GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering (Part Time)

Subject Code: 2941904

CONTROL ENGINEERING

4th Semester

Type of course: Open elective

Prerequisite: None

Rationale:

To develop comprehensive knowledge and understanding of classical and modern control theory, industrial automation, and systems analysis. Control engineering is a diverse and rapidly expanding discipline which has become increasingly important in a wide range of industries.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	0	4	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	**Basic concepts of control system:** Control System, Basic components of control system, classification of control system, Closed loop control versus open loop control, Servomechanism, Regulator and process control, Example of control system.	**3**
2	**Modelling of control systems:** Transfer function and impulse response function, Procedure for determining the transfer function of a control system, Block diagram of system, signal flow graph representation of physical systems along with rules, properties, Automatic control system, Lineatization of nonlinear mathematical model, mathematical modeling of Mechanical systems and Elactrical systems, Mathematuical modeling of pneumatic and hydraulic systems, Fluid systems and Thermal systems.	**12**
3	**Modelling in time domain and its response analysis:** Standard test signals along with examples of their usage, Applying state space representation, converting transfer function to state space, converting state space to transfer function, diagonalisation of state matrix, solution of state equation, concepts of controllability and observability, Poles, Zeros, and System response, First order systems, Second order systems, Higher order systems, Transient response analysis, Routh's stability criterion, Effects of Integral and Derivative control, steady state errors of feedback control systems, Root Locus plot, Lead Compensation, Lag compensation, Lag-Lead compensation, Parallel Compensation.	**11**
4	**Frequency response analysis:** Bode diagram, Polar plots, Log Magnitude versus Phase plot, Nyquist stability criterion, Stability analysis, Relative stability analysis, closed loop frequency response of unity	**10**

	feedback system, experimental determination of transfer function, control system design by frequency response approach, Lead Compensation, Lag compensation, Lag-Lead compensation	
5	**PID controllers** Tuning PID controllers, Design PID controllers, Modification of PID control, Two degree of freedom control	**5**
6	**Hydraulic control system:** Basic elements of hydraulic circuit, Principle used in hydraulic circuit, Sources of hydraulic power, Integral, Derivative, PD & PID controller with its transfer function, Comparison between hydraulic and electrical control system.	**5**
7	**Pneumatic control system:** Basic elements of pneumatic circuit, Difference between pneumatic and hydraulic control systems, Force balance and force distance type controllers, Nozzle-flapper amplifier, PD, PI and PID control system along with its transfer function.	**4**

Reference Books:

References:

1. Modern control theory, Katsuhiko Ogata, Pearson Education International, Fifth edition.
2. Control system engineering, Norman S Nise, John Wiley &Sons, Inc., Sixth edition
3. Control system engineering, S. K. Bhattacharya, Pearson India
4. Modern control systems, Richard C. Dorf, Robert H Bishop, Pearson Education International, Twelfth edition.
5. Automatic control systems, Farid Golnaraghi, Benjamin C Kuo, John Wiley & Sons, Inc., Nineth edition
6. Control System Engineering, J.Nagrath and M.Gopal New Age International Publishers, 5th Edition, 2007

Distribution of marks weightage for cognitive level

Bloom's Taxonomy for Cognitive Domain	Marks % weightage
Recall	10
Comprehension	10
Application	30
Analysis	40
Evaluate	05
Create	05

Course Outcome:

After learning the course the students will able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Summarized fundamentals of control systems and components of	15

	control systems.	
CO-2	Demonstrate the methodology for modelling mechanical, hydraulic and pneumatic systems for control.	30
CO-3	Develop the transfer functions, state space representation and block diagrams of physical systems for its control and stability.	20
CO-4	Analyze time domain and frequency domain responses of mechanical systems.	40
CO-5	Make use of PID controllers for control of physical systems.	15

Major Equipment:

1. Computational facility.

List of Open Source Software/learning website:

1. http://nptel.ac.in