M.TECH SECOND SEMESTER
DIGITAL CONTROL SYSTEMS

17EEPC2T5B **Credits: 4**
Lecture: 4 periods/week **Internal Assessment: 40 marks**
End Semester Assessment: 60 marks

Course Objective:
This subject is to introduce the students to the fundamentals of control theory as applied to digital controllers or sampled data control systems in general. The objective is to give knowledge about the state space and stability analysis of digital systems and also to familiarize the microprocessor and DSP control of digital control system.

Course Learning Outcomes: At the end of the course the student will be able to

1. Understand the concept of sampling theorem and the z-transform analysis of digital control systems.
2. Analyze the state space representation of digital systems with discretization principles.
3. Realize the design concepts using pole placement and state observation methods.
4. Understand the importance of microprocessor and DSP based control of systems.

UNIT-I:

Digital Control Systems – basic elements, advantages and disadvantages, examples - Impulse sampling and data hold – transfer functions of Zero order hold and First order hold. Reconstructing original signals from sampled signals – sampling theorem, ideal low pass filter, frequency response characteristics of the Zero order hold.

The Z-transform- Z transforms of some elementary functions, Important properties and theorems of the Z-transform, The inverse Z-transform, S-transform method for solving difference equations, the pulse transfer function, realization of digital controllers.

Unit-II:

Concept of the state space method, State space representations of discrete time systems, solving discrete time state space equations. Discretization of continuous time state space equations. Controllability, Observability, Principle of Duality. Mapping between the s-plane and the z-plane, the Jury stability test, stability analysis by use of the bilinear transformation and Routh stability criterion. Liapunov stability analysis of discrete time systems.

Unit-III:

Transient response specifications, steady state error analysis. Design based on frequency response method, Analytical design method. Design via pole placement necessary and sufficient condition. Ackerman's formula, Dead Beat response. State observers – necessary and sufficient condition for state observation, full order state observer, minimum order state observer.

Unit-IV:

Microprocessor and DSP control: Microprocessor control of control systems, single-board controllers with custom-designed chips, DMC – 105 board, digital signal processors – TMS 320 DSPs, development system and support tools. Effects of finite word length and quantization on controllability and closed loop pole placement. Effect of quantization – least upper bound on quantization error.

TEXT BOOKS:

1. Discrete-time Control Systems, 2nd edition K.OGATA, Pearson Education Asia.
2. Digital Control Systems, 2nd edition, B.C.KUO, Oxford University Press.

REFERENCE BOOKS:

1. Digital Control Engineering, 2nd edition, M.Gopal, New Age International.
2. Digital Control and State Variable Methods, 2nd Edition, M.Gopal, Tata McGraw Hill.
3. Digital Signal Processing, 2nd Edition, A.Nagoor Kani, Tata McGraw Hill.