

Approval: 1st Convocation Adhoc Meeting

Course Name: Control Systems Engineering

Course No.: EE 301

Credits: 2.5-0.5-0-3

Prerequisites

Students intended for: B.Tech.

Elective or Compulsory

Semester Odd/Even

Course contents:

Basic concepts: Introduction, basic terminology, objective of subject, some basic examples, Notion of feedback; open- and closed-loop systems.

Mathematical Models: Representation of physical systems and analogous systems, Laplace transforms, block diagrams, transfer functions for different type of systems, block diagrams reduction techniques; Signal flow graphs and Mason's gain formula.

Control hardware and their models: Potentiometers, synchros, LVDT, DC and AC servo motors, tachogenerators, electro-hydraulic valves, and pneumatic actuators.

Time-domain analysis: Time domain performance criterion, transient response of first order, second order and higher order systems; Steady state errors: Static and dynamic error constants, system types, steady state errors for unity and non unity feedback systems, performance analysis for P, PI and PID controllers.

Frequency-domain analysis: Bode and polar plots, frequency-domain specifications, correlation between transient response and frequency response.

Stability analysis: Concept of stability by Routh stability criterion, Nyquist stability criterion, gain and phase margins, relative stability, constant M and N circles, Nichol's chart and its application.

Root-locus technique: Nature of root-locus, rules of construction, root-locus analysis of control systems.

Compensation: Types of compensation, Proportional, PI and PID controllers; Lead-lag compensators.

State-space concepts: Eigen values and eigen vectors; Solution of state equations; Controllability; Observability; pole placement result, Minimal representations(**if time permits**).

Non-Linear systems: Characteristics of non-linear systems, types of non-linearities, phase-plane analysis, limit cycles and describing functions (**if time permits**).

References:

1. Nagrath I. J. and Gopal M., Control System Engineering.
2. Kuo B. C., Automatic Control Systems.
3. Ogata K., Modern Control Engineering.
4. Gopal M., Control Systems: Principle and Design.
5. NPTEL Video Lectures on Control Engg. by Prof. S. D Agashe.
6. NPTEL Lecture Notes on Control Systems by Prof. M. Gopal.
7. Dorf R. C. and Bishop R. H., Modern Control Systems.
8. Norman S. N., Control Systems Engineering.
9. IEEE Transactions on Automatic Control.
10. IEEE Transactions on Control Systems Technology.