

2/4 B.Tech - FOURTH SEMESTER

EC4T1

Control Systems

Credits: 4

Lecture : 4 periods/week

Tutorial: 1 period /week

Internal assessment: 30 marks

Semester end examination: 70 marks

Course Objectives:

- To give a basic idea about analysis of linear control systems.
- To emphasize the student about stability analysis of a system.
- To learn how to improve the performance of an existing system
- Enable an engineer to exploit time domain and frequency domain tools to design and study linear control systems.

Learning Outcomes:

Students will be able to

- Represent a system in different modals
- Recognize and analyze feedback control mechanisms
- Describe various time domain and frequency domain tools for analysis of a linear control systems
- Describe the methods to analyze the stability of systems from transfer function.

UNIT- I

Concepts Of Control Systems: Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Different examples of control systems, Classification of control systems, Feed-Back Characteristics, Effects of feedback. Mathematical models – Differential equations, transfer functions - Translational and Rotational mechanical systems.

UNIT- II

Transfer Function Representation: Block diagram representation of systems considering electrical systems as examples -Block diagram algebra – Representation by Signal flow graph - Reduction using mason's gain formula.

UNIT- III

Time Domain 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- IV

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- V

Frequency Response Analysis : Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin-Stability Analysis from Bode Plots.

UNIT – VI

Stability Analysis in Frequency Domain : Polar Plots, Nyquist Plots Stability Analysis.

UNIT- VII

Effects of proportional derivative, proportional integral systems, Proportional Integral and Derivative Controllers.

UNIT – VIII

State Space Analysis : 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 it's Properties – Concepts of Controllability and Observability.

Learning Resources

Text Books:

1. Automatic Control Systems 8th edition–B. C. Kuo– John wiley and son's., 2003
2. Control Systems Engineering –I. J. Nagrath and M. Gopal, New Age International (P) Limited, Pub. 2nd edition.,2005

References:

1. Modern Control Engineering, Katsuhiko Ogata, Prentice Hall of India Pvt. Ltd., 3rd ed., 1998.
2. Control Systems Engineering, Nise– John wiley , 3rd Edition 2000