

Control Systems Engineering

Course Code	19EE3501	Year	III	Semester	I
Course Category	Program Core	Branch	EEE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Signals and Systems (19EE3303) & Engineering Mathematics-III (19BS1301)
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Classify control systems, feedback characteristics and describe some applications. (L2)
CO2	Determine the transfer function and recognize different mathematical modeling of physical systems. (L3)
CO3	Demonstrate the time response analysis, PID controllers and investigate the stability of the system in time domain. (L3)
CO4	Use frequency response analysis to investigate the stability of the system in frequency domain. (L3)
CO5	Analyze linear control system using the state space technique. (L4)

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)														
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation														
* - Average value indicates course correlation strength with mapped PO														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	3		1						3	3	1
CO2	3	3	3	3		1						3	3	1
CO3	3	3	3	3		1			1			3	3	1
CO4	3	3	3	3		1						3	3	1
CO5	3	3	3	3		1						3	3	2

Syllabus		
Unit No.	Contents	Mapped CO
I	Introduction: Classification of control systems, open loop and closed loop control systems and their differences, Feedback characteristics, Concept of Transfer function- impulse response. Transfer function of DC servo motor – AC servo motor. Construction and working of synchro transmitter and receiver.	CO1 CO2
II	Mathematical Modeling of Control Systems: Finding Transfer functions for electrical networks. Mathematical models – Differential equations of mechanical systems (Translational and Rotational), electrical systems and electrical analogous of mechanical systems. Block diagram representation by signal flow graph – reduction using Mason’s gain formula.	CO2
III	Time Response Analysis & Stability: Standard test signals, Time response of first and second order systems with step input signal, time domain specifications, steady state error and static error constants. The concept of stability – Routh’s stability criterion –limitations of Routh’s stability, Root locus concept – construction of root loci (simple problems). P, PI, PD and PID Controllers.	CO3

IV	Frequency Response Analysis & Stability: Introduction to frequency domain specifications- correlation between time and frequency responses. Polar Plots- Stability analysis of Nyquist Plots- Bode plots – Phase margin and Gain margin. All pass and minimum phase systems.	CO4
V	State Space Analysis of LTI Systems: Concepts of state, state variables and state model, Conversion of state variable model to transfer function model and Transfer function form to state variable form (controllable canonical form), solving the time invariant state equations, State Transition Matrix and it's Properties, concepts of controllability and observability.	CO5

Learning Resources	
Text Books	
<ol style="list-style-type: none"> 1. Automatic Control Systems– by Farid Golnaraghi and Benjamin C. Kuo – John wiley and son's., 9th edition, 2010. 2. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Limited 2009, Publishers, 5th edition. 3. Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 3rd edition, 1998. 	
Reference Books	
<ol style="list-style-type: none"> 1. Control Systems principles and design by M.Gopal, Tata Mc Graw Hill education Pvt Ltd., 4th Edition, 2012. 2. Control Systems Engineering. by Norman S.Nise 8th Edition – John Wiley 2019 3. Control Systems Engineering by S.Palani, 2nd edition, Tata Mc Graw Hill Publications, 2009. 	
e- Resources & other digital material	
<ol style="list-style-type: none"> 1. https://nptel.ac.in/courses/107/106/107106081/ 2. https://nptel.ac.in/courses/108/106/108106098/ 3. https://nptel.ac.in/courses/108/102/108102043/ 	