

CONTROL SYSTEMS

Code: EC 513

Credits: 4

1] Introduction to Control Systems

Introduction to automatic control, open loop and closed loop control system, mathematical modeling of a system with typical examples. Block diagram representation.

2] Transfer Function Representation

Transfer function for single input single output system, characteristic equation, poles and zeroes, effect of parameter variations, effect of feedback on sensitivity gain and stability. Laplace transform effect of steps, ramp and impulse response on first order, second order and higher order systems in terms of steady state error and time constant, signal flow graph from transfer function and differential equations, block diagram from signal flow graph Mason's gain formula.

3] State Space Analysis

Advantages of state space techniques, state space representation for electrical network, with order differential equation, transfer function solution of time-invariant state equation, Laplace transform method, properties of state transition matrices, solution of non-homogeneous state equations, transfer matrix Eigen values and vectors, multiple input multiple of system, controllability and observability, Kalman's test, state space representation in canonical form – controllable, observable and diagonal commercial form, decomposition transfer function – direct, cascade and parallel decomposition, effect of pole-zero cancellation.

4] Stability Analysis

Concept of stability effect of location of poles on stability, conditions of stability, Routh Hurwitz criteria, Relative stability analysis, Root locus, rules for construction of root locus mapping of closed contour and principle of agreement, Nyquist contour, Nyquist plot, polar plot, Lyapunov's stability analysis.

5] Frequency domain Analysis

Bode plot, Minimum and non-minimum phase systems, phase margin and gain margin, Relative and absolute stability, constant magnitude and phase circles (M & N circles) gain adjustment by M circles.

6] Compensation Techniques

Types of compensation, design of compensation using Bode's plot – phase lead and lag network, analysis using root locus.

7] Non-linear system analysis

Common types of non-linearities – saturation, dead zone, friction, relays backlash, function description of the non-linear systems, stability analysis, phase-plane technique-phase trajectory of a second order system using method of isoclines, asymptotic stability [4L]

8] Controllers

Response of first order and second order systems with proportional control, derivative control, integral control, P&D control, P&I control, PID control, practical method. Introduction to Digital Control system .PLC & Application Case Studies: Speed control of DC Motors, Temp control Introduction to Fuzzy logic applications in control engineering.