COURSE TITLE : CONTROL SYSTEMS
COURSE CODE : 5043
COURSE CATEGORY : E
PERIODS/WEEK : 4
PERIODS/SEMESTER : 52/5
CREDITS : 4

TIME SCHEDULE

MODULE	TOPICS	PERIODS
1	Introduction To Control System.	13
2	Systems and Transfer Functions.	13
3	Time Response Analysis.	13
4	Stability Analysis.	13
	TOTAL	**52**

Course General Outcome:

Module	GO	On completion of the study of this course the students will be able:
1	1	To understand the basics of control system.
	2	To understand Laplace and inverse Laplace transform.
2	3	To know systems and transfer function.
	4	To understand methods of obtaining transfer function
3	5	To understand time response analysis.
	6	To understand stability of a system and Routh stability criterion.
4	7	To understand bode plot and root locus techniques for stability analysis.

GO - General Outcome

On the completion of the study the student will be able:

MODULE I INTRODUCTION TO CONTROL SYSTEM

1.1.0 To understand the basics of control system.

1.1.1 To understand physical model of control system.
1.2.1 To analyze mathematical model of control system.
1.1.2 To explain linear time invariant and linear time variant system.
1.1.3 To know open loop and closed loop control systems.

1.2.0 To understand Laplace and inverse Laplace transforms.

1.2.1 To discuss Laplace transforms.
1.2.2 To find the Laplace transform of $e^{at,}$ e^{-at}, t, sin at and cos at.
1.2.2 To find the Laplace transform of test inputs such as step, ramp, parabolic, impuls inputs.
1.2.3 To state Laplace transform theorems - differentiation theorem and integration theorem.
1.2.4 To find Inverse Laplace transforms using partial fraction method to solve simple problems.

MODULE II SYSTEMS AND TRANSFER FUNCTIONS

2.1.0 To know systems and transfer function.

2.1.1 To define transfer function.
2.1.2 To find the order of transfer function.
2.1.3 To write transfer function of linear system.
2.1.4 To derive of general transfer function of Mechanical Translational system and rotational system.
2.1.5 To derive the transfer function of Electrical circuits – R, L and C (series & parallel).
2.1.6 To describe force/torque - voltage and force/torque - current analogy.

2.2.0 To understand methods of obtaining transfer function.

2.2.1 To explain Block diagram reduction rules.
2.2.2 To find the overall transfer function of control systems by block diagram.
2.2.3 Reduction rules (single input- single reduced output systems).
2.2.4 To define the parameters of signal flow graph.
2.2.5 To write Mason's gain formula.
2.2.6 To draw SFG from block diagram.
2.2.7 To obtain overall transmittance of control system by signal flow graph.

MODULE III TIME RESPONSE ANALYSIS

3.1.0 To understand time response analysis.

3.1.1 To explain the time response of first order system.
3.1.2 To find the response of first order systems such as step, ramp, and impulse inputs.
3.1.3 To define the type of a system.
3.1.4 To define static error coefficients such as static position, velocity & acceleration error coefficient.
3.1.5 To derive steady state error in terms of Kp, Kv & Ka for Type 0, Type 1, Type 2 Systems.

3.2.0 To understand Routh Hurwitz criterion.

3.2.1 To state absolute stability, relative stability and marginal stability.
3.2.2 To explain Routh hurwitz criterion.
3.2.3 To solve simple problems using Routh Hurwitz criterion.

MODULE IV STABILITY ANALYSIS

4.1.0 To understand bode plot and root locus techniques of stability analysis.

4.1.1 To draw Bode plot for simple transfer functions. K, Ks, K/s, 1+Ts, Ts, 1/1+Ts, 1/1Ts.
4.1.2 To explain gain cross over frequency, phase cross over frequency, gain margin and phase margin.
4.1.3 To describe the Procedure to construct Root locus.
4.1.4 To construct Root Locus for transfer functions (Single poles only).

CONTENT

MODULE I Introduction to control system

Basics of control system - physical model - mathematical model of control system - linear time invariant and linear time variant system - open loop and closed loop control systems - Laplace transforms - Laplace transform of $e^{at,}$ e^{-at}, t, sin at and cos at - Laplace transform of step, ramp, parabolic, impulse inputs - Laplace transform theorems - differentiation theorem and integration theorem - Inverse Laplace transforms - partial fraction method to solve simple problems.

MODULE II Systems and Transfer Functions

Transfer function - definition and order - transfer function of linear system - general transfer function of Mechanical Translational system and rotational system - transfer function of Electrical circuits – R, L and C (series & parallel) - force/torque - voltage and force/torque - current analogy - block diagram reduction – rules - overall transfer function of control systems using block diagram reduction rules - signal flow graph - parameters - Mason's gain formula - procedure to draw SFG from block diagram - overall transmittance of control system by signal flow graph.

MODULE III Time Response analysis

Time response analysis - time response of first order system - response of first order system for step, ramp, and impulse inputs - type of a system - static error coefficients - static position, velocity & acceleration error coefficient - steady state error in terms of Kp, Kv & Ka for Type 0, Type 1, Type 2

Systems - Routh Hurwitz criterion - absolute stability, relative stability and marginal stability – simple problems using Routh hurwitz criterion

MODULE IV Stability analysis

Bode plot – stability analysis of simple transfer functions. K, Ks , K/s,1+Ts,1-Ts,1/1+Ts,1/1-Ts - gain cross over frequency, phase cross over frequency, gain margin, phase margin - Root locus - Procedure to construct - Root Locus for single pole transfer functions.

TEXT BOOK

1. Control systems Engg -I.J.Nagarath, N. Gopal (New Age International Publisher).
2. Control Systems- R.S. Manke (Khanna Publisher).

REFERENCE

1. Modern Control Engineering - Katsuhiko Ogata – PHI.
2. Control Systems Engineering - R.Anandanatarajan.P.Ramesh Babu (Scitech Publisher).