Title: Electrical Network Analysis

Code Number: EE2101

Credit Hours: 3 (3+1)

Prerequisites: EE1103 Linear Circuit Analysis

Semester: 3rd

Course Objectives

The course will enable students to:

1. Analyze the transient and steady-state responses of RL and RC circuits under source-free and driven conditions
2. Evaluate the behavior of RLC circuits under DC and AC excitation and understand resonance, Q-factor, and analog filters.
3. Apply sinusoidal steady-state analysis techniques to solve for voltage, current, and power in AC circuits.
4. Conduct experiments to measure and analyze instantaneous, average, apparent, and complex power in AC circuits, as well as assess the effectiveness of polyphase circuit configurations and magnetically coupled circuits.

Contents

Unit 1: Basic RL and RC Circuits

1. Source-Free RL and RC circuits
2. Unit Step Function
3. Driven RL and RC circuits
4. Natural and Forced Response

Unit 2: The RLC Circuit

1. Source-Free Parallel Circuit
2. RLC circuits with DC and AC excitation
3. Overdamped Parallel Circuit
4. Critical Damping
5. Underdamped Parallel Circuit
6. Source-Free Series Circuit
7. Complete Response of RLC Circuit
8. Lossless LC Circuit
9. Series and Parallel resonance in AC circuits
10. Q-Factor
11. Analog Filters

Unit 3: Sinusoidal Steady-State Analysis

1. Characteristics of Sinusoids
2. Forced Response to Sinusoids Functions
3. Phasor Diagrams and introduction to phasor representation of alternating voltage and current
4. Impedance and Admittance
5. Nodal and Mesh Analysis
6. Superposition, Source Transformations and Thevenin's Theorem

Unit 4: AC Circuit Power Analysis
1. Instantaneous Power
2. Average Power, Apparent Power and Power Factor
3. Effective Values of Current and Voltage
4. Complex Power

Unit 5: Polyphase Circuits
1. Polyphase Systems
2. Single-Phase Three-Wire Systems
3. Three-Phase Y-Y Connection
4. The Delta Connection
5. Power Measurement in Three-Phase Systems

Unit 6: Magnetically Coupled Circuits
1. Mutual Inductance
2. Linear Transformer
3. Ideal Transformer

Unit 7: Complex Frequency and Laplace Transform
1. Complex Frequency
2. Two-port networks and their interconnections
3. Laplace Transforms and Inverse Laplace Transforms
4. Application of Laplace transform in circuit analysis

Unit 8: Circuit Analysis in s-Domain
1. Impedance and Admittance in s-Domain
2. Nodal and Mesh Analysis in s-Domain
3. Transfer Functions

Lab Work Outline

Design and implement RL and RC circuits and verify their natural and forced responses using lab instruments. Analyze RLC circuits, including source-free, DC, and AC excitation, and validate their behavior through practical experiments. Conduct sinusoidal steady-state analysis using phasor diagrams and verify impedance and admittance measurements. Perform AC circuit power analysis and measure power in polyphase circuits. Explore magnetically coupled circuits and apply Laplace transforms for circuit analysis in the s-domain. Validate theoretical concepts through hands-on experiments and verify circuit theorems and transformations using lab instruments.

Teaching-Learning Strategies:

The pedagogical approach to this course relies on face-to-face teaching in a university classroom environment. The lectures are delivered using multimedia support and on white board. Students are engaged and encouraged to solve real world problems using computer-aided tools.

Assignments/Types and Number with calendar:

A minimum of four assignments to be submitted before the written exams for each term.

Assessment and Examinations:

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Sessional Assessment	25%	It is continuous assessment. It includes classroom participation, attendance, assignments and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Recommended Books:

1. Engineering Circuit Analysis by W. H. Hayt & J. E. Kemmerly
2. Introductory circuit analysis by Robert L. Boylestad
3. S. Franco, "Electric Circuits Fundamentals", Oxford University Press, (Latest Edition)
4. V.V. Burg, "Network Analysis", (Latest Edition)
5. J. D. Irwin and R. M. Nelms, "Basic Engineering Circuit Analysis", Wiley, 9th Edition, 2008
6. Hayt, J. Kemmerly and S. Durbin, "Engineering Circuit Analysis", McGrawHill, 7th Edition, 2007.