GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160104
BASIC CONTROL THEORY
B.E. 6thSEMESTER

Type of course: Engineering Science

Prerequisite: Basics of Maths

Rationale: In aircraft it is necessary to control three different types of axis i.e. yaw, pitch and roll. So in order to control such axis it is necessary to understand the basic concepts of control and its detailed theory.

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)	
2	0	2	3	70	30	30	20	150

Contents:

Sr. No.	Contents	Total Hours	% Weightage
1	**Unit 1: Introduction** Concept, Types of control system, Natural & Man made control systems, Open Loop & Closed Loop systems, SISO,SIMO,MISO and MIMO system, Examples of control systems.	2	10
2	**Unit 2: Mathematical Models of Systems** Introduction to Mathematical Modeling, Modeling of mechanical systems, Modeling of electrical systems, Modeling of Electro-Mechanical Systems, Examples.	3	10
3	**Unit 3: Block Diagrams & Signal Flow** Properties of block diagrams, Block diagram reductions, Construction of SFG, Mason's Gain Formula, Examples.	3	10
4	**Unit 4: Time Domain Performance Analysis** Excitation functions, First Order, Second Order and Higher Order Systems, Types of the system, Transient response, Steady State Error, Error constants, s- plane root location and transient response, Time response of second order system, Examples.	5	20
5	**Unit 5: Stability Analysis of Control Systems** Introduction, Bode's Plot, Polar plots, Hurwits Criterion, Routh-Hurtwitz criterion, Nyquist Plot, Nyquist Stability Criterion, Stability analysis, Relative Stability, Closed Loop Frequency response of Unity feed Back System, Examples.	5	10
6	**Unit 6: Root Locus Method** Introduction, Root Locus plots, Rules for construction of root loci, Feedback systems, Stability Conditions.	3	10
7	**Unit 7: State Space Analysis** Introduction, Comparison between modern control theory and conventional control theory, concepts of State, State Variables and State models, State Space Equations, Linear time-Invariant systems, State model for single input single output linear system, State space representation, Examples.	5	10
8	**Unit 8: Composite Controllers** Introduction, Discontinuous Controller: ON-OFF Controller, ON-	4	20

	OFF controller with dead zone, Multi-Position Controller, Continuous Controller: Proportional control, Derivative control, Integral control, Proportional – Integral (PI) control, Proportional – Derivative (PD) control, Proportional – Integral – Derivative (PID) control, Special terminology, (proportional band, repeats per minute, rate gain, direct action, reverse, action), desired features of a feedback control algorithms, Proportional mode, integral mode, derivative mode.		

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
35%	25%	20%	15%	5%	0%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy).

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Control Systems By A. Anand Kumar.
2. Control Theory By U. A. Bakshi& V. U. Bakshi.
3. Control System Engineering with SCILAB Exercise.
4. Process Control: Principles and Applications by SurekhaBhanot, Pub: Oxford University Press.
5. Control Systems By Rao V Dukkipati.
6. Automatic Control Systems By Prof B. S. Manke.
7. Process Control: Designing Processes and Control for Dynamic Performance by Thomas E. Marlin; Pub: McGraw – Hill, International Edition.

Course Outcome:

After learning the course the students should be able to:
1. Understand the basic concepts of control systems.
2. Know the procedure about how to analyze the problem.
3. Design the mathematical model of the system.
4. Design the composite types of controllers for any closed loop system.

List of Experiments:

1. To study about MATLAB software and its application for Control System Analysis.
2. To study about various MATLAB commands for Control System.
3. To study about building and analyzing multi block models.
4. To study about system time response to Unit Step, Unit Impulse, Unit Ramp, Unit Parabolic input signal.
5. To study the steady state error of type-zero, type-one and type-two control systems on standard test input signals.
6. To study about Bode plot and Nyquist plot for stability analysis using MATLAB.
7. To study about root locus for stability analysis using MATLAB.
8. To study about Bode's Plot for Frequency Response Analysis.
9. To study Simulation and Design using MATLAB.
10. To prepare P, I, D algorithm on MATLAB Simulink and visualize their response to the Step Signal.
11. To prepare PI, PD and PiD algorithm on MATLAB Simulink and visualize their response to the Step Signal.

Major Equipment/Software: MATLAB software or SCILAB or any open source software.

List of Open Source Software: SCILAB.

Learning website:http://nptel.ac.in.