DISCIPLINE SPECIFIC CORE COURSE –19: Control Systems

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Control Systems	**4**	**3**	**-**	**1**	**Class XII passed with Physics + Mathematics/Applied Mathematics + Chemistry OR Physics + Mathematics/Applied Mathematics + Computer Science/Informatics Practices**	**-**

Learning Objectives

This course provides the fundamental understanding of Mathematical modeling and analysis of open loop and closed loop control systems in terms of electrical equivalent circuits. Student should be in position to explain the nature of stability of systems using different criteria and plots. They should be able to identify the Controllability and Observability of a system to explore its applications.

Learning outcomes

After successful completion of this course, student will be able to

- Analyze the concepts of open and closed loop control systems
- Develop the mathematical model of a physical system
- Analyze the stability of control systems with the help of different criteria and plots.
- Identify the needs of different type of controllers.
- Analyze controllability and Observability by state space models.

SYLLABUS OF ELDSC-19 **Total Hours- Theory: 45 Hours, Practicals: 30 Hours**

UNIT – I (11 Hours)

Introduction to classification of systems: Linear and Nonlinear systems, Time invariant and Time varying system, Continuous time and Discrete time system, Dynamic and Static system, SISO and MIMO, Open loop and Closed loop control systems, Transfer functions, Mathematical modelling of Physical systems (Electrical, Mechanical and Thermal), D.C. motors and A.C. servomotors, block diagram representation & signal flow graph, Mason's Gain Formula, Effect of feedback on parameter variations

UNIT – II (12 Hours)

Test input signals for transient Analysis, transient response of first , second and higher order system for different test input signals , Time domain performance parameters of second order System , Steady state errors and Static error constants

Concept of Stability: Effect of location of poles on stability, Asymptotic stability and Conditional stability, Routh – Hurwitz criterion, Root Locus techniques and their applications. concept and applications of PI, PD and PID controllers .

UNIT – III (11 Hours)

Advantages of frequency domain analysis, Frequency domain specifications, Correlation between time and frequency response, Polar plot, Logarithmic plots (Bode Plots), Gain and Phase margins, Nyquist stability criterion.

UNIT – IV (11 Hours)

Definition of State, State variables and State models, State Space Representation of dynamic systems (Electrical networks and nth order differential equation), State Transition Matrix, Decomposition of Transfer Function, Controllability and Observability.

Compensation Techniques: Concept of compensation techniques Lag, Lead and Lag-Lead networks

Practical component (if any) – Control Systems Lab
(Hardware and Scilab/MATLAB/Other Mathematical Simulation software)

Learning outcomes

The Learning Outcomes of this course are as follows:

- Perform experiments involving concepts of control systems
- Design experiments for controlling devices like AC/DC motor etc.
- Study behavior of systems

LIST OF PRACTICALS (Total Practical Hours- 30 Hours)

1. To study response of systems for various standard test input signals.
2. To study position and speed control of DC motor.
3. To find torque speed characteristics of AC servomotor.
4. To study time and frequency domain specifications of a control system.
5. To plot Bode, Root locus and Nyquist plots and determine stability.
6. To study the effect of PI, PD and PID controller on closed loop systems.
7. State space analysis for a given Transfer function

Note: Students shall sincerely work towards completing all the above listed practicals for this course. In any circumstance, the completed number of practicals shall not be less than six.

Essential/recommended readings

1. J. Nagrath& M. Gopal, Control System Engineering, New Age International, 5th Edition, 2007
2. K. Ogata, Modern Control Engineering, Pearson, 5th Edition, 2010
3. B. C. Kuo and Farid Golnaraghi, Automatic control system, 9th Edition, Wiley, 2009

Suggestive readings

1. Joseph J Distefano, Allen R Stubberud, Ivan J Williams, - Control Systems, Schaum's Out lines, Tata McGraw Hill, third Edition, 2010

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.