EC- 502 Control Systems

Unit-I

Control system

Terminology and classification of control system, examples of control system, mathematical modeling of mechanical and electrical systems, differential equations, block diagram representation and reduction, signal flow graph techniques.

Feedback characteristics of control systems

Feedback and non-feedback systems, reduction of parameter variations by use of feedback, control over system dynamics and effects of disturbances by the use of feedback, linearization effect of feedback, regenerative feedback.

Unit-II

Time response analysis

Standard test signals, time response of 1st order system, time response of 2nd order system, steady-state errors and error constants, effects of additions of poles and zeros to open loop and closed loop system.

Time domain stability analysis

Concept of stability of linear systems, effects of location of poles on stability, necessary conditions for stability, Routh-Hurwitz stability criteria, relative stability analysis, Root Locus concept, guidelines for sketching Root-Locus.

Unit-III

Frequency response analysis

Correlation between time and frequency response, Polar plots, Bode Plots, all-pass and minimum-phase systems, log-magnitude versus Phase-Plots..

Frequency domain stability analysis

Nyquist stability criterion, assessment of relative stability using Nyquist Criterion (phase margin, gain margin and stability), closed-loop frequency response.

Unit-IV

Approaches to system design

Design problem, types of compensation, design of phase-lag, phase lead and phase lead-lag compensators in time and frequency domain, proportional, derivative, integral and PID compensation.

Digital control systems

System with digital controller, difference equations, the z-transform, pulse transfer function, inverse z- transform, the s and z domain relationship.

Unit-V

Concept of state, state variables and state model,

State space representation of systems, block diagram for state equation, transfer function decomposition, solution of state equation, transfer matrix, relationship between state equation and transfer function, controllability and observability.

References:

1. Nagrath and Gopal: Control System Engineering, New Age International Publishers.
2. Kuo: Automatic Control Systems, PHI Learning.
3. Varmah: Control Systems, TMH.
4. Distefano (Schaum series): Control Systems, TMH
5. Manke: Linear Control System, Khanna Publishers.
6. Stefani, Shahian: Design of feedback control systems, Oxford University Press.
7. Ogata: Modern Control Engineering, PHI Learning.