DIGITAL CONTROL SYSTEMS
(Elective-IV)

Course Code: 13EE1136

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Pre requisites:

Mathematics, Networks and control systems.

Course Educational Objectives:

- To equip the students with the basic knowledge of A/D and D/A conversion
- To understand the basics of Z- Transform
- To study the stability analysis of digital control system
- To equip the basic Knowledge about the design of digital control systems for different engineering model
- Analyze digital control systems using state-space methods.
- Analyze digital control systems using transform techniques (frequency response) and state-space methods (pole-assignment).

Course Outcomes:

- This course provides a foundation in discrete-time linear control system theory.
- Analyze digital control systems using transform techniques (frequency response) and state-space methods (pole-placement).
- Analyzing and understanding the challenges to interface digital computing devices with the Analog dynamics of most real-world systems.
- Evaluating and setting the necessary specifications for analog systems that are to be controlled by digital computing devices.

- Designing digital devices to satisfy given specifications and to achieve desired system-behavior

UNIT-I (12 Lectures)

SAMPLING AND Z-PLANE ANALYSIS:

Introduction, sample and hold operations, Sampling theorem, Reconstruction of original sampled signal to continuous-time signal.

REVIEW OF Z-TRANSFORMS:

Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane: Primary strips and Complementary Strips.

UNIT-II (12 Lectures)

STATE SPACE ANALYSIS:

State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and it's Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations. Concepts of Controllability and Observability, Tests for controllability and Observability. Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function.

UNIT-III (12 Lectures)

STABILITY ANALYSIS:

Stability Analysis of closed loop systems in the Z-Plane. Jury stability test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion. Stability analysis using Liapunov theorems.

UNIT-IV (12 Lectures)

DESIGN OF DISCRETE TIME CONTROL SYSTEM BY CONVENTIONAL METHODS:

Design of digital control based on the frequency response method – Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers.

UNIT-V (12 Lectures)

STATE FEEDBACK CONTROLLERS AND OBSERVERS:

Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula.

TEXT BOOKS:

1. B.C.Kuo, *"Digital Control Systems"*, 2nd Edition, Oxford University Press, 2003.
2. K. Ogata, *"Discrete-Time Control systems"*, 2nd Edition. PHI, 2002.

REFERENCES:

1. M. Gopal, "*Modern Control Systems Theory*", Wiley Eastern, 1984
2. M. Gopal, *"Digital control engineering"*, New Age International Publications,2003
3. M.Gopal, *"Digital Control and State Variable Methods"*, 3rd Edition, TMH, Sep-2008.