

7. List of Topics: 321CPE – Automatic Control Systems

List of Topics for Theory:

- **Introduction:** Terminology and basic structure, Mathematical modeling of mechanical, electrical, thermal, hydraulic and pneumatic systems. Industrial control devices: Potentiometers, DC and AC servo-motors, Open and closed loop systems: their merits and demerits.
- **Transfer Function & Block Diagram:** Transfer Functions of linear systems, Block Diagram representation, Block Diagram reduction techniques, and Signal Flow graph method.
- **Time Domain Analysis:** Time Response analysis of second order systems, Performance specifications in time domain. Stability concept. Steady state errors and error constants, static error coefficients. Root locus plots, examples, general rules for constructing root loci, analysis of control system by root loci.
- **Frequency Domain Analysis:** Routh-Hurwitz's stability criterion, Relationship between time and frequency response, Polar plot, Bode's Plot, Nyquist plot and Nyquist stability criterion, Relative Stability, Phase and Gain Margins.
- **Industrial Controllers & Controller Design:** Proportional (P), Proportional-Differential (PD), Proportional-Integral (PI) and Proportional-Integral-Differential (PID) controllers. Controller design considerations, lead compensation, lag compensation, lead-lag compensation.

List of Topics for Laboratory:

- Finding zeros and poles of a transfer function using MATLAB control system toolbox.
- Block Diagram simplification and transfer function extraction using MATLAB control system toolbox.
- Time Domain Analysis: Obtaining the unit-step response of a second order transfer function system using MATLAB control system toolbox
- Time Domain Analysis: Obtaining the rise time, peak time, maximum overshoot and settling time of unit-step response of a second order transfer function system using MATLAB control system toolbox.
- Time Domain Analysis: Obtaining the unit-impulse response of a second order transfer function system using MATLAB control system toolbox
- Time Domain Analysis: Obtain the time response of a system with given transfer function when the input is $r(t) = e^{-0.5t}$ using MATLAB control system toolbox
- Finding various responses Using SIMULINK
- Stability of the systems using Routh – Hurwitz criteria
- Root locus plot
- Bode Plot
- Transfer function modeling and Speed Control of the DC Motor (Labview and Elvis II board)
- Position Control of the Stepper Motor (Labview and c-RIO)
- Position Control and Step Size variation of the Servo motor (Labview and c-RIO)
- Flight Control of the VTOL helicopter (Labview and Elvis II board)