25ECMJ203: Network Theory

w. e. f. Academic Year:	**2026-27**
Semester:	**3**
Category of the Course:	**Program Core Course** (PCC).
Prerequisite:	Fundamental knowledge of electric circuit sources and elements, basic Mathematics (integration, differentiation, etc.)
Rationale:	Students of EC Engineering need to possess a good understanding of concepts and principles of passive circuit analysis and synthesis by applying various Circuit laws and theorems. This is one of the foundation courses that is required to understand the concepts of advanced courses and develop skills that are needed in Electronics field.

Course Outcomes:

After Completion of the Course, Student will able to:

	Course Outcome (CO)	**RBT Level (Cognitive Domain)**	**Marks% Weightage (Approx.)**
CO1	Explain fundamental concepts of electrical circuits including R, L, C parameters, sources, and network classifications.	Understand	20%
CO2	Apply Kirchhoff's laws, mesh and nodal analysis methods to solve electrical networks.	Apply	20%
CO3	Analyze electrical circuits using network theorems such as Thevenin, Norton, Superposition, and Maximum Power Transfer.	Analyze	20%
CO4	Evaluate circuit behavior under initial conditions, resonance, and filter operations.	Evaluate	20%
CO5	Analyze and interpret two-port networks and network topology parameters for complex circuits.	Analyze	20%

Teaching and Evaluation Scheme:

Teaching Scheme					**Examination Scheme**				
L	**T**	**P**	**C**	**Hrs/Week**	**IE**	**Theory**	**CIA**	**Practical**	**Total Marks**
3	0	2	4	5	40	60	30	20	150

IE: Internal Evaluation
CIA: Continuous Internal Assessment
Theory: Theory Exam (End Semester)
Practical: Practical Exam (End Semester)

Detailed Syllabus:

Topic		Hrs.	% of Weightage (Approx.)
UNIT: 1	**Concepts of Circuits & Basic Network Analysis Methods:**	**9**	**20**
Concepts of Circuits: Introduction, Charge and Current, Electric Energy, The Capacitance Parameter, The inductance Parameter, The Resistance Parameter, Network, Classification of Networks, Sources of Energy, The dot convention for coupled coils. **Basic Network Analysis Methods:** Introduction, Kirchhoff's laws (KVL & KCL), Branch current and mesh currents, Mesh analysis, Concept of Super mesh, Nodal analysis, Concept of Super node, Source transformation, duality.			
UNIT: 2	**Network Theorems:**	**9**	**20**
Introduction, Superposition Theorem, Reciprocity Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Millman's Theorem, Substitution Theorem, Compensation Theorem, Tellegen's Theorem for DC and AC circuits.			
UNIT: 3	**Initial Conditions & Resonance and Filters:**	**9**	**20**
Initial Conditions: Introduction, Initial Conditions in elements, Geometrical interpretation of Derivatives, Procedure for evaluating initial conditions. **Resonance and Filters:** Behaviors of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.			
UNIT: 4	**Two Port Parameters:**	**9**	**20**
Two Port Parameters: Introduction, Z-parameters, Y-Parameters, h-Parameters, g-Parameters, ABCD Parameters, Inverse Transmission Parameters, Relations between various Parameters.			
UNIT:5	**Network Topology:**	**9**	**20**
Introduction, Network Graph, Definitions, Incidence Matrix, Loop Matrix or Circuit Matrix, Cut Sets and Cut Set Matrix.			
		45	**100**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks in Percentage					
Remember	Understand	Apply	Analyze	Evaluate	Create
-	20	20	40	20	-

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.

List of Practical:

Topic	Hrs
1. To Verify Kirchhoff's Voltage Law (KVL).	2
2. To Verify Kirchhoff's current Law (KCL).	2
3. To Verify Superposition theorem.	2
4. To Verify Reciprocity Theorem.	2
5. To Verify Thevenin's Theorem.	2
6. To Verify Norton's Theorem.	2
7. To Verify Maximum Power Transfer Theorem.	2
8. To Verify Tellegan's Theorem.	2
9. Determination of Z-Parameters of given Two Port Network.	2
10. Determination of Y-Parameters of given Two Port Network.	2
11. Determination of h-Parameters of given Two Port Network.	2
12. Simulation and Analysis of DC Electrical Circuits.	8
	30

Text Books:

1. "Network Analysis and Synthesis", by U. A. Patel 11th Edition, Mahajan Publishing House.
2. "Circuits and Network Analysis and Synthesis", Sudhakar A and Shyam Mohan SP, Tata McGraw-Hill, 2007.

