

III B.Tech – I Semester
(20EC5008) CONTROL SYSTEMS ENGINEERING

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	-	-	3

Pre-Requisites: Signals & Systems

Course Objectives:

- To introduce the concepts of open loop and closed loop systems, mathematical models of mechanical and electrical systems, and concepts of feedback.
- To study the characteristics of the given system in terms of the transfer function and introducing various approaches to reduce the overall system for necessary analysis.
- To develop the acquaintance in analyzing the system response in time-domain and frequency domain in terms of various performance indices.
- To analyze the system in terms of absolute stability and relative stability by different approaches.
- To design different control systems for different applications as per given specifications and introduce the concepts of state variable analysis and also the concepts of controllability and observability.

UNIT-I:

Introduction: Concepts of System, Control Systems:

Open Loop and closed loop control systems and their differences. Different examples of control systems, Feed-Back Characteristics, Effects of feedback. Mathematical models, Differential equations, Impulse Response and transfer functions. Translational and Rotational mechanical systems

UNIT-II:

Transfer Function Representation:

Transfer Function of DC Servo motor - AC Servo motor- Synchro-transmitter and Receiver, Block diagram representation of systems considering electrical systems as examples -Block diagram algebra- Representation by Signal flow graph - Reduction using mason's gain formula.

Time Response Analysis: Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications –Steady state response - Steady state errors and error constants.

UNIT-III:

Stability Analysis In S-Domain:

The concept of stability – Routh's stability criterion – qualitative stability and conditional stability – limitations of Routh's stability.

Root Locus Technique: The root locus concept - construction of root loci-effects of adding poles and zeros to $G(s)H(s)$ on the root loci.

UNIT-IV:

Frequency response analysis: Introduction, Correlation between time and frequency response, Polar Plots, Bode Plots, Nyquist Stability Criterion

UNIT-V: Classical Control Design Techniques: Compensation techniques – Lag, Lead, Lead-Lag Controllers design in frequency Domain, Basic Controllers – P, I, D, PI, PD, PID Controllers. State Space

Analysis of Continuous Systems Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and its Properties –Concepts of Controllability and Observability.

Course Outcomes:

After successful completion of the course, the students can be able to

S. No	Course Outcome	BTL
1	Understand the concepts of feedback and its advantages to various control system.	L2
2	Understand the performance metrics to design the control system in time-domain and frequency domain.	L2
3	Understand the Concept of stability and analyze Control systems for various applications using time-domain methods.	L2
4	Analyze Control systems for various applications using frequency domain methods.	L4
5	Analyze the control system using the state space approach and concepts of controllability, observability.	L4

Correlation of COs with POs & PSOs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO3	2	3	1	-	-	-	-	-	-	-	-	-	1	-
CO 4	2	3	1	-	-	-	-	-	-	-	-	-	2	-
CO 5	3	3	2	-	-	-	-	-	-	-	-	1	3	-

Text Books:

1. Automatic Control Systems 8th edition – by B.C.Kuo – John Wiley and son's, 2003.
2. Control Systems Engineering– by I.J.Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 2nd edition, 2007.
3. Modern Control Engineering – by Katsuhiko Ogata–Pearson Publications, 5th edition, 2015.

Reference Books:

1. Control Systems by A. Nagoor kani, RBA publications, 3rd edition, 2017.
2. Control Systems by A. Anand kumar, PHI, 2nd Edition, 2014.