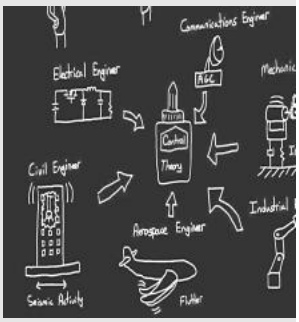
19EE212 CONTROL SYSTEMS



Source: http://moodle.rcoe.co.in/course/info.php?id=269

Hours Per Week :

L	T	P	C
3	-	2	4

COURSE DESCRIPTION AND OBJECTIVES:

This course offers the basic concepts of modeling, analysis and design of linear continuous time systems. The objective of the course is to introduce the modeling of systems from physical laws, feedback characteristics and a few important control system components. In addition, it also provides graphical methods to analyze and assess system stability in time and frequency domains. Further, it introduces the state variable approach and basics of controllers design.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes
1	Formulate differential equations for electromechanical systems.
2	Describe the effects of feedback on control systems.
3	Apply mathematical techniques to perform time response analysis of a control system.
4	Analyse linear control systems for absolute stability and relative stability using Root Locus technique and frequency domain analysis.
5	Design controllers and compensators.

SKILLS:

- ***ü*** *Model any physical system (Electrical, Mechanical, Electro-mechanical…).*
- ***ü*** *Determine overall transfer function of a system using Block Diagram Reduction Technique and SFG method.*
- ***ü*** *Analyse first and second order systems in time domain.*
- ***ü*** *Carry out stability analysis of any system in time and frequency domain.*
- ***ü*** *Design Lag, Lead Compensator using R, L and C for any Linear Time Invariant System.*

UNIT - I **L - 9**

INTRODUCTION TO CONTROL SYSTEMS: Concepts of control systems - Open loop and closed loop control systems and their differences; Different examples of control systems, Classification of control systems; Mathematical Models of Physical Systems; Differential equations, Transfer function and block diagram representation of electrical systems; Block diagram algebra, Signal flow graph reduction using Mason's gain formula, Translational and rotational mechanical systems.

UNIT - II **L - 9**

FEED-BACK CHARACTERISTICS AND CONTROL COMPONENTS: Effects of feedback - Reduction of parameter variations, Control over system dynamics; Elements of Control Systems; Operation and derivation of transfer function of DC and AC Servo motors, Synchro transmitter and receiver.

UNIT – III **L - 9**

TIME RESPONSE ANALYSIS: Standard test signals, Time response of first order systems, Characteristic equation and transient response of second order systems, Time domain specifications, Steady state response, Steady state errors and error constants.

STABILITY: Concept of stability, Routh stability criterion.

UNIT - IV **L - 9**

ROOT LOCUS TECHNIQUE: Root locus concept, Construction of root loci and analysis.

FREQUENCY RESPONSE ANALYSIS: Introduction, Frequency domain specifications, Bode plots Construction and determination of frequency domain specifications, Phase margin, Gain margin and stability analysis; Introduction to polar plots, Nyquist plots and Nyquist stability criterion.

UNIT – V **L - 9**

COMPENSATION TECHNIQUES: Design problem, Preliminary design considerations, Realization of basic compensators - lead, lag and lead-lag. PID controllers.

STATE SPACE ANALYSIS: Concept of state variables and state model, Derivation of state models from block diagrams and diagonalization, Solving the time invariant state equations, State transition matrix. Concept of controllability and observability.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

1. Time response of Second order system.
2. Characteristics of Synchros.
3. Study of Temperature Control System.
4. Transfer function of DC generator.
5. Characteristics of magnetic amplifier.
6. Characteristics of AC servo motor.
7. Linear system analysis (Time domain and Error analysis) using MATLAB.
8. Design of PID controller using MATLAB.
9. Stability analysis of Linear Time Invariant system using MATLAB.
10. State space model for classical transfer function using MATLAB – Verification.
11. Water level control system using PLC.
12. Traffic light control system using PLC.

TEXT BOOKS:

1. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, 6th edition, New Age International (P) Limited, 2018.
2. Katsuhiko Ogata, “ Modern Control Engineering “ 5th edition, Prentice Hall of India Private Ltd., New Delhi, 2010.

REFERENCE BOOKS :

1. Norman. S. Nise, “Control Systems Engineering”, 7th edition, John Wiley and Son’s, 2014.
2. M. Gopal, “Control Systems: Principles and Design”, 3rd edition, Mc Graw, Hill, 2008.
3. Benjamin. C. Kuo, “ Automatic Control System”, Prentice Hall of India Private Ltd., New Delhi, 2009.
4. R.C. Dorf and R.H. Bishop, “Modern Control Systems”, 12th edition, Prentice Hall, 2010.