GUJARAT TECHNOLOGICAL UNIVERSITY

POWER ELECTRONICS (29)

ADVANCE CONTROL SYSTEM

SUBJECT CODE: 2732905

ME SEMESTER: III

Type of course: Major Elective-IV

Prerequisite: Higher Engineering Mathematics, Fundamental knowledge of signals and systems along with types, Transfer Function of System, Mathematical representation of signals and system modeling in time. Transforms especially like Laplace and Z

Rationale: The course intends to provide foundations related to control engineering to graduate students. The course should enhance their ability to analyze and control multiple domain systems using techniques and tools related to control systems

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	30	00	20	00	150

Content:

Sr. No.	Topics	Teaching Hrs.	% Weightage
1	**Solving of State-Equation for linear systems:** Solution of the Linear Time Invariant State Equations, Understanding the Stability Criteria through the State-Transition Matrix, Numerical Solution of Linear Time-Invariant State-Equations, Numerical Solution of Linear Time-Varying State-Equation, Numerical Solution of Nonlinear State-Equation.	**8**	**22**
2	**Design of Control System in State Space** Classical Design vs. Modern Design, Controllability Pole-Placement Design Using Full-State Feedback, Pole-placement regulator design for single-input plants, Pole-placement regulator design for plants with noise , observers, Observability, and Compensators, Pole-placement design of full-order observers and compensators, Pole-placement design of reduced-order observers and compensators.	**10**	**22**
3	**Controllability and Observability:** Concept of Controllability and Observability; Kalman's Theorems on Controllability and Observability, Alternative Tests (Gilbert's Method) of Controllability and Observability, Principle of Duality, Relationship among Controllability, Observability and Transfer Function.	**8**	**18**
4	**Phase Plane Method:** Phase Plane Analysis, Phase plane method - basic concept, trajectories, phase portrait, singular points and their classification, and limit cycle and behavior of limit cycle, Phase plane analysis of nonlinear systems, Construction of phase trajectories using delta method.	**7**	**12**

5	**Digital Control Systems** Digital Systems, A/D Conversion and the *z*-Transform, Pulse Transfer Functions of SISO Systems, Frequency Response of SISO Digital Systems, Stability of SISO Digital Systems, Performance of SISO Digital Systems, Closed-Loop Compensation Techniques for SISO Digital Systems.	**4**	**10**
6	**Modern Control System** H_2, H∞ Robust control, Structured Singular Value Synthesis for Robust Control, Time-Optimal Control with Pre-shaped Inputs, Output-Rate Weighted Linear Optimal Control, Nonlinear Optimal Control.	**4**	**10**
7	**Introduction to Adaptive Control System:** Definition of adaptive control system, functions of adaptive control, gain scheduling, model reference, series and parallel schemes and their industrial applications.	**3**	**6**

Reference Books:

1. Ashish Tiwari." Modern Control Design- with MATLAB and SIMULINK", John Wiley & Sons, Ltd., 2002
2. K. Ogata, "Modern Control Engineering", PHI, 2010.
3. B. C. Kuo, "Automatic Control System", Wiley, 2009.
4. L. J. Nagrath & M. Gopal , " Control Systems Engineering" , New Age International Publishers, 2009.

Course Outcome:

After learning the course the students should be able to:

1. Students will be able to develop mathematical models for controlling system behaviour.
2. Students will be able to control the systems with nonlinear behaviours.
3. Students will learn fundamentals and applications of control theory for multi-disciplinary engineering problems.
4. Students will learn fundamentals of intelligent/smart control systems used in automation

List of Experiments:

1. To study about Linear Time Invariant State Equations.
2. To study about Nonlinear Time Invariant State-Equation.
3. To study about Controllability and Observability.
4. To study about Digital Control Systems.
5. To study about Modern Control System
6. To study about Classical Design vs. Modern Design.
7. To Study about Pole placement design.
8. To Study about State Observers.

Open Ended Problems:

Students may carry out analysis of specific application based control system with its mathematical analysis and feedback control system. Control system analysis may be of a linear, nonlinear or discrete category and can be carried out using any simulation software**.**

Major Equipments:

1. All these experimental study with Software Tool: MATLAB.

List of Open Source Software/learning website:

Matlab.

Learning website:
www.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.