ELE 215.3 Network Theory (3-1-2)

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives;

1. To provided the basis for formula and solution of network equations.
2. To understand the behavior of network.
3. To develop one – port and two port networks with given network functions

Course Contents:

1. Review of Network Analysis (2hrs)

Mesh and Nodal-pair (

2. Circuit Differential Equations (6 hrs)
(formulations and solutions)

The differential operator, Operational impedance, Formulation of circuit differential equations, Complete response (transient and steady state) of first order differential equations with or without initial conditions, Use of software in solving network different equations

3. Circuit Dynamics (6 hrs)

First order RL and RC circuits, Complete response of RL and RC circuit to sinusoidal input, RLC circuit, Step response of RLC circui9t, Response of RLC circuit to sinusoidal inputs, Resonance, Damping factors and Q-factor.

4. Review of Laplace Transform (6 hrs)

Definition and properties, Laplace transform of common forcing functions, Initial and final value theorem, Inverse Laplace transform, Partial fraction expansion, Solutions of first order and second order system, RL and RC circuit, RLC circuit, Transient and steady-state responses of network to unit step, unit impulse, ramp and sinusoidal forcing functions.

5. Transfer Functions (3 hrs)

Transfer functions of Network system, Poles and Zeros, Time- domain behavior from pole-zero locations, Stability and Routh's Criteria, Network stability.

6. Fourier Series and Transform (3 hrs)

Evaluation of Fourier coefficients for periodic non-sinusoidal waveforms, Fourier Transform, Application of Fourier transforms for non-periodic waveforms.

7. Frequency Response of Network (4 hrs)

Magnitude and phase responses, Bode plots and its applications, Half-power point, bandwidth, roll-off and skirt, Effects of quality factor on frequency response, concept of ideal and non-ideal LP, HP, BP and BS filters.

8. One-port passive network (8 hrs)

Properties of one-port passive network, Driving point functions, Positive Real Function, Loss-less network synthesis of LC one- port network, Properties of RL and RC network, Synthesis of RL and RC network, Properties and synthesis of RLC one –port network.

9. Two-Port Passive Network (7 hrs)

Properties of two-port network, Reciprocity and symmetry, Short circuit and open circuit parameters transmission parameters, Hybrid parameter, Relation and transformations between sets of parameters, Synthesis of two-port LC and RC ladder network based on zero shifting and partial pole removal, Equivalent T and π section representation, Properties of resistively terminated loss-less ladder.

Laboratory:

1. Transient and steady state responses of first order Passive network;
   - 1.1 Measurement of step, impulse and ramp response of RC and RL circuit using oscilloscope.
   - 1.2 Measurement of sinusoidal response of RC and RL circuit using oscilloscope.

2. Transient and Steady state responses of second order Passive network;
   - 2.1 Measurement of step, impulses and ramp response of RLC series and parallel network using oscilloscope.
   - 2.2 Measurement of sinusoidal response of RLC series and parallel network using oscilloscope.
   - 2.3 Measurement of resonance, effects of quality factor.

3. Measurement of Frequency responses of first order and second order circuits.
   - 3.1 Amplitude response and phase response of first orders and second orders circuits.
   - 3.2 Elate Bode plots to pole-zero plots of transfer functions.

4. Measurement of Harmonic content of a waveform;
   - 1.1 Computer the Fourier coefficients of a periodic non-sinusoidal waveform and verify with the harmonic analyzer.
5. Conversion of a T network into a network and measurement of network response.

6. Synthesis of one-port network function and verify the responses using oscilloscope.

Reference Books:

1. M.E., Van Valkenburg *Network Analysis*, Third edition Prentice Hall of India, 1995.
2. M.L. Soni, and J.C. Gupta, *Course in Electrical Circuit Analysis*, Dhanapat Rai & Sons, India.
3. KC Ng, *Electrical Network Theory*, A.H. Wheeler and Company (P) Limited, India.