CONTROL SYSTEMS

IV Semester: EEE ; **V Semester:** ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
AECC21	Core	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Prerequisites: Mathematical Transform Techniques

I. COURSE OVERVIEW:

This course deals with the basic concepts of block diagram reduction technique, time response analysisof 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 addresses the various real time issues and how the control strategies are used in automation areas associates with variety of engineering streams.

II. COURSE 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 transfer function and state space.

III. COURSE OUTCOMES:

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

CO 1	**Relate** the physical and mechanical systems into equivalent electrical analogies using the mathematical form of physicalsystems.	Understand
CO 2	**Utilize** various reduction techniques for developing the transfer function, transient and steady state error with the standard inputsignals.	Apply
CO 3	**Make use of** the ROUTH-HOURITZ criterion to determine thestability of a system	Apply
CO 4	**Demonstrate** the stability of a system using root locus techniquefor analysing the system performance	Understand
CO 5	**Illustrate** the system using polar plot, Nyquist plot, and Bodeplot for determining the stability of the system.	Analyze
CO 6	**Interpret** linear system equations in state space form for theanalysis of LTI system	Understand

IV. COURSE SYLLABUS:

MODULE-I: INTRODUCTION TO CONTROL SYSTEMS (08)

Control systems: Introduction, open loop and closed loop systems, examples, comparison, mathematicalmodeling for Physical Systems: Electrical circuits, dc generator and motors, Mechanical systems, computational systems. Linearization of nonlinear 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, AC servomotor, signal flow graph, Mason's gain formula; Time-domain specifications,–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, derivative and proportional derivative, integral and PID controllers.

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

Concept of stability: Necessary and sufficient conditions for stability, BIBO stability, Routh's and Routh Hurwitz stabilitycriterions 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, Bodeplot, Nyquist plot, Nyquist stability criterion, 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, Solution of state equations ,derivation of state models fromblock 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. 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

VIII. E-TEXT BOOKS:

1. https://www.jntubook.com/
2. https://www.freeengineeringbooks.com