CONTROL SYSTEMS

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:

Students will try to learn:

I. The mathematical models of dynamic systems using the concepts of basic sciences

II. The system performance using time domain and frequency domain analysis for standard inputs.

III. Classification of Controllers and Compensators as per the desired dynamic response of the system.

IV. The different ways of system representation such as transfer function and state space.

COURSE OUTCOMES

Upon the successful completion of this course, the students will be able to:

CO 1 **Compare** open and closed loop control systems with their merits and demerits to know the accuracy of the system.

CO 2 **Illustrate** the basic concepts of Control Systems for modeling and develop the mathematical form of complex physical systems.

CO 3 **Relate** the different physical and mechanical systems into equivalent electrical models using force-voltage and force-current analogy.

CO 4 **Apply** block diagram reduction technique and Mason's gain formula to represent system's transfer function.

CO 5 **Make use of** different standard test input signals for the performance analysis of second order systems and steady state errors

CO 6 **Interpret** the feedback characteristics of linear control systems for Overall gain, Sensitivity, Stability and Noise.

CO 7 **Illustrate** the time domain analysis to predict transient response specifications of the system for system stability

CO 8 **Make use of** the closed loop performance and stability using root locus technique.

CO 9 **Infer** the stability of a first and second order systems using frequency domain concept

CO 10 **Classify** the types of compensators in time domain and frequency domains specifications for increases the steady state accuracy of the system.

CO 11 **Interpert** linear system equations in state-variable form for the analysis of system's dynamic behavior .

MODULE-I	INTRODUCTION AND MODELING OF PHYSICAL SYSTEMS	Classes: 09
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: 09**
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: 09**
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: 09**
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.electrical4u.com 2. https://www.freevideolectures.com		