Course Name: Electric Circuit Theory
Course Code: EE 301
Credit: 4

Prerequisites:

Sl. No.	Subject	Description	Level of Study
01	Mathematics	Vector , Calculus, Laplace, Fourier, Graph Theory	Class XII, 1st Sem, 3rd sem
02	Physics	Electrostatics, Electromagnetism	1st Sem, 2nd Sem

Course Objective:

- To provide a methodical approach to problem solving.
- To learn a number of powerful engineering circuit analysis techniques such as nodal analysis, mesh analysis, theorems, source transformation and several methods of simplifying networks.
- To understand the concept of graphical solution to electrical network
- To understand frequency response in electrical circuits
- To develop a clear understanding of the important parameters of a magnetic circuit.
- To analyze various types of filters and attenuators.
- Different types of two-port network analysis using network parameters, with different types of connections.

Course Outcomes:

At the end of the course, a student will be able to:

CO1. **Match**concepts in trigonometry, complex algebra, and matrix algebra to utilize techniques, skills, and modern engineering tools necessary for electrical engineering practices.

CO2. **Select**proper network reduction techniques, circuital laws and theorems for magnetic / electric circuit solution considering economic, performance, efficiency and availability constraints.

CO3. **Estimate**parameters for different types of attenuators and filters used in signal modulation for power systems and communication systems**.**

CO4. **Analyze**circuits and systems by their standard parameters to identify their characteristics in general form, applicable for generation, transmission and distribution considering economical, ethical and practical limitation.

CO5. **Develop** various methodology/strategies throughvarious domain of analysis toevaluateperformancecharacteristics ofelectricalnetworks and **analyze**theiroperationunderdifferentoperating conditions for various electrical/electromagnetic systems.

CO6. **Apply** computer mathematical and simulation programs to solve various real life multi-disciplinary topics through circuit solution.

CO- PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	-	-	-	3	-	-	-	-	-	-	1
2	2	1	-	-	-	1	-	-	-	-	-	1
3	-	-	1	-	-	2	2	-	2	-	2	-
4	-	1	2	-	1	2	2	1	-	-	-	2
5	-	1	-	1	-	1	1	-	-	-	-	-
6	2	2	-	-	-	-	-	-	2	-	-	1

Correlation levels 1, 2 or 3 as defined above: 1: Slight (Low) 2: Moderate (Medium)3: Substantial (High) and "-" if there is no correlation.

Syllabus Indicating CO:

Module No.	Content	Relevant CO's
1	**Introduction:** Continuous & Discrete, Fixed & Time varying, Linear andNonlinear, Lumped and Distributed, Passive and Active networks and systems.Independent & Dependent sources, Step, Ramp, Impulse, Sinusoidal, Square, Sawtooth signals.	**CO1**
2	**Coupled circuits:** Magnetic coupling, Polarity of coils, Polarity of inducedvoltage, Concept of Self and Mutual inductance, Coefficient of coupling,Modeling of coupled circuits, Solution of problems.	**CO1,**
3	**Laplace transforms:** Impulse, Step & Sinusoidal response of RL, RC, and RLCcircuits. Transient analysis of different electrical circuits with and without initialconditions. Concept of Convolution theorem and its application. Solution ofProblems with DC & AC sources.	**CO2, CO3, CO4**
4	**Fourier method of waveform analysis:** Fourier series and Fourier Transform (incontinuous domain only). Application in circuit analysis, Solution of Problems	**CO2, CO3, CO4**
5	**Network equations**: Formulation of network equations, Source transformation, Loop variable analysis, Node variable analysis. Network theorem: Superposition, Thevenin's, Norton's & Maximum powertransfer theorem. Millman's theorem and its application in three phase unbalancedcircuit analysis. Solution of Problems with DC & AC sources.	**CO2, CO3, CO4**
6	**Graph theory and Networks equations:** Concept of Tree, Branch, Tree link, Incidence matrix, Tie-set matrix and loop currents, Cut set matrix and node pair potentials. Duality, Solution of Problems	**CO5**
7	**Two port networks analysis:** Open circuit Impedance & Short circuit Admittance parameter, Transmission parameters, Hybrid parameters and their inter relations. Driving point impedance & Admittance. Solution of Problems	**CO6**
8	**Filter Circuits:** Analysis and synthesis of Low pass, High pass, Band pass, Band reject, All pass filters (first and second order only) using operational amplifier. Solution of Problems	**CO1, CO3, CO5,CO6**

