GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3132406
Semester – III
Subject Name: Circuit Theory

Type of course: Professional Core Course

Prerequisite: Basic concepts of Electrical Engineering.

Rationale: The course has been designed to introduce fundamental principles of circuit theory used in engineering . Techniques and principles of electrical circuit analysis, resistive circuits, transient and steady-state responses of circuits; circuits with DC and sinusoidal sources, steady-state power and three-phase systems, including Laplace transforms applications for solving circuit problems**.**

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	1	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	CIRCUIT PARAMETERS AND FUNDAMENTAL LAWS Introduction, Electric charge. Electric work. Potential. Potential difference. Electric current, Power, Energy, Kirchoff's law. Analysis with dependent current and voltage sources, Node and Mesh Analysis. Concept of duality and dual networks. Star-delta connection, source transformation.	**7**
2	NETWORK THEOREMS Introduction, Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem.	**6**
3	SOLUTION OF FIRST AND SECOND ORDER NETWORKS Introduction, Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady and transient response.	**9**
4	SINUSOIDAL STEADY STATE ANALYSIS Representation of sine function as rotating phasor, phasor diagrams, AC circuit analysis, effective or RMS values, average power and complex power, Instantaneous Power in AC circuit and power triangle, Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits.	**8**

5	CIRCUIT ANALYSIS USING LAPLACE TRANSFORMS Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots) for series and parallel resonances, tuned circuits.	8
6	TWO PORT NETWORK AND NETWORK FUNCTIONS Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters ,admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.	**7**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**20**	**10**	**10**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. Gopal G. Bhise, Prem R. Chadha, Durgesh C. Kulshreshtha, "Engineering Network Analysis and Filter Design", Umesh Publication., 2002.
4. A.Chakrabarti, "Circuits Theory", Dhanpat Rai & Co.(PVT) Ltd., 2003.

Course Outcomes: At the end of this course, students will be able to clarify

Sr. No.	CO statement	Marks % weightage
CO-1	To understand basic concept of circuit theory.	20
CO-2	Apply network theorems for the analysis of electrical circuits.	20
CO-3	Obtain the transient and steady-state response of electrical circuits.	20
CO-4	Analyze circuits in the sinusoidal steady-state.	20

CO-5	Analyze two port circuit behaviour.	20

List of Experiments: The following are suggested list of experiments.

Sr. No.	Theme	Remarks
1	To verify Kirchoff's voltage law (KVL) and Kirchoff's current law (KCL).	
2	To verify Thevenin's theorem for resistive network.	
3	To verify Norton's theorem for resistive network.	
4	To verify maximum power transfer theorem for resistive network.	
5	To verify superposition theorem for resistive network.	
6	To obtain transient response of a RL/RC circuit.	
7	To obtain Transient Response of a RLC circuit.	
8	To determine Z-parameters of given Two Port Network.	
9	To determine ABCD parameters of given Two Port Network.	
10	To determine H- Parameters of given Two Port Network.	

Major Equipment:

Experiment Kit, Multimeter, AC/DC Sources, AC/DC Meters etc.

List of Open Source Software/learning website:

1.Simulation software like MATLAB along with necessary toolbox, PSIM or Scilab.
2. Courses available through NPTEL - website : nptel.ac.in
3. https://www.analog.com/en/design-center/evaluation-hardware-and-software/lt-spice-demo-circuits.html
4. http://www.ti.com/tool/TINA-TI
5. http://kicad-pcb.org/
6. https://www.circuitlab.com/
7. http://www.partsim.com
8. https://www.falstad.com/circuit/
9. http://ngspice.sourceforge.net/