4/4 B.Tech. EIGTH SEMESTER

EE8T3A DIGITAL CONTROL SYSTEMS Credits: 3
Lecture: 3 periods/week Internal assessment: 30 marks
Tutorial: 1 period /week Semester end examination: 70 marks

Course Objective:

This course covers the basic difference between continuous and discrete time signals and provides an introduction to analysis and design of computer-controlled systems. This course not only focuses on mathematical concepts in digital control, including Z-transform, pulse transfer functions, state space models and digital controllers design by conventional methods, state feedback controllers and observers.

Course Outcomes:

At the end of the course the student will be able to

1. Understand the basic knowledge of A/D and D/A conversion, issues faced in sampling digital data and discrete time systems.
2. Understand the basics of Z- Transforms and mathematical models of linear discrete-time control systems using pulse transfer functions, state-space models and tests for controllability and Observability.
3. Determine the stability analysis of digital control systems
4. Analyze control system design techniques, their limitations and benefits.
5. Analyze the performance of digital control systems and design feedback controllers to meet the required performance system specifications.

UNIT I

Sampling and reconstruction

Introduction to continuous and discrete time signal and its properties. Examples of data control systems – digital to analog conversion and analog to digital conversion, block diagram representation of S/H Device, mathematical modeling of the sampling process, sampling theorem, sample and hold operations.

UNIT II

Z-Transform and Pulse Transfer Functions

Z- Transform – theorems and properties, inverse Z-transforms, solving difference equations, pulse transfer function, block diagram analysis of sampled data systems, mapping between S-plane and Z-plane.

UNIT III

Stability analysis

Mapping between the S- Plane and the Z-Plane, primary strips and complementary strips, constant frequency loci, constant damping ratio loci, stability analysis of closed loop systems in the Z-plane. Jury stability test – stability analysis using bilinear transformation and Routh criterion.

UNIT IV

State space analysis

State space representation of discrete time systems, pulse transfer function matrix, solving discrete time state equations, solution of LTI discrete time state equations, state transition matrix and its properties, methods for computation of State transition matrix, Discretization of continuous time state space equations.

UNIT V

Controllability and Observability

Concepts of controllability and observability, tests for controllability and observability. Duality between controllability and observability, conditions for Pulse Transfer Function.

State feedback controllers and observers

Design of state feedback controller through pole placement – necessary and sufficient conditions, Ackerman‘s formula

Learning resources

Text Books:

1. “Digital control systems” by ‘B.C. KUO’, Saunders college publication-second edition, 1992.
2. “Discrete-Time Control systems” by ‘K. Ogata’, Pearson Education/PHI-2nd Edition.

Reference Book:

“Digital Control and State Variable Methods” by ‘M. Gopal’ ,Tata McGraw – Hill Companies,1997.