INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

CONTROL SYSTEMS								
IV Semester: EEE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AEED12	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Linear Algebra and Calculus , DC Machines and Transformers								

I. COURSE OVERVIEW:
This course deals with the basic concepts of block diagram reduction technique, time response analysis of first order and second order systems. It deals with various time and frequency domain analysis. It elaborates the concept of stability and its assessment for linear time invariant systems. This course address the various real time issues and howthe control strategies are used in automation areas associates with variety of engineering streams

II. COURSE OBJECTIVES:
The students will try to learn:

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.

III. COURSE OUTCOMES:
The students will try to learn:

1. Relate the physical and mechanical systems into equivalent electrical analogies using the mathematical form of physical systems
2. Utilize various reduction techniques for developing the transfer function, transient and steady state error with the standard input signals
3. Make use of the ROUTH-HOURITZ criterion to determine the stability of a system
4. Demonstrate the stability of a system using root locus technique for analysing the system performance.
5. Illustrate the system using polar plot, Nyquist plot, and Bode plot for determining the stability of the system.
6. Interpret linear system equations in state space form for the analysis of LTI system.

IV. COURSE CONTENT:
MODULE-I: INTRODUCTION AND MODELING OF PHYSICAL SYSTEMS (08)
Control systems: Introduction, open loop and closed loop systems, examples, comparison, mathematical modelingand differential equations of physical systems, concept of transfer function, translational and rotational mechanicalsystems, electrical systems, force - voltage and force - current analogy.

MODULE-II: BLOCK DIAGRAM REDUCTION, TIME RESPONSE ANALYSIS AND CONTROLLERS (10)
Block Diagrams: Block diagram representation of various systems, block diagram algebra, characteristics of feedbacksystems, AC servomotor, transfer function of DC motor, signal flow graph, Mason‘s gain formula; Time response analysis: Standard test signals, shifted unit step, 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 P, PD, PI and PID controllers. Programmable Logic Controller: Physical structure of PLC, Types of PLCs, PLC applications, PLC programming and examples

MODULE-III: CONCEPT OF STABILITY AND ROOT LOCUS TECHNIQUE (09)

Concept of stability: Necessary and sufficient conditions for stability, Routh's and Routh Hurwitz stability criterionsand 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 (10)

Frequency domain analysis: Introduction, frequency domain specifications, stability analysis from Bode plot, Nyquistplot, calculation of gain margin and phase margin, determination of transfer function, correlation between time and frequency responses.

MODULE-V: STATE SPACE ANALYSIS AND COMPENSATORS (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.

V. 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.

VI. 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.

VII. ELECTRONIC RESOURCES:

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

VIII. MATERIALS ONLINE:

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open end experiments
5. Definitions and terminology
6. Assignments
7. Model question paper - I
8. Model question paper - II
9. Lecture notes
10. E-learning readiness videos (ELRV)
11. Power point presentation