BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

INSTRUCTION DIVISION

SECOND SEMESTER 2015-2016

Course Handout (Part II)

Date: 13/01/2016

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : CHE F342
Course Title : Process Dynamics and Control
Instructor-in-charge : HARE KRISHNA MOHANTA
Instructor (Tut/Prac) : Pradipta Chattopadhyay, Srinivas Appari

Course Description:
Dynamic modeling and simulation of momentum, energy, mass transfer and reacting systems; analysis of the dynamic behaviour of lumped and distributed parameter systems; analysis and design of simple feedback and advanced control systems; design of control systems with multiple input and multiple output; introduction to computer control.

Scope and Objective of the course:

This course deals with the design of the control systems for chemical processes, not as a mathematical problem, but as an engineering task with all its attractive challenges and practical shortcomings using the fundamental concepts of process dynamics as the basis. The course aims to help the student in the selection of the best among the several alternative control configurations usually possible for a given processing unit or a complete plant. Finally the course will familiarize the student with a plethora of analytical tools and design methodologies to be understood before attempting the process control problems.

Text Book:

Seborg, D. E., Edgar, T. F. and Mellichamp, D.A., "Process Dynamics and Control", 3rd Ed., John Wiley and Sons, 2011.

Reference Books:

1. Coughanowr, D.R., Process Systems Analysis and Control, 2nd Ed., McGraw-Hill, 1991.
2. George Stephanopoulos, Chemical Process Control: An Introduction to Theory and Practice, Prentice Hall, 1984.

Course Plan:

Lecture No.	Learning Objectives	Topics to be covered	Ref. to T.B Chap.
1-2	Introduction to process control	Need of process control, process control strategies, process control activities	1
3-5	Theoretical models of chemical process	Modeling principles, dynamic models, degrees of freedom analysis, solution of dynamic models	2
6	Laplace Transforms	Solution of differential equation	App. A
7-9	Transfer functions models	Development and properties of transfer functions, linearization of non-linear models, state-space and transfer function matrix models, use of MATLAB.	3
10-12	Dynamic Behavior of First and second order	Response of first and second order processes, use of MATLAB.	4

	Processes		
13-16	Dynamics response characteristics of more complicated processes	Poles and Zeros and their effects, Effect of time delays, Dynamic response of higher order systems, use of MATLAB.	5
17-20	Feedback controllers	Concept & type of feedback control, block diagram representation, response of PID controller, use of MATLAB.	7
21	Control system instrumentation	Transducers, transmitters, final control elements	8
Mid-Semester Test			
22-25	Process Safety and Process Control	Layers of protection, Alarm management, Abnormal event detection, Risk assessment.	9
26-27	Dynamic behavior and stability of closed loop system	Closed loop representation, transfer functions, stability analysis, use of MATLAB.	10
28-29	PID controller design and tuning	Performance criterion, Model based design, controller tuning relations, Use of Simulink in controller tuning.	11
30-32	Frequency response analysis and control system design	Bode, Nyquist, Gain and Phase margin, closed-loop frequency response and sensitivity functions, use of MATLAB.	13
33-35	Feed forward and ratio control	Ratio control, feed forward controller design based on steady state and dynamics equation, feed forward-feed-back controller, Use of Simulink	14
36-39	Enhanced single-loop control strategies	Cascade control, time-delay compensation, Inferential control, Override control, Nonlinear and adaptive control	15
40-42	Digital sampling, filtering and control	Signal processing, data filtering, tuning of digital PID controllers	17

Evaluation Schedule:

Component	Duration (Minutes)	Weightage	Date & Time	Remarks
Mid-Semester Test	90	95 (31.67%)	16/3 9:00 - 10:30 AM	CB+OB
Tutorial Tests (best 7 out of 8)	15-20	70 (23.33%)	During Tutorial Hour	CB/OB
Surprise Tests (3)	During Class hour	15 (5%)	Throughout the Semester	CB/OB
Comprehensive Examination	180	120 (40%)	11/5 FN	CB+OB

Chamber consultation hour: To be announced in the class.

Make-up Policy: Make-up will be granted only for genuine cases.

Notices: All notices concerning this course will be displayed in the Chemical Engineering Notice Board and in the on-campus Learning Management System, ***http://nalanda.bits-pilani.ac.in/***

Instructor-in-charge
CHE F342