
		CLO 10	Examine the electric networks in time domain and frequency domain.
CO 4	Understand the features of two port networks and to obtain their equivalent circuits.	CLO 11	Calculate Z, Y, ABCD, H and image parameters of two port network.
		CLO 12	Derive the condition for symmetry and reciprocity for different parameters of two port networks.
		CLO 13	Inter relationships between various two port networks them.
		CLO 14	Outline the concepts of interconnections of two port networks.
CO 5	Design low pass, high pass, band pass and band elimination filter networks.	CLO 15	Design of low pass, high pass, band pass, band elimination and study their characteristics.

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
AEEB09.01	CLO 1	Verify the law of conservation of energy, superposition principle, reciprocity and maximum power transfer condition for the electrical network with DC excitation.	PO1, PO2, PO3	3
AEEB09.02	CLO 2	Summarize the procedure of Thevenin's, Norton's and Milliman's theorems to reduce complex network into simple equivalent network.	PO1, PO2, PO3	3
AEEB09.03	CLO 3	Estimate the transient response of series and parallel circuits with DC excitation.	PO1, PO2	3
AEEB09.04	CLO 4	Analyze the transient response of series and parallel circuits with AC excitation.	PO1, PO2	3
AEEB09.05	CLO 5	Evaluate the transient response of first and second order electric circuits using differential equation approach.	PO1, PO2	3
AEEB09.06	CLO 6	Determine the transient response of first and second order electric circuits using Laplace transform technique.	PO1, PO2	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEEB09.07	CLO 7	Explain the concept of locus diagram for series and parallel circuits.	PO1, PO2	3
AEEB09.08	CLO 8	Generalize the concept of network functions for one port and two port networks	PO1, PO2	2
AEEB09.09	CLO 9	Observe the Time Response From pole - zero plots.	PO1,PO2	2
AEEB09.10	CLO 10	Examine the electric networks in time domain and frequency domain.	PO1,PO2	2
AEEB09.11	CLO 11	Calculate Z, Y, ABCD, H and image parameters of two port network.	PO1,PO2	3
AEEB09.12	CLO 12	Derive the condition for symmetry and reciprocity for different parameters of two port networks.	PO1,PO2	3
AEEB09.13	CLO 13	Inter relationships between various two port networks them.	PO1, PO2	2
AEEB09.14	CLO 14	Outline the concepts of interconnections of two port networks.	PO1	2
AEEB09.15	CLO 15	Design of low pass, high pass, band pass, band elimination and study their characteristics.	PO1, PO2, PO3	3
AEEB09.16	CLO 16	Apply the concept of network theorems, switching transient to solve real time world applications.	PO1, PO2, PO3	3
AEEB09.17	CLO 17	Process the knowledge and skills for employability and to succeed national and international level competitive examinations.	PO1, PO2, PO3	3

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

Course Outcomes (COs)	Program Outcomes (POs)			
	PO 1	PO 2	PO 3	PSO1
CO 1	3	2	3	2
CO 2	3	2		2
CO 3	3	2		2
CO 4	3	2		2
CO 5	3	2	2	2

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XII. 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	3	2										2		
CLO 2	3	3	2												
CLO 3	3	3											2		
CLO 4	3	3											2		
CLO 5	3	3											2		
CLO 6	3	3											1		
CLO 7	2	3													
CLO 8	2	2													
CLO 9	2	2											2		
CLO 10	2	2											2		
CLO 11	2	3											2		
CLO 12	2	3													
CLO 13	2	2													
CLO 14	2	2													
CLO 15	2	3	3										2		
CLO 16	3	3	2										3		
CLO 17	2	3	2										3		

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XIII. ASSESSMENT METHODOLOGIES – DIRECT

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

XIV. ASSESSMENT METHODOLOGIES – INDIRECT

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

XV. SYLLABUS

MODULE-I	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 .	
MODULE-II	**SOLUTION OF FIRST AND SECOND ORDER NETWORKS**
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.	
MODULE-III	**LOCUS DIAGRAMS AND NETWORKS FUNCTIONS**
Locus diagrams: Locus diagrams of RL, RC, RLC circuits. 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.	
MODULE-IV	**TWO PORTNETWORK 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.	
MODULE-V	**FILTERS**
Filters: Classification of filters, filter networks, classification of pass band and stop band, characteristic impedance in the pass and stop bands, constant-k low pass filter, high pass filter, m-derived T-section, band pass filter and band elimination filter.	
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.	

