Course Syllabi: UEI501 Control Systems (L : T : P :: 3 : 1 : 2)

1. **Course number and name:** UEI501; Control Systems

2. **Credits and contact hours:** Credits: 4.5; Hours: 6

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

   - *Gopal, M., Digital Control System, Wiley Eastern (1986).*
   - *Nagrath, I.J. and Gopal, M., Control System Engineering, New Age International (P) Limited, Publishers (2003).*
   - *Ogata, K., Modern Control Engineering, Prentice-Hall of India Private Limited (2001).*
   - *Kuo, B.C., Automatic Control System, Prentice-Hall of India Private Limited (2002).*
   - *Sinha, N.K., Control System, New Age International (P) Limited, Publishers (2002).*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

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

   Basic Concepts: Historical review, Definitions, Classification, Relative merits and demerits of open and closed loop systems
   Mathematical Models of Physical Systems: Linear and non-linear systems, Transfer function, Mathematical modeling of electrical, Mechanical, Thermal, Hydraulic and pneumatic systems, Analogies, Block diagrams and signal flow graphs.
   Components: AC and DC servomotors and tachogenerators, Potentiometers, Synchros, Stepper motors.
   Analysis: Time and frequency domain analysis, Transient and frequency response of first and second order systems, Correlationship between time and frequency domain specifications, Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.
   Stability: Definition, Routh-Hurwitz criterion, Root locus techniques, Nyquistcriterion, Bode plots, Relative stability, Gain margin and phase margins, M and N circles, Nichol's charts
   MATLAB: Introduction, Applications in solution of control system problems.
   Compensation: Lead, Lag and lag-lead compensators, Design of compensating networks for specified control system performance.
   Components: D.C. and A.C. Servomotors, D.C. and A.C. Tachogenerators, Potentiometers and optical encoders, Synchros and stepper motors, Introduction to PLCs, their hardware and ladder diagram programme.
   State Space Analysis: Concepts of state, State variables and state models, State space equations, Transfer function, Transfer model, State space representation of dynamic systems, State transition matrix, Decomposition of transfer function, Controllability and observability.
   Laboratory Work
   Linear system simulator, Compensation design, D.C. position control and speed control, Synchro characteristics, Servo demonstration, Stepper motor, Potentiometer error detector, Rate control system, Series control system, Temperature control system.

5. **Specific goals for the course**

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

- Distinguish between open loop and closed loop systems.
- Develop the mathematical models of different physical systems.
- Analyze the stability of a given control system.
- Explain the concept of modern control theory.

6. **Brief list of topics to be covered**
    - Mathematical Models of Physical Systems
    - Components
    - Analysis
    - Stability
    - Compensation
    - State Space Analysis