PEI 105 : PROCESS MODELING AND CONTROL

L	T	P	Cr
3	1	0	3.5

Course objective: To understand the concepts of process model and control, to enable to develop model and simulation of process control

Static and Dynamic characteristics: Dynamic analysis of instrumentation system, Relative merits of analytical and experimental modeling of dynamic behavior, Response system to step, Pulse, Harmonic and random test signals, Frequency spectra, Auto correlation spectral density, Loading effects under static and dynamic conditions.

Simulation and Modelling: Importance of simulation, Terms used Simulation, Mathematical modeling, Process dynamics of fluid flow and heat transfer systems, Mass transfer dynamics and distillation column, Reaction kinetics of chemical processes. Modeling of chemical processes like CSTR, single tank / multi-tank system and Distillation column, study the behaviour of above mentioned systems for various test signals , analysis of PID controller response.

Advanced Control Schemes: Structure, analysis and application of Cascade control, Selective control, Ratio Control, Design of steady state and dynamic feed forward controller, Feed forward combined with feedback control, Structure, analysis and applications of inferential control, Dead time and inverse response compensators, Concepts and applications of Adaptive control, Model reference adaptive control, Self tuning regulator.

Design of Multi-loop Controllers: Interactions and decoupling of control loops. Design of cross controllers and selection of loops using Relative Gain Array (RGA).

Digital Control: Sampling and reconstruction, Transform analysis of sampled–data systems: z–transform and its evaluation, Inverse z–transform, Theorems of z–transform, Modified z–transform, Mapping of j–plane to z–plane, Pulse transfer function, Stability analysis in z–plane, Mapping approximation of z–transform, Numerical solution of differential equations, Implementation of digital controller, case studies.

Discrete Event System Modelling: Introduction to various methods of modelling, Automata theory, Introduction to Petri Nets.

State Space Analysis: State space representation of continuous and discrete time control systems, Converting a continuous and discrete time system into its state space equivalent using MATLAB, Control theory, State space concepts, State variables, Pole placement design and state observes, Controllability and Observability of linear time invariant systems and the relation between them. Stability analysis, Definition, First and second method of Liapunov, Stability analysis of linear systems.

Laboratory work (if any): Nil

Minor Project:

1. Implementation of advance control schemes such as cascade, feed forward etc using Matlab.
2. To develop state space model of physical system.
3. To perform state space analysis of physical system.

Course learning outcome (CLO): After the completion of the course the students will be able to

1. Perform static and dynamic analysis of existing instrumentation system
2. Model and simulate instrumentation system
3. Implement advanced control schemes for different process.
4. Design multi-loop controllers and digital controller and model discrete event system.
5. Analyse the system using state space analysis.
6. Apply fundamentals to real time control problems.

Recommended Books:

1. *Bequette, B.W., Process Control: Modeling, Design And Simulation Prentice Hall of India (2003).*
2. *Harriott, P., Process Control, Tata McGraw Hill (2002).*
3. *Luyben, E., Essentials of Process Control, Tata McGraw Hill (1989).*

Evaluation Scheme:

S.No.	Evaluation Elements	Weightage (%)
	MST	30
	EST	45
	Sessionals (May include Assignments/ Projects/ Tutorials/ Quizes/ Lab Evaluations)	25