Approval: 8th Senate Meeting

Course Number: Network Theory

Course Name: EE203

Credit: 3-0-0-3

Prerequisites: IC 160 Electrical System Around us

Students intended for: UG

Elective or Compulsory: Core for EE, Elective for other UG branches

Semester: Odd

Course Preamble: The basic objective of this course is to introduce the fundamental theory and mathematics for the analysis of electrical circuits, frequency response and transfer function of circuits. The students will be able extend these fundamental principles into a way of thinking for problem solving in mathematics, science, and engineering

Course Outline: Overview of network analysis techniques, Transient and steady state sinusoidal response. Network graphs and their applications in network analysis. Two-port networks, combination of two ports, Analysis of common two ports, Resonance, Coupled circuits, Scattering matrix and its application in network analysis. Network functions, parts of network functions, obtaining a network function from a given part. Network transmission criteria; delay and rise time, Elmore's and other definitions. Elements of network synthesis techniques. Introduction to filters and frequency response.

Modules:

1. **Transient Network Analysis: [6 Lectures]**

Transient and steady state sinusoidal response. Response of RL, RC and RLC networks using Laplace Transforms for unit step, impulse and ramp inputs.

2. **Two Port Networks and their Characterization: [10 lectures]**

Open circuit, short circuit, hybrid and transmission parameters; Series, parallel and tandem connections of two-port networks, multi-port networks, multi-terminal networks; Resonant and band pass circuits, magnetically coupled circuits, analysis of coupled circuits. Network transmission criteria; delay and rise time, Elmore's and other definitions.

3. **Network Functions: [4 Lectures]**

Concept of complex frequency, Driving point impedances; Transfer functions of networks, Poles and zeros, Stability analysis.

4. **Network Synthesis: [8 lectures]**

Positive real functions and their properties, tests for positive real functions, Hurwitz polynomials; Driving-point synthesis of LC, RC and RL networks, Foster forms and Cauer forms.

5. **Network graphs and their applications in network analysis: [3 lectures]**

6. **Three-Phase A.C. Circuit Analysis: [3 Lectures]**

Analysis of balanced and unbalanced three-phase networks; Symmetrical components and their application in analysis of unbalanced networks.

7. **Analysis of A.C. circuits with non-sinusoidal inputs: [2 Lectures]**

Filters: Introduction to filters, various types of filters - LP, HP, BP and BS. Transformation of LP to other types. Butterworth, Chebyshev and Elliptic approximations to LPF.

8. **Frequency response: [6 lectures]**

Polar plots, magnitude and phase plots, Bode plot.

Text & Reference Books:

1. Network Analysis and Synthesis by Franklin Fa-Kun Kuo, John Wiley & Sons, 1996.
2. Network Analysis by Van Valkenburg, PHI Learning, 2014