LNCT University
Diploma EX, VI Semester Syllabus

CONTROL SYSTEM (DEX-603-A)

COURSE OUTCOMES:

After Completing the course student should be able to:

CO-1	Understand types and components of control systems and their industrial relevance.
CO-2	Model control systems using transfer functions, block diagrams, and signal flow graphs.
CO-3	Analyse time response and evaluate steady-state performance of control systems.
CO-4	Assess system stability using Routh's criterion and root locus method.
CO-5	Use frequency response tools and basic controllers in system analysis and industrial control.

UNIT I: INTRODUCTION TO CONTROL SYSTEMS

Definition and need for control systems. Open loop vs. closed loop systems. Types of control systems: linear, non-linear, time-invariant, time-variant. Applications of control systems in electrical, mechanical and process industries. Basic elements of a control system: sensors, controllersand actuators.

UNIT II: MODELLING OF CONTROL SYSTEMS

Transfer function concept. Mathematical modelling of electrical and mechanical systems. Block diagram representation and simplification. Signal flow graph: Mason's gain formula. Examples of first-order and second-order systems.

UNIT III: TIME DOMAIN ANALYSIS

Time response of first and second-order systems. Transient and steady-state response. Time domain specifications: rise time, settling time, peak time, overshoot. Steady-state error and error constants. Effect of feedback on system performance.

UNIT IV: STABILITY AND ROOT LOCUS TECHNIQUE

Concept of stability: BIBO stability, Routh-Hurwitz stability criterion, Root locus: basic rules for construction. Effects of pole-zero placement on stability and response, System performance from root locus plot.

UNIT V: FREQUENCY DOMAIN ANALYSIS AND CONTROLLERS

Introduction to frequency response. Bode plot: gain margin and phase margin, Concept of bandwidth and resonance. Basic control actions: proportional, integral, derivative (P, PI, PD, PID). Introduction to controller tuning and industrial applications.

List of Suggestive Experiments: -

1. Study of Open Loop and Closed Loop Systems using a trainer kit or simulation software.
2. Identification and Classification of Control Systems (Linear/Non-linear, Time-Invariant/Variant).
   Objective: Analyse different systems and classify them based on their characteristics.
3. Study of Basic Elements of a Control System: Sensors, Controllers, and Actuators.
4. Derive Transfer Function for a simple RLC circuit or mechanical system. Objective: Understand mathematical modelling.
5. Block Diagram Reduction and simplification using software or manual methods.
6. Signal Flow Graph and application of Mason's Gain Formula for a given system.
7. Routh-Hurwitz Stability Criterion for stability assessment of a given system.
8. Draw Root Locus Plot for a system using MATLAB or manually.
9. Analyse the Effect of Pole-Zero Placement on system stability and performance.
10.

Reference Books: -

1. Control Systems Engineering, Nagrath & Gopal
2. Automatic Control Systems, B.C. Kuo
3. Modern Control Engineering, Ogata
4. Control Systems, A. Anand Kumar