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

COURSE CONTENT

CONTROL SYSTEMS								
III Semester: ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AEEE13	**Core**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Mathematical Transform Techniques								

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 time and frequency domain analysis. It elaborates the concept of stability and its assessment for linear time invariant systems. This course addresses the real time issues and control strategies, which are used in automation areas, associates with several engineering streams.

II. COURSES OBJECTIVES:
The 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. The classification of controllers and compensators as per the desired dynamic response of the system.
IV. The system representation such as transfers function and state space.

III. COURSE OUTCOMES:
At the end of the course students should be able to:

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

IV. COURSE CONTENT:

MODULE-I: INTRODUCTION TO CONTROL SYSTEMS (10)
Control systems: Introduction, Classification of control systems-open loop and closed loop systems, examples, comparison, mathematical modeling for Physical Systems: Electrical circuits, Mechanical systems, computational systems. Transfer function representation.

MODULE-II: BLOCK DIAGRAM REDUCTION AND TRANSIENT RESPONSE ANALYSIS (10)
Block Diagrams: Block diagram representation of various systems, block diagram algebra, characteristics of feedback systems, signal flow graph, Mason's gain formula; Time-domain specifications, standard test signals, shifted unit step, shifting theorem, convolution integral, impulse response, unit step response of first and second order systems, steady state errors, system error and non-unity feedback systems, effects of PID controllers.

MODULE-III: CONCEPT OF STABILITY AND ROOT LOCUS TECHNIQUE (09)
Concept of stability, types of systems based on stability, necessary and sufficient conditions for stability, BIBO stability, Routh's and Routh Hurwitz stability criterions and limitations.

Root locus technique: Introduction, Root locus plots, construction of root locus, 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, Bode plot, Nyquist plot, Nyquist stability criterion, relative stability, calculation of gain margin and phase margin, determination of transfer function, correlation between time and frequency responses.

MODULE-V: STATE SPACE ANALYSIS AND COMPENSATORS (09)

State Space Analysis: Concept of state, state variables and state model, Solution of state equations, derivation of state models from block diagrams, diagonalization, solving the time invariant state equations, state transition matrix and properties, concept of controllability, observability and pole placement, lead lag compensators: via root locus and frequency domain methods.

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. ELECTRONICS RESOURCES:

1. NPTEL : Electrical, Electronics and Communication: control systems
2. https://ocw.mit.edu/courses/6-012-control-systems--2009/pages /
3. https://archive.nptel.ac.in/content/storage2/courses/10312325/Courses/Lecture18.html

VIII. MATERIALS ONLINE

1. Course Outline Description
2. Lecture notes
3. PowerPoint presentation
4. Definitions and Terminology
5. Tutorial Question Bank
6. Case Studies
7. Real life Examples
8. Complex Engineering Problems
9. Tech Talk Topics
10. Concept Video Topics
11. Open-ended Exercises

12. Assignments
13. Model Question Paper – I
14. Model Question Paper – II
15. GATE Question Bank
16. Previous Question Papers and Solutions