BVM ENGINEERING COLLEGE [AN AUTONOMOUS INSTITUTION]

2EC11: CONTROL SYSTEMS
CREDITS - 3 (LTP:3,0,0)

Course Objective:
To explore the fundamentals of systems and control. To focus on (1) Understanding and predicting system behavior (2) Design and analysis of closed loop control systems and (3) System stability prediction.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	100
3	0	0	3	60	40	00	00	

Course Contents:

Unit No.	Topics	Teaching Hours
1.	**Introduction to Control Systems :** Introduction, Examples of Control Systems, Closed-loop Control versus Open-Loop Control, Design and Compensation of Control Systems.	05
2.	**Mathematical Modeling of Control Systems :** Introduction, Transfer Function and Impulse-Response Function, Mathematical Modelling of Mechanical Systems, Mathematical Modelling of Electrical Systems, Block Diagram Reductions and Signal Flow Graphs, Design Examples.	08
3.	**State Variable Models** : Introduction, The State Variable of a Dynamic System, The State Differential Equation, Signal Flow Graph and Block Diagram Models using State Space, Alternative Signal Flow Graph and Block Diagram Models, The Transfer Function from the State Equation, Design Examples.	08
4.	**Transient and Steady State Response Analysis:** Introduction, Test Input Signals, First-Order Systems, Second-Order Systems, Performance Indices, The s-plane Root Location and Transient Response, Control Actions and its Effect on System Performance, Steady-State Errors in Unity-Feedback Control Systems, Design Examples.	08
5.	**Control System Analysis and Design by Root Locus Analysis:** Introduction, The Concept of Stability, The Routh-Hurwitz Stability Criterion, The Relative Stability of Feedback Control System, Root-Locus Plots, General Rules for Constructing Root Loci, Lead Compensation, Lag Compensation, Lag-Lead Compensation, Effect of Additions of Open-loop Poles and Zeroes on Root Locus, Design Examples.	08

Unit No.	Topics	Teaching Hours
6.	**Control System Analysis and Design by Frequency Response Method:** Introduction, Frequency Response Plots and Measurements, Bode Diagrams, Polar Plots, Log-Magnitude-versus-Phase Plots, Nyquist Stability Criterion, Stability Analysis, Relative Stability Analysis, Lead Compensation, Lag Compensation, Lag-Lead Compensation, Design Examples.	08
	Total	**45**

List of References:

1. Richard C. Drof and Robert H. Bishop, "*Modern Control System*", Pearson Education, 11th Edition, 2008.
2. Katsuhiko Ogata, "*Modern Control Engineering*",Prentice Hall of India, 5thEdition,2010.
3. Benjamin C.Kuo & Farid Golnaraghi, "*Automatic Control Systems*", John Wiley & Sons, 8thEdition, 20,0,2.
4. Nagrath and Gopal, "*Control Systems Engineering*", New Age Publication, 5thEdition, 2007.

Course Outcomes (COs):

By learning this course student will be able to …

1. Demonstrate an understanding of the fundamentals of feedback control systems.
2. Understand systems theory to complex real world problems in order to obtain models that are expressed using differential equations, transfer functions, and state space equations.
3. Predict system behavior based on the mathematical model of that system where the model may be expressed in time or frequency domain.
4. Analyze the absolute stability of a closed-loop control system.
5. Apply Root-Locus, Bode-Plot and Niquist-Plot techniques to analyze and design control systems.
6. Design controllers using classical PID methods.