EE602 Control System Applications

Credit: 2.5-0.5-0-3 Approval: Approved in 2nd Senate

Prerequisite: Consent of the faculty member

Students intended for: MS/PhD

Elective or Core: Elective Semester: Odd/Even

Course objective:

The course 'Control Systems Application' is primarily a project development/problem solving based course. This course is intended to introduce mainly linear control theory & a brief introduction to non-linear control theory to the MS/PHD students having minimum knowledge/experience of the subject and to encourage them to apply the theory/techniques learned to their respective research areas. A good multi-disciplinary research outcome is expected.

Course content:

1. **Basic concepts**: Introduction, basic terminology, objective of subject, some basic examples, Notion of feedback; open- and closed-loop systems.
2. **Mathematical Models**: Representation of physical systems and analogous systems, Lapalce transforms, block diagrams, transfer functions for different type of systems, block diagrams reduction techniques; Signal flow graphs and Mason's gain formula.
3. **Control hardware and their models**: Potentiometers, synchros, LVDT, DC and AC servo motors, tachogenerators, electro-hydraulic valves, and pneumatic actuators.
4. **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.
5. **Frequency-domain analysis**: Bode and polar plots, frequency-domain specifications, correlation between transient response and frequency response.
6. **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.
7. **Root-locus technique**: Nature of root-locus, rules of construction, root-locus analysis of control systems.
8. **Compensation**: Types of compensation, Proportional, PI and PID controllers; Lead-lag compensators.
9. **State-space concepts**: Eigen values and eigen vectors; Solution of state equations; Controllability; Observability; pole placement result, Minimal representations.

Text & Reference Books:

Nagrath I. J. and Gopal M., Control System Engineering.

Kuo B. C., Automatic Control Systems.

Ogata K., Modern Control Engineering.

Gopal M., Control Systems: Principle and Design.