II B.Tech – II Semester
(20EE4635) DIGITAL CONTROL SYSTEM DESIGN

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	4	-	-	4

Pre-Requisites: Control Systems

Course Objectives: At the end of the course, the students are supposed to

- Represent discrete time systems under the form of z-domain transfer functions and state-space models.
- Analyse stability, transient response and steady state behaviour of linear discrete-time systems,
- Describe and test controllability and observability of linear systems.
- Design of digital control systems using transform techniques in frequency-domain and the state vector feedback approach.

UNIT-I: Introduction to Digital Control Systems

Block Diagram of typical control system- advantages of sampling in control systems – examples of discrete data and digital systems – data conversion and quantization – sample and hold devices – D/A and A/D conversion – sampling theorem – reconstruction of sampled signals –ZOH. Z-transform: Definition and evaluation of Z-transforms – mapping between s-plane and z-plane – inverse z-plane transform – theorems of the Z-transforms –limitations of z-transforms –pulse transfer function –pulse transfer function of ZOH – relation between G(s) and G(z)

UNIT-II: State Space Analysis:

State space modeling of digital systems with sample and hold – state transition equation of digital time in variant systems – solution of time in variant discrete state equations by the Z-Transformation – transfer function from the state model – Eigen values – Eigen vector and diagonalisation of the A-matrix – Jordan canonical form. Computation of state transition matrix-Transformation to phase to variable canonical form-The state diagram – decomposition of digital system – Response of sample data system between sampling instants using state approach.

UNIT-III: Stability Analysis and Concepts of Controllability & Observability

Stability analysis Mapping between the S–Plane and the Z–Plane – Primary strips and Complementary Strips – Stability: Definition of stability –Modified routh's stability criterion and jury's stability test- The second method of Liapunov.– Concepts of controllability and observability – Tests

UNIT-IV: Design of Discrete–Time Control Systems using Conventional Approaches

Transient and steady state specifications – Design using frequency response in the w–plane for lag and led compensators – Root locus technique in the z– plane- Digital PID controller-Design with deadbeat response

UNIT-V: State Feedback Compensator Design

Pole placement through state feedback-Design of full order state observer-Discrete Euler Lagrange Equation – Discrete maximum principle.

Course Outcomes:

After successful completion of the course, the students will be able to:

S.No	Course Outcome	BTL
1.	Inspect the signal conversion, effect of sampling and modelling of discrete-time systems in the z-domain transfer function and the state-space representation.	L2
2.	Transform the appropriate state-space model to the required canonical form.	L4
3.	Test the stability, controllability and observability of a given discrete state-space dynamical model.	L6
4.	design a compensator in frequency and time-domain approaches to meet the desired specifications of a discrete- dynamic system	L6

Correlation of COs with POs& PSOs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2					1						2	1
CO2	3	2					1						2	1
CO3	3	2					1						2	1
CO4		3	2	1								1	2	2

Text Books:

1. Discrete-Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition.
2. Digital Control and State Variable Methods by M. Gopal, TMH.

Reference Books:

1. B. C.Kuo, Digital Control Systems, Oxford University Press, 2/e, Indian Edition, 2007.
2. G. F. Franklin, J. D.Powell and M. L. Workman, Digital Control of Dynamic Systems,