Course Syllabi: UEI841: Advanced Control Systems (L : T : P :: 3 : 1 : 0)

1. **Course number and name**: UEI841: Advanced Control Systems

2. **Credits and contact hours**: 3.5 and 4

3. **Text book, title, author, and year**

   Text Books / Reference Books

   - *Slotine& Li, Applied Non-Linear Control,* Englewood Cliffs, NJ: Prentice-Hall, (1991).
   - *Bandyopadhyay, M.N., Control Engineering: Theory and Practice, Prentice-Hall of India Private Limited (2003).*
   - *Ogata, K., Discrete-time Control Systems, Pearson Education (2005).*

   a. Other supplemental materials
   - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Nonlinear Control Systems: Introduction to Nonlinear systems and their properties, Common Non-linearities, Describing functions, Phase plane method, Lyapounov's method for stability study, concept of Limit Cycle.

   Optimal Control Theory: Introduction, Optimal control problems, Mathematical procedures for optimal control design: Calculus of variations, Pontryagin's optimum policy, Bang-Bang Control, Hamilton-Jacobi Principle.

   z-Plane Analysis of Discrete-Time Control Systems: Introduction, Impulse sampling and data hold, Reconstructing original signal from sampled signals, concept of pulse transfer function, Realization of digital controllers.

   Design of Discrete-time Control Systems: Introduction, Stability analysis of closed-loop systems in the z-plane, Transient and steady state response analysis, Design based on the root-locus method, Design based on the frequency-response method.

   State-Space Analysis: Introduction, State-space representations of discrete-time systems, Solving discrete-time state-space equations, Pulse transfer function matrix, Discretization of continuous time state space equations, Lyapunov stability analysis, Controllability and Observability, Design via pole placement, State observer design.

5. **Specific goals for the course**

   After the completion of the course, the students will be able to:

   - Demonstrate non-linear system behavior by phase plane and describing function methods.
   - Perform the stability analysis nonlinear systems by lyapunov method develop design skills in optimal control problems.
   - Derive discrete-time mathematical models in both time domain (difference equations, state equations) and z-domain (transfer function using z-transform).
   - Predict and analyze transient and steady-state responses and stability and sensitivity of both open-loop and closed-loop linear, time-invariant, discrete-time control systems.
   - Acquire knowledge of state space and state feedback in modern control systems, pole placement, design of state observers and output feedback controllers.

6. Brief list of topics to be covered

- Nonlinear control system
- State space analysis
- Optimal control theory
- Discrete time control system