25ECMJ203: Network Theory

w. e. f. Academic Year:	**2026-27**
Semester:	**B.E. 3rd (Electronics and Communication Engineering)**
Category of the 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:

CO No.	Course Outcome (CO)	RBT Level (Cognitive Domain)
CO1	Explain fundamental concepts of electrical circuits including R, L, C parameters, sources, and network classifications.	Understand
CO2	Apply Kirchhoff's laws, mesh and nodal analysis methods to solve electrical networks.	Apply
CO3	Analyze electrical circuits using network theorems such as Thevenin, Norton, Superposition, and Maximum Power Transfer.	Analyze
CO4	Evaluate circuit behavior under initial conditions, resonance, and filter operations.	Evaluate
CO5	Analyze and interpret two-port networks and network topology parameters for complex circuits.	Analyze

Teaching and Evaluation Scheme:

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

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

Detailed Syllabus:

Unit No.	Topic	Hrs.	Marks % 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:** 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.	**9**	**20**
UNIT: 3	**Initial Conditions & Resonance and Filters:** **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.	**9**	**20**
UNIT: 4	**Two Port Parameters:** Introduction, Z-parameters, Y-Parameters, h-Parameters, g-Parameters, ABCD Parameters, Inverse Transmission Parameters, Relations between various Parameters.	**9**	**20**
UNIT: 5	**Network Topology:** Introduction, Network Graph, Definitions, Incidence Matrix, Loop Matrix or Circuit Matrix, Cut Sets and Cut Set Matrix.	**9**	**20**
		45	**100**

List of Tutorial and /or Practical:

Sr No	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

Learning Resources:

1. **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.

2. **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" De Carlo/Lin, 2nd Edition, Oxford University Press.

Teaching Learning Methods:

- Lecture-Based Teaching-Learning.
- Learning Through Problem-Solving.
- Technology-Based Learning.
- Kinesthetic Learning / Practicals.
- Group Teaching and Learning.
- Peer Teaching.
- Individual Learning / Self-Study.
- Inquiry-Based Learning.
- Expeditionary Learning / Real-World Problems.
- Game-Based Learning.

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,	PO1, PO2, PO3,	Analyze	Procedural, Conceptual	9

	Superposition, and Maximum Power Transfer.	PO5, PSO1			
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.