Electric Circuit Theory

Course Objectives:
To continue work in Basic Electrical Engineering including the use of the Laplace Transform to determine the time and frequency domain responses of electric circuits.

1. Network Analysis of AC circuit & Dependent Sources(8 hours)
    a. Mesh Analysis
    b. Nodal Analysis
    c. Series & parallel resonance in RLC circuits
        i. Impedance and phase angle of series Resonant Circuit
        ii. Voltage and current in series resonant circuit
        iii. Band width of the RLC circuit.
        iv. High-Q and Low-Q circuits

2. Initial Conditions(2 hours)
    a. Characteristics of various network elements
    b. Initial value of Derivatives
    c. Procedure for evaluating initial conditions
    d. Initial condition in the case of RLC network

3. Transient analysis in RLC circuit by direct solution(10 hours)
    a. Introduction
    b. First order Differential equation
    c. Higher order homogeneous and non-homogeneous differential equations
    d. Particular integral by method of undetermined coefficients
    e. Response of R-L circuit with
        i. DC excitation
        ii. Exponential excitation
        iii. Sinusoidal excitation
    f. Response of R-C circuit with
        i. DC excitation
        ii. Exponential excitation
        iii. Sinusoidal excitation
    g. Response of series RLC circuit with
        i. DC excitation
        ii. Exponential excitation
        iii. Sinusoidal excitation
    h. Response of parallel RLC circuit with DC excitation

4. Transient analysis in RLC circuit by Laplace Transform(8 hours)
    a. Introduction
    b. The Laplace Transformation
    c. Important properties of Laplace transformation
    d. Use of Partial Fraction expansion in analysis using Laplace Transformations
    e. Heaviside's partial fraction expansion theorem
    f. Response RL circuit with
        i. DC excitation
        ii. Exponential excitation
        iii. Sinusoidal excitation

g. Response of RC circuit with
   - DC excitation
   - Exponential excitation
   - Sinusoidal excitation

h. Response of series RLC circuit with
   - DC excitation
   - Exponential excitation
   - Sinusoidal excitation

i. Response of parallel RLC circuit with exponential excitation
j. Transfer functions Poles and Zeros of Networks

5. Frequency Response of Network(6 hours)
   a. Introduction
   b. Magnitude and Phase response
   c. Bode Diagrams
   d. Bandwidth of Series & parallel Resonance circuits
   e. Basic concept of filters, high pass, low pass, band pass and band stop filters

6. Fourier Series and transform(5 hours)
   a. Basic concept of Fourier series and analysis
   b. Evaluation of Fourier coefficients for periodic non-sinusoidal waveforms in electric networks
   c. Introduction of Fourier transforms

7. Two-port Parameter of Networks(6 hours)
   a. Definition of two-port networks
   b. Short Circuit admittance parameters
   c. Open Circuits impedance parameters
   d. Transmission Short Circuit admittance parameters
   e. Hybrid Parameters
   f. Relationship and Transformations between sets of parameters
   g. Application to Filters
   h. Applications to Transmission Lines
   i. Interconnection of two-port network(Cascade, series, parallel)

References:

1. M. E. Van Valkenburg, "Network Analysis", third edition Prentice Hall, 2010.
2. William H. Hyat. Jr. & Jack E. Kemmerly, "Engineering Circuits Analysis", Fourth edition, McGraw Hill International Editions, Electrical Engineering Series, 1987.
3. Michel D. Cilletti, "Introduction to Circuit Analysis and Design", Holt, Hot Rinehart and Winston International Edition, New York, 1988.