7th Semester

PET7J005 ADVANCED CONTROL SYSTEMS

MODULE-I (15 Hours)

Discrete - Time Control Systems:

Introduction: Discrete Time Control Systems and Continuous Time Control Systems, Sampling Process.

Digital Control Systems: Sample and Hold, Analog to digital conversion, Digital to analog conversion.

The Z-transform: Discrete-Time Signals, The Z-transform, Z-transform of Elementary functions, Important properties and Theorems of the Z-transform. The inverse Z-transform, Z Transform method for solving Difference Equations.

Z-Plane Analysis of Discrete Time Control Systems:

Impulse sampling & Data Hold, Reconstruction of Original signals from sampled signals: Sampling theorem, folding, aliasing.

Pulse Transfer function: Starred Laplace Transform of the signal involving Both ordinary and starred Laplace Transforms; General procedures for obtaining pulse Transfer functions, Pulse Transfer function of open loop and closed loop systems.

Mapping between the s-plane and the z-plane, Stability analysis of closed loop systems in the z-plane: Stability analysis by use of the Bilinear Transformation and Routh stability critgion, Jury stability Test.

MODULE-II (15 Hours)

State Variable Analysis & Design:

Introduction: Concepts of State, State Variables and State Model (of continuous time systems): State Model of Linear Systems, State Model for Single-Input-Single-Output Linear Systems, Linearization of the State Equation.

State Models for Linear Continuous – Time Systems: State-Space Representation Using Physical Variables, State – space Representation Using Phase Variables, Phase variable formulations for transfer function with poles and zeros, State – space Representation using Canonical Variables, Derivation of Transfer Function for State Model.

Diagonalization: Eigen values and Eigen vectors, Generalized Eigen vectors.

7th Semester

MODULE -III (12 Hours)

Solution of State Equations: Properties of the State Transition Matrix, Computation of State Transition Matrix, Computation by Techniques Based on the Cayley-Hamilton Theorem, Sylvester's Expansion theorem.

Concepts of Controllability and Observability: Controllability, Observability, Effect of Pole-zero Cancellation in Transfer Function.

Pole Placement by State Feedback, **Observer Systems**. **State Variables and Linear Discrete – Time Systems:** State Models from Linear Difference Equations/z-transfer Functions, Solution of State Equations (Discrete Case), An Efficient Method of Discretization and Solution, Linear Transformation of State Vector (Discrete-Time Case), Derivation of z-Transfer Function from Discrete-Time State Model.

MODULE-IV

Nonlinear Systems:

Introduction: Behaviour of Non linear Systems, Investigation of nonlinear systems.

Common Physical Non Linearities: Saturation, Friction, Backlash, Relay, Multivariable Nonlinearity.

The Phase Plane Method:

Basic Concepts, Singular Points: Nodal Point, Saddle Point, Focus Point, Centre or Vortex Point

Stability of Non Linear Systems: Limit Cycles,

Construction of Phase Trajectories: Construction by Analytical Method, Construction by Graphical Methods.

The Describing Function Method:

Basic Concepts: Derivation of Describing Functions: Dead-zone and Saturation, Relay with Dead-zone and Hysteresis, Backlash.

Stability Analysis by Describing Function Method: Relay with Dead Zone, Relay with Hysteresis, Stability Analysis by Gain-phase Plots.

ADDITIONAL MODULE (Terminal Examination-Internal)

Jump Resonance. Liapunov's Stability Analysis:

Introduction, Liapunov's Stability Criterion: Basic Stability Theorem, Liapunov Functions, Instability.

Direct Method of Liapunov& the Linear System: Methods of constructing Liapunov functions for Non linear Systems.

Text Books

1. Discrete-Time Control System, K.Ogata, PHI ,2nd Edition, 2009.
2. Control Systems Engineering, I.J. Nagrath and M.Gopal, New Age International (P) Ltd. Publishers, 5th Edition, 2007/ 2009.

Reference books

1) Design of Feedback Control Systems, Stefani,
2) , Oxford University Press, Fourth Edition,2009.
3) Modern Control Systems, K.Ogata, PHI, 5th Edition,2010.
4) Modern Control Systems Richard C. Dorf. And Robert, H.Bishop, Pearson Education Inc. Publication, 11th Edition,2008.
5) Control Systems (Principles & Design), M.Gopal, Tata Mc. Graw Hill Publishing Company Ltd, 3rd Edition,2008.
6) Control Systems Engineering, Norman S.Nise, Wiley India (P) Ltd, 4th Edition,2008.