20PEB310E (Open Elective)					Process Dynamics and Control					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

- To teach the fundamental aspects of process dynamics and control, which includes developing dynamic models of processes, control strategies for linear time-invariant systems and instrumentation aspects.

UNIT 1 Introduction to Process Dynamics and Control **6 Hrs.**

Plant/Process, Sensors, Transmitters, Signal Conditioning, Feedback- Process Control Terminology: Manipulated Variables, Controlled Variables, Controlling Variables, Controller Efforts, set point /target Variables, Measured and Unmeasured Variables - Block diagram, Transfer Function, Importance of Negative and Positive Feedback - Introduction to industrial automation: Distributed Control System, SCADA, A/D, D/A, Data Acquisition.

7 Hrs.

UNIT 2 Process Modeling and Simulation

First Principle based Modeling (Conservation Laws) - Different types of mathematical representation of a process/system : Mathematical model in form of a differential equation , transfer function and state space equations - First Principle based modeling of Mechanical Systems: Rotational and Transitional mechanical systems such as Spring-Mass-Damper, Suspension System etc., Electrical Systems: F-C analogy, F-V analogy, DC Motor, Electrical Systems Analogy with mechanical systems, Chemical Systems: Single Tank, Two Tank, Four Tank, CSTR etc., Electro-mechanical systems: electrically suspended ball - Linear Models and Deviation Variables - Linear Models and Deviation Variables: Taylor's series expansion and linearization, Concept of deviation variables, MATLAB exercise - Numerical Solution of linear and Non-linear Algebraic and Ordinary Differential Equations.

10 Hrs.

UNIT 3 Analysis of a Dynamic Behaviour of a System

Time Response Analysis - Order and type of the system, Error, Poles, Zeros, ZPK Form, MATLAB functions, Standard Test Signals, Behaviour of First Order System in response to standard test signals, Concept of time constant, Behaviour of Second Order System - Time Response Specifications: Settling Time, Rise Time, peak time, Damping, dead time, speed of the response, Maximum Peak Overshoot Special behaviour of processes: Overshoot, Undershoot, Inverse Response, Integrating Process, Unstable systems, Minimum and Non-minimum Phase Behaviour, Processes with dead time – Concept of Characteristic Equation, Routh-Hurwitz Criterion for stability analysis - Frequency Response Analysis - Frequency Response Specifications: Bandwidth, Gain cross-over frequency, Phase cross-over frequency, Gain Margin, phase Margin, cut off frequency, Resonance Peak etc. Stability analysis using Bode Plots, Polar Plots and Nyquist Plots

3 Hrs.

UNIT 4 Industrial Automation

Conventional controller such as P, PI, PID controllers, tuning of PID controllers, Introduction to programmable logic controllers

Max. 30 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 -Fundamental understanding of process control strategies and process design
CO2 - Describe the dynamic behaviour of the first order and second order process
CO3 - Apply mathematical transformations to solve differential equations
CO4 - Analyze feed-forward and backward control system
CO5 - Evaluate the advance control strategies
CO6 - Design of SISO and MIMo models

TEXT/REFERENCE BOOKS

1. B. A. Ogunnaike, W. H. Ray, "Process Dynamics, Modeling and Control", Oxford University Press, 1994.
2. Seborg, Edgar and Mellichamp, "Process Dynamics and Control", John Wiley, 2nd Edition, 2004.
3. J.F. Franklin, J.D. Powell, A. Emami-Naeini, "Feedback control of dynamic systems", Addison- Wesley Publishing Company, 1994.
4. B. Wayne Bequette, "Process Control: Modeling, Design, and Simulation", Prentice-Hall of India, 2006.
5. Katsuhiko Ogata, "Modern Control Engineering", Prentice-Hall, 3rd Edition, 2006.Toby Darling, Well logging and Formation Evaluation, Gulf Professional Publishing, Elsevier Science<Book-2>

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Short Notes, Problems, Numerical> <5-7 > Marks (each)

Part B/Question: <Justification, Criticism, Long answers, Interpretation > <8-10> Marks (each)