III Year I Semester	L	T	P	C
Code:20EC5008	3	0	0	3

CONTROL SYSTEMS ENGINEERING

Course Objectives:

1. To introduce the concepts of open loop and closed loop systems, mathematical models of mechanical and electrical systems, and concepts of feedback.
2. 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.
3. To develop the acquaintance in analyzing the system response in time-domain and frequency domain in terms of various performance indices.
4. To analyze the system in terms of absolute stability and relative stability by different approaches.
5. 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 infrequency 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:

A student who successfully fulfils this course requirement will 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
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO 2	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO 3	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 – byB.C.Kuo – Johnwileyandson's,2003.
2. Control Systems Engineering– by I.J.Nagrathand 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.