S. No.	Gap	Actiontaken	Relevance toPOs,
1	**Passive Filter:** *This technique is very useful to deal with Active Filter design, but missing in the syllabus.* **Topics covered:** Image Impedance, Hyperbolic Trigonometry, Propagation Constant, Properties of Symmetrical Network, filter fundamentals	The various topics are addressed by **lecture classes, providing notes, and by solving numerical problems.**	**PO 1, PO 2**
2	**Network Function and:** *This topic is very much relevant for mathematical and generalized analysis but missing in the syllabus.* **Topics covered:**Determinant and cofactors for determining network function, Driving point function, Transfer Function,	Additional **lecture classes** are organized to cover the topics..	**PO 1, PO 2, PO 5**
3	**Network Synthesis :***This is an emergent area under scheduling and therefore imperative to deal with.* **Topics covered:** Time domain behavior from pole-zero plot, positive real functions, Synthesis of dissipative network	These are emergent topics under scheduling and therefore are covered in continuation with the static scheduling by **lectures and providing research papers**.	**PO 1, PO 2, PO 3, PO 5**
4	**Basic Manufacturing of Circuit Elements:** *This is one of the most fundamental and important areas under circuit theory,but unfortunately not covered in the syllabus.* **Topics covered:** Design of Resistance, Inductor and Capacitor.	The various topics are addressed by **lecture classes, providing notes, and by solving numerical problems.** The students are **given assignments** for solving problems.	**PO 1, PO 3, PO 4, PO 5**

Gaps in Syllabus:

Lecture Plan:

Cl. No.	Date	Topics	Remarks
1		Introduction: Continuous & Discrete, Fixed & Time varying, Linear and Nonlinear, Lumped and Distributed, Passive and Active networks and systems.	
2 & 3		Independent & Dependent sources, Step, Ramp, Impulse, Sinusoidal, Square, Saw tooth signals.	
4		Coupled circuits: Magnetic coupling, Polarity of coils, Polarity of induced voltage, Concept of Self and Mutual inductance,	
5 & 6		Coefficient of coupling, Modeling of coupled circuits, Solution of problems.	
7		Laplace transforms:	
8		Impulse, Step & Sinusoidal response of RL,	Problems to be solved
9 & 10		Impulse, Step & Sinusoidal response of RC, and RLC circuits.	Problems to be solved as home assignments
11		Transient analysis of different electrical circuits with and without initial conditions.	
12		Concept of Convolution theorem and its application.	Problems to be solved
13 &14		Solution of Problems with DC & AC sources.	Problems to be solved
15		Fourier method of waveform analysis:	
16		Fourier series(in continuous domain only)	
17		Fourier series(in continuous domain only)	
18		Fourier Transform.	
19 & 20		Application in circuit analysis, Solution of Problems	Problems to be solved
21 & 22		Application in circuit analysis, Solution of Problems	Problems to be solved
23		Network equations: Formulation of network	Problems to be

		equations, Source transformation,	solved
24		Loop variable analysis, Node variable analysis.	
25 & 26		Network theorem: Superposition, Thevenin's,	Problems to be solved
27 & 28		Norton's & Maximum power transfer theorem.	Problems to be solved
29 & 30		Millman's theorem and its application in three phase unbalanced circuit analysis. Solution of Problems with DC & AC sources.	Problems to be solved
31		Graph theory and Networks equations: Concept of Tree, Branch, Tree link,	
32		Incidence matrix, Tie-set matrix and	
33		loop currents, Cut set matrix and node pair potentials.	
34		Duality, Solution of Problems	
35 & 36		Two port networks analysis: Open circuit Impedance & Short circuit Admittance parameter,	
37		Transmission parameters, Hybrid parameters and their inter relations. Driving point impedance & Admittance.	
38		Solution of Problems.	
39		Solution of Problems.	
40		Filter Circuits: Analysis and synthesis of Low pass, High pass, Band pass, Band reject, All pass filters (first and second order only)	
41		Filter using operational amplifier.	
42 &43		Solution of Problems.	

Recommended Books:

1. Networks and Systems, D. Roy Chowdhury, New Age International Publishers

2. Network Analysis and Synthesis, C.L. Wadhwa, New Age International Publishers

3. Circuit and Networks: Analysis and synthesis, A. Sudhakar& S.S. Palli4th edition. Tata McGraw Hill Education Pvt. Ltd.

4. Circuit theory, Dr. AbhijitChakrabarty, DhanpatRai& Co Pvt. Ltd.