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III Year B.Tech, EEE, I-Semester

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CONTROL SYSTEMS

Prerequisite: Circuits theory

OBJECTIVES:

- To understand the different ways of system representations such as Transfer function representation and state space representations and to assess the system dynamic response.
- To assess the system performance using time domain analysis and methods for improving it.
- To assess the system performance using frequency domain analysis and techniques for improving the performance.
- To understand the different types compensators performance.

UNIT – I (~9 Lecture Hours)

INTRODUCTION: 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, Impulse Response and transfer functions - Translational and Rotational mechanical systems.

UNIT – II (~9 Lecture Hours)

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.

UNIT – III (~10 Lecture Hours)

TIME RESPONSE ANALYSIS & STABILITY 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 – Effects of proportional derivative, proportional integral systems.

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 (~9 Lecture Hours)

FREQUENCY RESPONSE & STABILITY 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. Polar Plots, Nyquist Plots- Stability Analysis.

Compensation Techniques – Lag, Lead, Lead-Lag Controllers design in frequency Domain, PID Controllers.

UNIT – V (~9 Lecture Hours)

STATE SPACE ANALYSIS OF CONTINUOUS TIME 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.

TEXT BOOKS:

1. B. C. Kuo, "Automatic Control Systems", 8th edition, John Wiley & Son's, 2003.
2. I. J. Nagrath, M. Gopal, "Control Systems Engineering", 2nd edition, New Age International (P) Ltd.

REFERENCE BOOKS:

1. NagoorKani, "Control Systems", RBA Publishers.
2. Katsuhiko Ogata, "Modern Control Engineering", 3rd edition, Prentice Hall of India Pvt. Ltd., 1998.
3. NISE, "Control Systems Engg.", 3rd Edition, John wiley
4. Narciso F. Macia, George J. Thaler, "Modelling & Control Of Dynamic Systems", Thomson Publishers.

COURSE OUTCOMES:

After completion of this course the student is able to

1. Obtain the mathematical modal of Translational and rotational mechanical systems
2. Obtain the mathematical modals of DC Servo motor - AC Servo motor- Synchro transmitter and Receiver
3. Improve the system performance by selecting a suitable controller and/or compensator for a specific application.
4. Apply various time domain and frequency domain techniques to assess the system performance.
5. Able to design Lag ,Lead and Lag- Lead compensators.
6. Test system Controllability and Observability using state space representation.