G.NARAYANAMMA INSTITUTE OF TECHNOLOGY & SCIENCE
(FOR WOMEN)
UGC AUTONOMOUS

III Year B.Tech. ECE I-Sem	L	T	P	C
Course Code:	3	0	0	3

LINEAR CONTROL SYSTEMS

Prerequisite: Ordinary Differential Equations & Laplace Transform, Mathematics I

Course Objectives:

1. To understand the different ways of system representations such as Transfer function representation and state space representations and to assess the system dynamic response.
2. To assess the system performance using time domain analysis and methods for improving it.
3. To assess the system performance using frequency domain analysis and techniques for improving the performance.
4. To design various compensators to improve system performance.

Course Outcomes: At the end of this course, students will be able to

1. Differentiate open-loop & closed-loop systems and discuss RH and Root locus techniques to determine the stability.
2. Formulate Transfer function of Mechanical and Electrical systems
3. Analyze first and second order systems with different inputs and design in time domain for a given specifications.
4. Investigate the stability of given system using appropriate techniques such as Nyquist and Bode plot in frequency domain.
5. Design different types of compensators for feedback control systems to improve system performance.
6. Apply state space analysis to solve problems on continuous control systems.

Syllabus Contents:	No. of Lecture Hours
UNIT I: Introduction	10
Introduction, time variant, time invariant open loop and closed loop Control System. Development of Block diagrams and Transfer Function of physical/Mechanical and Electrical systems. Feedback elements of closed loop Control Systems: DC and AC Servo motors, Synchro's, Tachometer.	
Block diagram reduction, signal flow graphs, Mason's gain formula, numerical problems.	

1) N.Mallelelly   5)   10)   15)
2) D.Sujubalatt   6)   11)   16)R.Balasubramanyam
3)   7)   12) G.Arun
4) S.S9   8)   13) Jsreddy
                       9)   14) Rmjo

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UNIT II: Time Domain Analysis

Unit step ,ramp and impulse signals, Steady state error using error constants, step and ramp response of first order and second order systems, time domain specifications, derivations, problems. P, PD, PI, PID controllers with derivations.

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UNIT III: Stability Analysis

Concept of stability, Absolute stability, Conditional stability, Relative stability, Limited stability, Routh Hurwitz criterion, Problems.

Root Locus: Construction of Root locus, Effect of addition of poles and zeros in transfer function on stability.

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UNIT-IV: Nyquist, Bode plots and compensators

Frequency domain specifications, Bode plot, finding frequency domain specifications from plot, Effect of gain K , frequency domain specifications with the help of Bode plot.

Nyquist plot of different systems including systems with dead time, Performance specifications like ω_c, ω_g, Gain margin, Phase margin.

Compensators: Lead, Lag compensators, Lead-Lag compensators. Design of system using compensators.

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UNIT V: State Variable Analysis:
Concept of state, State Equations, State Transition matrix, State Transition Equation, Transfer Function from differential equations and state equations, State equations from differential equations, State models, Controllability, Observability.

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TEXT BOOKS:

1. B.C. Kuo, "Automatic Control Systems", John wiley and sons, 8th Edition, 2003.
2. I.J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International (P) Limited, Publishers, 5th Edition, 2009.

REFERENCE BOOKS:

1. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt.Ltd., 3rd Edition, 1998.
2. M. Gopal, "Control Systems Principles and Design", 2nd Edition, Tata McGraw-Hill.
3. A.Nagoorkani, "Control Systems", 1st Edition, RBA Publications.
4. A K. Jairath, "solutions and problems of Control Systems, CBS publications and distributors

Online Websites/ Materials:

1. Lecture Series on Control Engineering by Dr. Rama Krishna Pasumarthy, Associate Professor, Department of Electrical Engineering, IIT Madras.

   https://onlinecourses.nptel.ac.in/noc19_ee30/preview