Devi Ahilya University, Indore, India Institute of Engineering & Technology				**IV Year BE (Mechanical Engg.) (Full Time)**			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
6MERE5:	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
Control Systems for Mechanical Engineers	**3**	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

Course Objective:
The course is designed

1. To provide the fundamental knowledge of control system engineering and the concept of mathematical modeling of the physical system.
2. The subject gives various classical analysis tools for design and stability of system in time and frequency domain.

Prerequisites: Applied Mathematics I/II/III, Engineering Thermodynamics, Fluid Mechanics, Thermal Engineering, Basic Electronics Electrical Engineering,

COURSE CONTENTS

UNIT -1

Review: Elementary review of dynamic systems. Equations of motion. Numerical solution of ODEs. Linearization. Stability, Laplace transforms and inverse Laplace transforms

UNIT -II

Representations: Block diagrams. Transfer functions. Feedback loops. Poles and zeros. Transient responses. The Routh-Hurwitz criterion. Non-minimum phase systems and their transient responses. Steady state responses

UNIT-III

System Components Compensators. Lead and lag compensators. PID controllers. Tuning rules. Stabilization using a stable controller: motivation and sample problems. Discrete time systems. Stability.

UNIT -IV

State space fundamentals: State space. Standard form for an LTI system. General solution. Controllability and observability. Pole placement. Connections with classical control.

UNIT -V:

Simulations of controls: Introduction to optimal control. The linear quadratic regulator, Introduction to time-delayed control. Simulations of nonlinear systems with linearization based controllers.

Course Outcome:
Students earned credits will develop ability to
CO1. Present the structure of feedback control theory
CO2. Discover feedback control
CO3. physical system modeling and practical control system designs with realistic system specifications
CO4. Design and Analyse Control systems in Mechanical Applications

BOOKS RECOMMENDED

[1] K. Ogata. Modern Control Engineering (current edition). Prentice-Hall India.
[2].G. F. Franklin, J. D. Powell, and A. Emami-Naeini. Feedback Control of Dynamic Systems (current edition). Pearson Education.
[3]. F. Golnaraghi and B. C. Kuo. Automatic Control Systems. Wiley
[4] Richard C. Dorf and Robert H. Bishop, Modern Control Systems, Prentice Hall, 2001.

List of Practical Assignment:

1. Find the transfer function of various LTI control systems (open loop and close loop) using MATLAB/SciLAB command.
2. Write a program to plot the poles and zeroes for the different sets of transfer function using MATLAB/ SciLAB
3. Write a program to plot the time response of first and second order control system on impulse, unit-step, ramp and parabolic input signals using MATLAB. Also find the value of various transient response parameters
4. To determine the position, velocity and acceleration error coefficient of given transfer functions using MATLAB
5. Plot the root locus for various transfer functions using MATLAB command.
6. Plot the Nyquist plot for the given transfer function using MATLAB. Also comment on the systems stability
7. Plot the Bode plot for a given transfer function

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Course Outcome:

Students earned credits will develop ability to

CO.No.	CO	PO
CO1	Present the structure of feedback control theory.	PO1, PO2
CO2	Discover feedback control.	PO1, PO5, PO12
CO3	physical system modeling and practical control system designs with realistic system specifications.	PO1, PO3, PO4
CO4	Design and Analyse Control systems in Mechanical Applications.	PO1, PO2, PO4

CO-PO Relationship

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO1	3	3										
CO2	3				3							2
CO3	3		3	3								
CO4	3	3		3								
CO5												

* CO (rows) mention nil/very small/insignificant contribution to the PO(column)

1→ relevant and small significance 2 → medium or moderate and 3 →strong