CONTROL SYSTEMS

B.Tech-IV-Semester: EEE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AEEB16	Core	L	T	P	C	CIA	SEE	Total
		3	1	--	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Organize modeling and analysis of electrical and mechanical systems.
II. Analyze control systems by block diagrams and signal flow graph technique.
III. Demonstrate the analytical and graphical techniques to study the stability.
IV. Illustrate the frequency domain and state space analysis.

COURSE OUTCOMES (COs):

CO1: Classify the types and configurations of control systems and describe the mathematical models of dynamic systems
CO2: Apply various techniques to obtain transfer functions and examine the time response of control systems using standard test signals
CO3: Analyze the system response and stability in time domain
CO4: Examine the characteristics and stability of control systems in frequency domain.
CO5: Obtain the models of control systems in state space form and design compensators to meet the desired specifications.

COURSE LEARNING OUTCOMES (CLOs):

1. Differentiate between open loop, closed loop system and their importance in real time applications.
2. Predict the transfer function of translational and rotational mechanical, electrical system using differential equation method.
3. Analyze the analogy between electrical, translation and rotational mechanical systems.
4. Apply the block diagram and signal flow graph technique to determine transfer function of an control systems.
5. Demonstrate the response of first order and second order systems with various standard test signals.
6. Estimate the steady state error and its effect on the performance of control systems and gives the importance of PID controllers.
7. Summarize the procedure of Routh – Hurwirtz criteria to study the stability of physical systems
8. List the steps required to draw the root – locus of any control system and predict the stability.
9. Explain the effect on stability by adding zeros and poles to the transfer function of control system.
10. Discuss the method of Bode plot and Polar plot to calculate gain margin and phase margin of control system.
11. Describe the characteristics of control system and its stability by plotting Nyquist plot.
12. Compare the behavior of control system in terms of time domain and frequency domain response.
13. Define the state model of control system using its block diagram and give the role of diagonalization in state space analysis.
14. Formulate the state transmission matrix and explain the concept of controllability and observability.
15. Design of lag, lead, lag – lead compensator to improve stability of control system.
16. Applications of the principles of communication engineering and digital signal processing.

MODULE-I	INTRODUCTION AND MODELING OF PHYSICAL SYSTEMS	Classes: 08
Control systems: Introduction, open loop and closed loop systems, examples, comparison, mathematical modeling and differential equations of physical systems, concept of transfer function, translational and rotational mechanical systems, electrical systems, force, voltage and force, current analogy.		
MODULE-II	**BLOCK DIAGRAM REDUCTION AND TIME RESPONSE ANALYSIS**	**Classes: 10**
Block Diagrams: Block diagram representation of various systems, block diagram algebra, characteristics of feedback systems, AC servomotor, signal flow graph, Mason‟s gain formula; Time response analysis: Standard test signals, shifted unit step, shifting theorem, convolution integral, impulse response, unit step response of first and second order systems, time response specifications, steady state errors and error constants, dynamic error coefficients method, effects of proportional, derivative and proportional derivative, proportional integral and PID controllers.		
MODULE-III	**CONCEPT OF STABILITY AND ROOT LOCUS TECHNIQUE**	**Classes: 09**
Concept of stability: Necessary and sufficient conditions for stability, Routh‟s and Routh Hurwitz stability criterions and limitations. Root locus technique: Introduction, root locus concept, construction of root loci, graphical determination of „k‟ for specified damping ratio, relative stability, effect of adding zeros and poles on stability.		
MODULE-IV	**FREQUENCY DOMAIN ANALYSIS**	**Classes: 10**
Frequency domain analysis: Introduction, frequency domain specifications, stability analysis from Bode plot, Nyquist plot, calculation of gain margin and phase margin, determination of transfer function, correlation between time and frequency responses.		
MODULE-V	**STATE SPACE ANALYSIS AND COMPENSATORS**	**Classes: 08**
State Space Analysis: Concept of state, state variables and state model, derivation of state models from block diagrams, diagonalization, solving the time invariant state equations, state transition matrix and properties, concept of controllability and observability; Compensators: Lag, lead, lead - lag networks.		
Text Books:		
1. I J Nagrath, M Gopal, "Control Systems Engineering", New Age International Publications, 3rd Edition, 2007. 2. K Ogata, "Modern Control Engineering", Prentice Hall, 4th Edition, 2003. 3. N C Jagan, "Control Systems", BS Publications, 1st Edition, 2007.		
Reference Books:		
1. Anand Kumar, "Control Systems", PHI Learning, 1st Edition, 2007. 2. S Palani, "Control Systems Engineering", Tata McGraw-Hill Publications, 1st Edition, 2001. 3. N K Sinha, "Control Systems", New Age International Publishers, 1st Edition, 2002.		
Web References:		
1. https://www.researchgate.net		

2. https://www.aar.faculty.asu.edu/classes 3. https://www.facstaff.bucknell.edu/ 4. https://www.electrical4u.com 5. https://www.iare.ac.in
e-text books:
1. https://www.jntubook.com/ 2. https://www.freeengineeringbooks.com