



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3171714

Semester – VII

Subject Name: ADVANCE CONTROL THEORY

Type of course: Professional Elective Course

Prerequisite: Knowledge of engineering mathematics, basics of control theory and process control, simulation on matlab/ scilab or other equivalent software

Rationale: To meet the requirement of control speed and complexity, the complex system demands for modern control theories. In this subject, as the name suggest, the advance theory of control engineering and their possible applications are to be explored so that the modern control theory can be applied to improve the performance of the systems. This subject may be useful for those who aspire for the post graduation.

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)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Discretization of continuous systems, sampling theorem, z transform, zero order hold, convert transfer function, continuous to discrete domain, mapping between s and z domain, stability criteria in z- domain. Effect of sample time on systems stability. Root locus for discrete time systems stability.	12
2	Converting of continuous time state space systems to discrete time state space, State space analysis and design of discrete time systems, stability in state space, design of state feedback controller, state observer design. Digital implementation of PID controller	06
3	Introduction to nonlinear systems. Types of common nonlinearities, Stability of nonlinear systems, describing functions analysis, limit cycles, phase plane analysis, phase trajectories.	12
4	Introduction to Multivariable Systems, interaction and decoupling, Relative Gain Array, stability of multivariable systems. Two degree of freedom controller design for SISO system in continuous and discrete domain	06



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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	14	14	21	21	-

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. Modern Control Engineering by K. Ogata, PHI.
2. Discrete Time Control Systems by K. Ogata, PHI.
3. Automatic Control Systems by B C Kuo, PHI.
4. Control Systems, Principles and Design by M. Gopal, MC Graw Hill, 2012.
5. Modern control systems / Richard C. **Dorf**, Robert H. **Bishop**, **Pearson**.

Course Outcome:

After learning the course the students should be able to:

After learning this course, the students should be able to:	
CO 1	Demonstrate an understanding of the fundamentals of advance control systems.
CO 2	Develop and use models (transfer function & state space in digital domain) of physical systems in forms suitable for use in the analysis and design of digital control systems.
CO 3	Apply relevant concepts to select and design advance control systems like multivariable control and discrete time state feedback control systems.
CO 4	Analyse nonlinear properties of systems and interpret the stability of nonlinear systems.
CO 5	Use and apply simulation tools for design & performance evaluation of advance control systems



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List of Experiments:

(Following practicals are recommended but they are not limited for modifications and or alterations by the faculty member/s teaching the particular subject. The use of MATLAB or SCILAB or equivalent software is suggested.)

1	Modeling of continuous and discrete time system using Matlab/Scilab.
2	Discretize the continuous system in to z transform using Matlab/Scilab.
3	Analysis of effect of sampling time in z transform using Matlab/Scilab/simulink.
4	Root locus analysis of control system model in z-domain using Matlab/Scilab.
5	Time Response analysis of control system in continuous and discrete domain using Matlab/Scilab.
6	State space representation of continuous system in to discrete time using Matlab/Scilab.
7	Analyze the effect of sampling on discrete time state space using Matlab/Scilab.
8	Find stability of discrete time state space model using Eigen value analysis and plot its state response using Matlab/Scilab/simulink.
9	Design state feedback controller for the discrete time state space model using Matlab/Scilab.
10	Design state observer for the discrete time state space model using Matlab/Scilab.
11	Implement discrete PID controller for the discrete time state space model using Matlab/Scilab/simulink.
12	Analyze the effect of nonlinear element on sinusoidal input using Matlab/Scilab/simulink.
13	Obtain Relative Gain Array of multivariable system using Matlab/Scilab/simulink.
14	Analyze the effect of interacting and non-interacting multivariable systems using Matlab/Scilab/simulink.

All practical can be designed in MATLAB or SCILAB ./Proteus /Keil.

Design based Problems (DP)/Open Ended Problem:

Design 2 DOF controllers for the continuous and discrete system using Matlab/Scilab/simulink.

Major Equipment:

Educational prototype models, Computers, simulation software, microcontrollers etc.

List of Open Source Software/learning website:



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<http://nptel.ac.in/video.php>

<https://nptel.ac.in/courses/101/108/101108047/>

<https://nptel.ac.in/courses/108/103/108103007/>