B.E. Semester: 3
Electronics & Communication Engineering
Subject Name: Circuit Theory
Subject Code: EC-302

A. Course Objective :

- To present a problem oriented introductory knowledge of Electronics Engineering Circuits.
- To understand the basics of circuit components, their characteristics and responses.
- To solve the networks using various theorems and laws.
- To reduce the complex network using network topology.

B. Teaching/Examination Scheme :

SUBJECT		Teaching Scheme				Total Credit	Examination Scheme					Total Marks
		L	T	P	Total		THEORY		IE	CIA	PR. / VIVO	
CODE	NAME	Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	
EC-302	Circuit Theory	4	0	2	6	5	3	70	30	20	30	150

C. Detailed Syllabus :

1. **Concepts of Circuits:**
   Network classification, Energy sources, VI relations for R, L and C. Graphical analysis of Voltage, Current and Charge for passive elements, Dot convention
2. **Basic Network Analysis methods:** Kirchhoff's laws (KVL & KCL), Branch current and mesh currents, Mesh analysis for independent, dependent and sinusoidal sources, Supermesh, Nodal analysis for independent, dependent and sinusoidal sources, Supernode, Source transformation techniques, duality concept
3. **Network Theorems:**
   Superposition, Thevenin's, Norton's, Reciprocity, Substitution, Compensation, Millman's, Tellegen's, Maximum Power Transfer
4. **Two Port Parameters:**
   Z-parameters, Y-Parameters, h-Parameters, g-Parameters, ABCD Parameters, Inverse T Parameters, Relations between various Parameters
5. **Network Graph Theory:**
   Formation of graph and its orientation, Basic concepts of graph, Incidence matrix (A_a), Reduced Incidence Matrix (A), Fundamental Tie-sets(B_f) and Cut-sets (Q_f) , Relation between A_a, A, B_f and Q_f, Kirchhoff's laws in A_a, B_f and Q_f formations
6. **Initial Conditions:**
   Initial Conditions in elements, Derivative interpretation, Initial condition evaluation
7. **Transients in First and Second order linear circuits-RL, RC and RLC:**
   First order differential equation and solution, Time constant, Second order homogeneous differential equation and solution, RL and RC sinusoidal transient
8. **Laplace Transform for Network Analysis:**
   Basic Laplace and Inverse Laplace transformation rules, Laplace of Unit step, Ramp, Impulse waveforms, Initial and Final value theorem, Step response of RL,RC and RLC using Laplace transforms.

D. Lesson Planning :

Sr. No.	Lectures (Hours)	Weightage in % in Exam	Topics
1	06	35	**Concepts of Circuits:** Network classification, Energy sources, VI relations for R, L and C. Graphical analysis of Voltage, Current and Charge for passive elements, Dot convention
2	06		**Basic Network Analysis methods:** Kirchhoff's laws (KVL & KCL), Branch current and mesh currents, Mesh analysis for independent, dependent and sinusoidal sources, Supermesh, Nodal analysis for independent, dependent and sinusoidal sources, Supernode, Source transformation techniques, duality concept
3	08		**Network Theorems** Superposition, Thevenin's, Norton's, Reciprocity, Substitution, Compensation, Millman's, Tellegen's, Maximum Power Transfer
4	06	25	**Two Port Parameters** Z-parameters, Y-Parameters, h-Parameters, g-Parameters, ABCD Parameters, Inverse T Parameters, Relations between various Parameters
5	08		**Network Graph Theory** Formation of graph and its orientation, Basic concepts of graph, Incidence matrix (A_a), Reduced Incidence Matrix (A), Fundamental Tie-sets(B_f) and Cut-sets (Q_f) , Relation between A_a, A, B_f and Q_f, Kirchhoff's laws in A_a, B_f and Q_f formations
6	08	20	**Initial Conditions** Initial Conditions in elements, Derivative interpretation, Initial condition evaluation
7	05		**Transients in First and Second order linear circuits-RL, RC and RLC** First order differential equation and solution, Time constant, Second order homogeneous differential equation and solution, RL and RC sinusoidal transient
8	06	20	**Laplace Transform for Network Analysis** Basic Laplace and Inverse Laplace transformation rules
9	07		Laplace of Unit step, Ramp, Impulse waveforms, Initial and Final value theorem, Step response of RL,RC and RLC using Laplace transforms.
TOTAL	**60**	**100**	

E. Instructional Method & Pedagogy :

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations.
- Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.

- One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.
- Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
- Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.

F. Suggested List of Experiments :

1. Introduction to MATLAB, Simulink and Programming Techniques.
2. Experimental verification and simulation of Thevenin's Theorem
3. Experimental verification and simulation of Norton Theorem
4. Experimental verification and simulation of Superposition theorem
5. Experimental verification and simulation of Maximum power transfer Theorem
6. Experimental verification and simulation Transient analysis of RL/RC circuits
7. Experimental verification and simulation of Transient analysis of RLC circuits
8. Experimental verification and simulation of Two Port Network
9. Experimental verification and simulation of Two Port Ladder Network
10. Experimental verification and simulation of T & π Networks
11. Verification of Z-parameters, Y- parameters and H-parameters.
12. Programming & solution of network using cut-set matrix and tie-set matrix.

G. Students Learning Outcomes :

On successful completion of the course

- The student can learn about various methods of network reduction and analysis.

H. Recommended Study Materials :

TEXT BOOK:

- Network Analysis and Synthesis by U.A.Patel 6th Edition, Mahajan Publishing House.

REFERENCE BOOKS:

- Circuit Theory (Analysis and Synthesis) By A. Chakrabarti, Dhanpat Rai & Company.
- Network Analysis by M.E.Vanvalkenburg, PHI Publication.
- Linear Circuit Analysis by De Carlo/Lin 2nd Edition, Oxford University Press Indian Edition.