Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
(Autonomous Institute Affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
EL42	Principles of Control System	03	01	--	03	01	--	04
		Examination Scheme						
		ISE	MSE		ESE			
		10	30		100 (60% Weightage)			

Pre-requisite Course Codes		BS11 (Engineering Mathematics - I) BS21 (Engineering Mathematics - II) BS31 (Applied Mathematics - I) EL32 (Circuit Theory)
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Classify different types of Control systems and formulate mathematical modeling of the given system.
	CO2	Illustrate the Transient and steady state behavior of given system for standard test inputs..
	CO3	Analyze the stability of systems in time domain and frequency domain.
	CO4	Justify the concept of Controllability and observability using State variable model
	CO5	Apply the control theory to design the compensators to enhance stability of system
	CO6	Evaluate the system performance with the use of Compensators & Controllers

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to control system:** Definition of system, Notion of feedback, Open loop and closed loop systems; feedback and feedforward control structure; Examples of control systems.	1,2	10
	1.2	**Dynamic Response:** Standard test signals; Transient and steady state behavior of first and second order systems; Generalized error coefficients, steady state errors in feedback control systems and their types.	1,2	
	1.3	**Control System Modeling:** Types of models Impulse response model, State variable model, Transfer function model, Modeling of electrical systems, translational and rotational mechanical systems.	1,2	
2	2.1	**Representation of Control System: Block** diagram representation of systems, Block diagram reduction methods, Closed loop transfer function, signal flow graph. Mason's gain rule	1,2	10

	2.2	**State Space Analysis:** Concepts of state space, State equations, State transition matrix, properties of state transition matrix, Solution of homogeneous systems.	1,2	
	2.3	**Controllability and Observalibity:** Concept of controllability, Controllability analysis of LTI systems, Concept of observability, Observability analysis of LTI systems using Kalman approach, pole placement using state feedback PBH test	3,4	
3	**3.1**	**Time Domain System Stability Analysis :** Concepts of Stability Concept of absolute, relative and robust stability	1,2	08
	3.2	Routh-Hurwitz stability criteria	1,2	
	3.3	**Root Locus Analysis:** Root-locus concepts; General rules for constructing root-locus; Root-locus analysis of control systems.	1,2	
4	**4.1**	**Frequency Domain System Stability Analysis:** Relation between time and frequency response	1,2	08
	4.2	**Bode Plot:** Magnitude and phase plot, Method of plotting Bode plot; Stability analysis by using Gain and phase margins on the Bode plots	1,2	
	4.3	Polar plots, Nyquist stability criterions; Nyquist plot; Gain and phase margins.	1,2	
5	**5.1**	**Compensators & Controllers:** Types of compensators, Realization of basic compensators –cascade compensation in time domain and frequency domain, Design of lag, lead, lag-lead compensator using Bode plot and Root locus.	1,2	06
	5.2	**Controllers**: Concept of ON/OFF controllers; Concept of P, PI, PD and PID Controllers.	1,2	
	5.3	**Advanced Control Systems:** Introduction to Robust Control, Adaptive control and Model predictive control, Neuro- fuzzy controllers, Design of Real life applications of control system	3,4	
			Total	**42**

References:

[1] I. J. Nagrath, M. Gopal, "Control Systems Engineering", New Age International, Fifth Edition.

[2] M. Gopal, "Control Systems: Principle and design", Tata McGraw Hill, First Edition.

[3] Ogata.K, "Modern Control Engineering", Prentice Hall of India, Fifth edition.

[4] Richard C. Dorf and Robert H. Bishop, "Modern Control System", Pearson, Eleventh Edition.