XVI. 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
1-5	Prove the law of conservation of energy, Tellegen's, superposition principle, reciprocity and maximum power transfer condition for the electrical network with DC and AC excitations.	CLO 1	T1:3.9 R2 :15.1
6-10	Summarize the procedure of Thevenin's, Norton's and Milliman's theorems to reduce complex network into simple equivalent network.	CLO 2	T1:3.12 R2 :15.4
11-12	Tutorial Problems	CLO 1, CLO 2	T1:3.16 R2 :15.8
13	Observe the Transient behavior of R, L and C elements in a circuit.	CLO 3	T2 - 11.1 R2 :17.1
14-15	Compute initial conditions and time response for current and voltage in first order R-L and R-C circuits to DC excitation	CLO 3	T2 :11.2 R2 :17.3
16	Analyze and solve problems on complicated RLC circuits to DC excitation	CLO 3	T2 :11.2 R2:17.12
17-18	Describe the AC Transient analysis of a series RL, RC circuits to AC excitation	CLO 4	T2:11.5 R2:17.5
19	Analyze Transient behavior of a series RLC circuits to AC excitation	CLO 4	T2 - 11.7 R2:17.6
20-22	Analyze the Transients using Laplace transform method	CLO 3, CLO 4	T2 :11.7 R2:17.10
22-24	Tutorial Problems	CLO 3, CLO 4	T1:9.1 R2:17.12
25-28	Discuss the concepts of locus diagram	CLO 7	T2 – 8.13 R2:15.12
29	Learn about complex frequency	CLO 8	T2 – 15.1 R2:15.1
30-31	Design Transform Impedance and Transform Circuits	CLO 8	T2 – 15.3 R2:15.1
32	Learn terminal pairs or ports	CLO 8	T2 – 15.5 R2:15.1
33	Study the significance of poles and zeros	CLO 9	T2 – 15.8 R2:15.1
34	Understand the properties of Transfer functions, Necessary conditions for driving point functions	CLO 8	T2 :15.14 R2:15.1
35	Study the Necessary conditions for transfer functions, time domain response from pole zero plot	CLO 9	T2 :15.14 R2:15.1
36-40	Tutorial Problems	CLO 8, CLO 9	T2:15.15 R2:16.2
41	Discuss about network parameters	CLO 11	T1 :13.6 R2:16.3
42-43	Obtain Z parameters and Y parameters	CLO 11	T1 :13.6 R2:16.4
44	Analyze problems on Z and Y parameters	CLO 11	T1 :13.9 R2:16.5
45-46	Design h parameters and ABCD parameters	CLO 11	T1 :13.6 R2:16.6
47	Analyze problems on h and ABCD parameters	CLO 11	T1 :13.6 R2:16.7
48	Interrelate Z, Y, h & T parameters	CLO 13	T1 :13.7 R2:16.8
49	Study the Cascade, series, parallel connection of Networks	CLO 14	T1 :13.14

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
			R2:16.9
50-51	Tutorial Problems	CLO 13, CLO 14	T1:14.13 R2:16.12
52	Understand the Constant-k Low Pass filter characteristics and design	CLO 15	T1: 18.6 R2:19.12
53	Design the Constant-k High Pass filter and study its characteristics	CLO 15	T1 :18.8 R2:19.2
54	Understand the m-derived T-section Low Pass filter characteristics and design	CLO 15	T1 :18.9 R2:19.3
55	Design the m-derived T-section High Pass filter and study its characteristics	CLO 15	T1 :18.10 R2:19.5
56-57	Tutorial Problems	CLO 15	T1 :18.11 R2:19.6
58	Analyze and Design Band Pass filter	CLO 15	T1 :18.8 R2:19.3
59	Understand the characteristics of Band Elimination filter	CLO 15	T1 :18.14 R2:19.4
60	Tutorial Problems	CLO 15	T1: 18.16 R2:19.5

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

S No	Description	Proposed Actions	Relevance With POs	Relevance With PSOs
1	Designing of Filters using Lab View.	Guest Lectures / NPTEL	PO1,PO2, PO3	PSO 3
2	Mathematical modelling of electrical network using MATLAB.	Matlab Demos / NPTEL	PO1, PO2,PO3	PSO 3
3	Design of attenuators using MATLAB.	NPTEL / Term Paper	PO1, PO2, PO3	PSO 3

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