Course No.	Course Name	L-T-P-Credits	Year of Introduction
IC202	LINEAR SYSTEMS AND NETWORKS	3-1-0-4	2016

Prerequisite: Nil

Course Objectives

- To model linear circuits and systems using differential equations and Transfer Functions..
- To expose to the concept of poles and zeros.
- To develop equations for large linear circuits by using network laws, and analyse their responses to different types of signals in time domain.
- To familiarise with two port network parameters.

Prerequisites

Laplace Transform, Kirchhoff's voltage and current law.

Syllabus

Differential equation model and Transfer Function model–Poles and zeros - transfer matrix. Laplace Transform analysis of RL, RC and RLC networks. Initial conditions in the circuit elements of resistance, inductance and capacitance - DC, Sinusoidal and exponential inputs- RLC circuits with DC excitation. Network functions: Ladder networks- Network functions for general networks- Poles and zeroes. Restriction of poles and zero locations for driving point function and other transfer function- Time domain behavior from pole zero plot- Two port network parameters- Short circuit admittance parameters- Open circuit impedance parameters- Hybrid parameters- Relationship between parameter sets.

Expected Outcome

Upon completion of this course, students will be able to

1. Use network laws, like Kirchhoff's voltage and current law, to write equations for large linear circuits.
2. Transform time domain signals and circuits parameters to frequency domain.
3. Apply the Laplace transform to linear circuits and systems.
4. Sketch the poles and zeros of a network function and their effects on time and frequency domain responses.

Text books

1. Van Valkenberg, *Network Analysis*, Prentice Hall of India
2. Desoer C.A. & Kuh E.S., *Basic Circuit Theory*, McGraw Hill

Reference books

1. Ryder J.D., *Networks, Lines and Fields*, Prentice Hall
2. Siskind, *Electrical Circuits*. McGraw Hill
3. Edminister, *Electric Circuits*, Schaum's Outline Series, McGraw Hill
4. Huelsman L.P., *Basic Circuit Theory*. Prentice Hall of India

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to system modeling- open loop and closed loop systems. Differential equation model and Transfer function model – Impulse response and transfer function – concept of poles and zeros - transfer matrix.	8	**15%**
II	Determination of transfer functions for simple electrical, mechanical, electromechanical, hydraulic and pneumatic systems - Analogous systems.	10	**15%**
FIRST INTERNAL EXAM			
III	Laplace Transform analysis of RL, RC and RLC networks. Transients- Review of transients in RC and RL networks with and significance of time constant- Initial conditions in the circuit elements of resistance, inductance and capacitance- Evaluation of initial condition- Initial state of a network- RLC network with internal excitation.	10	**15%**
IV	RC and RLC networks with external excitation, DC, Sinusoidal and exponential inputs- RLC circuits with DC excitation.	9	**15%**
SECOND INTERNAL EXAM			
V	Network functions: Network function for one port and two port networks- Ladder networks- Network functions for general networks- Poles and zeroes. Restriction of poles and zero locations for driving point function and other transfer function- Time domain behavior from pole zero plot	10	**20%**

VI	Two port network parameters- relationship of two port parameters- Short circuit admittance parameters- Open circuit impedance parameters- Hybrid parameters- Relationship between parameter sets.	9	**20%**
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks : 100 Exam Duration: 3 Hours

Part A

Answer any two out of three questions from Module 1 and 2 together. Each question carries 15 marks and can have not more than four sub divisions. (15 x 2 = 30 marks)

Part B

Answer any two out of three questions from Module 3 and 4 together. Each question carries 15 marks and can have not more than four sub divisions. (15 x 2 = 30 marks)

Part C

Answer any two out of three questions from Module 5 and 6 together. Each question carries 20 marks and can have not more than four sub divisions. (20 x 2 = 40 marks)

Total 100 Marks

Note: Each part shall have questions uniformly covering both the modules in it.