EEPC3001 CONTROL SYSTEM (3-0-0)

Course Objectives :

This course provides fundamental knowledge of control systems, covering mathematical modeling, time and frequency domain analysis, stability criteria (Routh-Hurwitz, Nyquist), and controller design (P, PI, PID). Students will learn state-space representation, system simplification techniques, and apply performance indices to analyze and design effective control systems.

Module-I: (08 Hrs.)

Introduction to Control System: Motivation, Open-loop versus Closed Loop Control System, Examples of Control System, Block Diagram of Control System, Principle of Feedback Control System. Mathematical Modelling and Representation of Systems: Mathematical Modelling of Electrical Systems (RLC Series and Parallel Circuits), Mechanical Systems (Mass-Spring-Damper System, Rotational Mechanical System). Analogous System: Force (Torque)-Voltage Analogy and Force (Torque)-Current Analogy. Introduction to Laplace Transformation and Important Formulas. Transfer Functions: Open-Loop and Closed-Loop Transfer Functions. Block Diagram Algebra: Block Diagram Reduction Techniques, Signal flow graph, Mason's gain formula.

Module-II: (06 Hrs.)

Transient and Steady State Analysis of Linear Time-Invariant (LTI) Systems: Introduction to LTI systems, Standard Test Signals, Time Response of First Order System, Time Response of Second Order System, Time Response Specifications. Steady-State Error and Error Constants. Effect of Adding Zeroes to a System. Performance Indices: ISE, ITSE, IAE, ITAE Indices Comparison.

Module-III: (08 Hrs.)

Frequency Domain Stability Analysis of LTI System: Routh Hurwitz Criteria, Stability Analysis using Root Locus, Stability Analysis using Bode Plot and Nyquist Criteria.

Module-IV: (04 Hrs.)

Controller and Compensator Design: P, PI, and PID Controller Design, Lag, Lead and Lead-Lag Compensator Design.

Module-V: (04 Hrs.)

Analysis of Control Systems in State Space: Introduction, State-Space Representations of Transfer-Function Systems, Solving the Time-Invariant State Space Model, Controllability and Observability.

Course Outcomes:

On completion of this course, students are able to:

CO-1: Develop the mathematical model of the physical systems and simplify the complicated system.

CO-2: Employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions.

CO-3: Formulate different types of analysis in the frequency domain to explain the nature of the stability of the system

CO-4: Identify the needs of different types of controllers and compensators to ascertain the required dynamic response from the system.

CO-5: Model and Analyse state space representation of LTI system to check the controllability and observability

Text Book(s):

1. K. Ogata, Modern Control Engineering, Pearson Education India, 2015
2. I.J. Nagrath and M. Gopal, Control System Engineering, New age international Publishers, 2009.
3. Norman S. Nise, Control Systems Engineering, Willey India Pvt. Ltd, 2024

Reference Book(s):

1. R.C. Dorf and R.H.Bishop, Modern Control System, Pearson Education, 2017.
2. B.C. Kuo, Automatic Control System, Prentice Hall, 1990.
3. S. Hasan Saeed, Automatic Control Systems (with Matlab Programs), Katson Books, 2017.