

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL ENGINEERING (07)

DIGITAL CONTROL SYSTEM

SUBJECT CODE: 2720704

SEMESTER: II

Type of course: Engineering Science

Prerequisite: Fundamentals of Modern Control System

Rationale: The course provides systematic approach for the Digital Control to the students of various branches of engineering.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
	Module I	5	10
1	Introduction - Advantages of Digital control systems - Practical aspects of the choice of sampling rate and multirate sampling - Basic discrete time signals - Quantization – Sampling theorem – Data conversion and Quantization - Sampling process - Mathematical modeling - Data reconstruction and filtering of sampled signals – zero - order hold.	5	10
	Module II	15	30
2	z - transform and inverse z - transform, Relationship between s - plane and z - plane – Difference equation - Solution by recursion and z - transform - pulse transfer functions of the zero - order Hold and relationship between G(s) and G(z)– Bilinear transformation .	7	15
3	Digital control systems - Pulse transfer function - z transform analysis of open loop, closed loop systems - Modified z Transform - transfer function - Stability of linear digital control systems -Stability tests.	8	15
	Module III	15	30
4	Root loci - Frequency domain analysis - Bode plots - Gain margin and phase margin - Design of Digital Control Systems based on Root Locus Technique.	7	15
5	Cascade and feedback compensation by continuous data controllers - Digital controllers - Design using bilinear transformation - Realization of Digital PID controllers.	8	15
	Module IV	15	30
6	State equations of discrete data systems, solution of discrete state equations, State transition Matrix: z -transform method. Relation between state equations and transfer functions.	5	10
7	Concepts on Controllability and Observability - Digital state observer:	5	10

	Design of the full order and reduced order state observer - Pole placement design by state feed back.		
8	Design of Dead beat Controller - some case studies - Stability analysis of discrete time systems based on Lyapunov approach.	5	10

Reference Books:

1. K. Ogata, Discrete Time Control Systems, PHI/Addison - Wesley Longman Pte. Ltd., India, Delhi, 1995.
2. B.C Kuo, Digital Control Systems, 2nd Edition, Oxford Univ Press, Inc., 1992.
3. F. Franklin, J.D. Powell, and M.L. Workman, Digital control of Dynamic Systems, Addison - Wesley Longman, Inc., Menlo Park, CA , 1998.
4. Gopal, Digital Control and State Variable Methods, Tata McGraw Hill, India, 1997.
5. C. H. Houpis and G.B. Lamont, Digital Control Systems, McGraw Hill, 1985.
6. John S. Baey, Fundamentals of Linear State Space Systems, Mc. Graw – Hill, 1st edition.
7. Bernard Fried Land, Control System Design, Mc. Graw – Hill, 1st edition
8. Dorsay, Continuous and Discrete Control Systems, McGraw - Hill.

Course Outcome:

After learning the course the students should be able to:

- Do the z-transform analysis for open and closed loop systems.
- Design digital control system
- Do stability analysis of discrete time system

List of Experiments:

The simulation exercise as per the content in the syllabus should be given as lab exercise/ assignments.

Design based Problems (DP)/Open Ended Problem:

Course coordinator can assign the design based problem/open ended problem.

Major Equipment:

Simulation tools like MATLAB or any other software as deemed suitable by the course instructor can be used.

List of Open Source Software/learning website:

1. MIT OPEN COURSEWARE by Massachusetts Institute of Technology
- website: ocw.mit.edu
2. Courses available through NPTEL.
- website : nptel.ac.in

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry

portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.