2/4 B.Tech. FOURTH SEMESTER

EE4T5 CONTROL SYSTEMS Credits: 3

Lecture: 1 periods/week Internal assessment: 30 marks

Practice: 3 periods/week Semester end examination: 70 marks

Course Objectives:

In this course it is aimed to provide sound knowledge in the basic concepts of linear control theory, design of control system and giving an exposure to the students on characteristics, stability of linear systems and addresses the analysis of feedback systems and finally to equip the student with the ability to select and design suitable control systems.

Course Outcomes:

Upon completion of the course, students will be able to:

1. Understand the basic concepts, properties of feedback and applications of control systems in day to day life.
2. Understand the transfer function analysis in mathematical modeling of control systems.
3. Perform time domain and frequency domain analysis of control systems required for stability analysis.
4. Analyze control system design techniques, their limitations and benefits.
5. Present and analyze linear control system using the state space technique.

UNIT I

Introduction

Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Different examples of control systems- Classification of control systems, Effects of feedback. Concept of Transfer function- impulse response. Mathematical models – Differential equations, Finding Transfer function for mechanical systems (Translational and Rotational), electrical systems and electrical analogous of mechanical systems. Transfer Function of DC Servo motor - AC Servo motor, Synchro transmitter and Receiver.

UNIT II

Transfer Function Representation

Block diagram algebra-Reduction techniques – 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 static error constants

UNIT III

Stability Analysis in S-Domain

Stability of linear systems- BIBO stability- Concept of absolute stability, Relative stability- Stability analysis using Routh- Hurwitz Criterion.

Root Locus Technique:

The root locus concept - construction of root loci

UNIT IV

Frequency Domain Analysis of Control Systems and Stability

Introduction, Frequency domain specifications- Polar Plots- stability analysis of Nyquist Plots- Bode plots Magnitude vs phase plot – Phase margin and Gain margin

Design of Compensators:
Compensation techniques – Lag, Lead, and Lead-Lag Controllers design in frequency Domain, PID Controllers.

UNIT V
State Space Analysis of Continuous Systems
Concepts of state, state variables and state model, derivation of state models from block diagrams, Conversion of state variable model to transfer function model and vice-versa - 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" by 'B. C. Kuo', John Wiley and Sons-8th edition, 2003.
2. "Control Systems Engineering" by 'I. J. Nagrath and M. Gopal', New Age International Pvt.Ltd. Publishers-5th edition, 2009.
3. "Modern Control Engineering" by 'Katsuhiko Ogata', Prentice Hall of India Pvt. Ltd.-3rd edition, 1998.

Reference Books:
1. "Control Systems Engineering" by 'Norman S.Nise', John Wiley 6th Edition 2011.
2. "Modern Control Engineering" by 'K P Mohandas Sanguine', Pearson Revised Edition, 2010.
3. "Modern Control Systems Richard" by 'C. Dorf and Robert H. Bishop Addison' – Wesley, 1999.
4. "Linear Control System Analysis and Design" by 'John J.DAzzo & Constantine H.Houpis', Tata Mc Graw-Hill, Inc., 1995.