Linear Control Systems

Course Code	**23ES1402**	**Year**	II	**Semester**	II
Course Category	ES	**Offering Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
ContinuousInternal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		BL
CO1	**Classify** control systems and determine the stability of a system using various models	L2
CO2	**Apply** standard test signals to a system to determine their characteristics	L3
CO3	**Make use of** stability concepts to obtain the desired characteristics	L3
CO4	**Inspect** the characteristics of a linear control system using various time and frequency domain tools	L4
CO5	**Examine** the system behaviour using various stability analysis techniques	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H: High (3), M: Medium (2), L:Low (1))

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2						2		2			2	
CO2	1						2		2			2	
CO3	3						2		2			2	
CO4		2					3		3			3	
CO5		2					3		3			3	
Average	2	2					2		2			2	

Syllabus		
Unit No.	**Content**	**Mapped CO**
1	**Introduction:** Concepts of System, Control Systems: Open Loop and closed loop control systems and their differences. Different examples of control systems, Feed-Back Characteristics, Effects of feedback. Mathematical models: Differential equations, transfer functions. Translational and Rotational mechanical systems.	CO1, CO3
2	**Transfer Function Representation:** Block diagram representation of systems –Block diagram algebra–Representation by Signal flow graph-Reduction using mason's gain formula. **Time Response Analysis:** Standard test signals – Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems – Time domain specifications – Steady state response - Steady state errors and error constants.	CO1-CO4

3	**Stability Analysis in S-Domain:** The concept of stability – Routh's stability criterion – qualitative stability and conditional stability – limitations of Routh's stability. **Root Locus Technique:** The root locus concept - construction of root loci-effects of adding poles and zeros to G(s) H(s) on the root loci.	CO1, CO3,CO4, CO5
4	**Frequency response analysis:** Introduction, Correlation between time and frequency response, Polar Plots, Bode Plots, Nyquist Stability Criterion.	CO1, CO3, CO4,CO5
5	**State variable analysis:** State, State variables, State variable representation, State variable form from Transfer function (Diagonal form), transfer function from State variable form, State transition matrix, properties of state transition matrix, Controllability and Observability	CO1, CO5

Learning Recourse(s)
Text Books
1. I. J.Nagrath and M.Gopal, Control Systems Engineering, New Age International (P) Limited, Publishers, 7th Ed., 2022.
Reference Books
1. Ogata, Modern Control Engineering, 2nd Ed.,, Prentice Hall of India.,2011 2. R.C. Sukla, Control Systems, 3rd Ed., Dhanpatrai and Sons,1998 3. Nise, Control Systems Engg., John wiley , 3rd Ed., 2000
e- Resources & other digital material
1. https://nptel.ac.in/courses/108/106/108106098/ 2. https://freevideolectures.com/course/2337/control-engineering