Reference Books:

1. "Circuit Theory Analysis and Synthesis" Abhijit Chakrabarti, Dhanpat Rai & Co (P) Ltd.
2. "Network Analysis" M. E. Vanvalkenburg, PHI Publication.
3. "Linear Circuit Analysis" DeCarlo/Lin, 2nd Edition, Oxford University Press Indian

Teaching Learning Method:

1. Lecture Method using chalk–board and multimedia presentations for explaining circuit concepts, network theorems, and mathematical derivations.
2. Problem-Solving and Tutorial Sessions to develop analytical skills through numerical examples and circuit analysis exercises.
3. Simulation-Based Learning using software tools (e.g., MATLAB/PSPICE) to visualize circuit behavior and transient responses.
4. Assignment Method
5. Design Thinking Method

Course Outcomes Mapping:

CO No.	Course Outcome (CO)	POs/PSOs Mapped	Cognitive Level (RBT)	Knowledge Category	Class Sessions (Lecture)
CO1	Explain fundamental concepts of electrical circuits including R, L, C parameters, sources, and network classifications.	PO1, PO2, PO5, PSO1	Understand	Conceptual	9
CO2	Apply Kirchhoff's laws, mesh and nodal analysis methods to solve electrical networks.	PO1, PO2, PO3, PSO1	Apply	Procedural	9
CO3	Analyze electrical circuits using network theorems such as Thevenin,Norton,Superposition, and Maximum Power Transfer.	PO1, PO2, PO3, PO5, PSO1	Analyze	Procedural, Conceptual	9
CO4	Evaluate circuit behavior under initial conditions, resonance, and filter operations.	PO1, PO2, PO4, PO5, PSO2	Evaluate	Procedural, Conceptual	9
CO5	Analyze and interpret two-port networks and network topology parameters for complex circuits.	PO1, PO2, PO3, PO4, PSO1	Analyze	Conceptual, Procedural	9

Mapping of COs with POs & PSOs:

CO	PO											PSO	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2	0	0	3	0	0	0	0	0	0	3	0
CO2	3	3	2	0	0	0	0	0	0	0	0	3	0
CO3	3	3	3	0	3	0	0	0	0	0	0	3	0
CO4	3	2	0	3	3	0	0	0	0	0	0	0	2
CO5	3	3	3	3	0	0	0	0	0	0	0	3	0

3: High, 2: Medium, 1: Low

Sustainable Development Goals (SDG) Integration:

The Network Theory course supports the Sustainable Development Goals by strengthening core engineering knowledge and analytical skills (SDG 4: Quality Education). It enables the design of efficient electrical circuits and systems, contributing to energy optimization and sustainability (SDG 7: Affordable and Clean Energy). The course also promotes innovation in electrical and communication infrastructure (SDG 9: Industry, Innovation and Infrastructure). Overall, it helps develop engineers capable of building reliable and sustainable technological solutions.

SDG Mapping with Course Outcomes:

CO	Course Outcome	Relevant SDGs	Justification
CO1	Explain fundamental concepts of electrical circuits including R, L, C parameters, sources, and network classifications.	SDG4	Builds strong foundational knowledge in circuit theory, supporting technical education and lifelong learning in engineering.
CO2	Apply Kirchhoff's laws, mesh and nodal analysis methods to solve electrical networks.	SDG4, SDG9	Develops analytical and problem-solving skills essential for designing efficient electrical systems used in modern infrastructure.
CO3	Analyze electrical circuits using network theorems such as Thevenin, Norton, Superposition, and Maximum Power Transfer.	SDG 7, SDG 9	Enables optimization of electrical networks, improving energy efficiency and supporting sustainable energy system design.
CO4	Evaluate circuit behavior under initial conditions, resonance, and filter operations.	SDG 7, SDG 12	Helps in designing stable and efficient circuits, reducing energy losses and promoting responsible use of electrical resources.
CO5	Analyze and interpret two-port networks and network topology parameters for complex circuits.	SDG 9, SDG 11	Supports advanced circuit design used in communication systems, smart grids, and sustainable urban infrastructure.