ADVANCED DIGITAL CONTROL SYSTEMS
(ELECTIVE-I)

Course Code: 13EE2107 **L P C**
4 0 3

Pre requisites: Mathematics, Networks, Control Systems.

Course Educational Objectives:

1. To study the State Space and stability analysis of digital control system.
2. To equip the basic knowledge about the design of digital control systems for different
   Engineering models using Conventional Techniques.
3. To equip the students with the basic knowledge about Pole placement techniques.
4. To equip the students with the basic knowledge about state observers.
5. To equip the students with the basic knowledge about Linear Quadratic Regulators –Riccati Equation.
6. To equip the students with the basic knowledge of State Estimation Using Kalman Filter.
7. To equip the students with the basic knowledge about adaptive control.
8. To equip the students with the basic knowledge of digital simulation and DSP Processors.

Course Outcomes:

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

5. Designing digital devices to satisfy given specifications and to achieve desired system-behavior.
6. Understanding the Basic Concepts of Microprocessor control of control systems and custom designed chips like Galil DMC-105

UNIT-I

STATE SPACE ANALYSIS

State space representation of discrete time systems, pulse transfer function matrix, solving discrete time state space equations, state transition matrix and its properties methods for computation of state transition matrix, discretization of continuous time state-space equations

STABILITY ANALYSIS

Stability analysis of closed loop systems in the Z-plane, Jury stability criterion test-Stability analysis by use of the bilinear transformation and routh stability criterion. Stability analysis using liapunov theorems

UNIT-II

DESIGN OF DISCRETE TIME CONTROL SYSTEM BY CONVENTIONAL METHODS

Design of digital control systems based on Root locus techniques-Design of digital control based on the frequency response methods-Bilinear transformation and design procedure in the w-plane, lead, lag and Lead-lag compensators and digital PID controllers. Design digital control through dead beat response methods.

UNIT-III

STATE FEEDBACK CONTROLLERS AND OBSERVERS

Concept of controllability and observability-Design of state feedback controller through pole placement-Necessary and sufficient conditions, Ackerman’s formula, State observers-Full order and Reduced Order observer

UNIT-IV

LINEAR QUADRATIC REGULATORS

Min/Max principle, Linear Quadratic Regulators, Kalman Filters, State Estimation through kalman Filters, Introduction to adaptive controls

UNIT-V

DIGITAL SIMULATION

Introduction, Digital Simulation- Digital Modeling with Sample and Hold Devices, State Variable Formulation, Numerical Integration, Rectangular Integration, Frequency Domain Characteristics- Frequency Warping, Frequency Prewarping.

MICROPROCESSOR AND DSP CONTROL

Introduction, Microprocessor Control of Control Systems, Single- Board Controllers with Custom-Designed Chips, The Galil DMC-105 Board, Digital Signal Processors- The Texas Instruments TMS320 DSP's, Development Systems and Support Tools.

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