BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
K. K. BIRLA GOA CAMPUS
SECOND SEMESTER 2019-2020
Course Handout Part II

Date: 07/01/2020

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 : AMOL DESHPANDE
Instructor (Tut/Prac) : Amol Deshpande

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:

1. Seborg, D. E., Edgar, T. F. and Mellichamp, D.A., "Process Dynamics and Control", 2nd Ed., John Wiley and Sons, 2004,

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	3
7-8	Transfer functions and state space models	Development and properties of transfer functions, linearization of non-linear models, state-space and transfer function matrix models	4

9-11	First and second order processes	Response of first and second order processes	5
12-14	Dynamics response of more complicated systems	Dynamic response of higher order systems	6
15-18	Development of empirical models from empirical data	Model development using non-linear regression, fitting first and second order models, neural network model, discrete time models, identification of systems	7
19-21	Feed back control	Concept & type of feedback control, block diagram representation, response of it, PID controller	8
22	Control system instrumentation	Transducers, transmitters, final control elements	9
23-24	Overview of Control system design	Influence of process design on process control, degrees of freedom for process control, Selection of variables	10
25-26	Dynamic behavior and stability of closed loop system	Closed loop representation, transfer functions, stability analysis	11
27-29	PID controller design and tuning	Performance criterion, Model based design, controller tuning relations	12
30-31	Control system design based on frequency response analysis	Bode, Nyquist, Gain and Phase margin, closed-loop frequency response and sensitivity functions	14
32-35	Feedforward and ratio control	Ratio control, feed forward controller design based on steady state and dynamics equation, feedforward-feed-back controller	15
36-38	Enhanced single-loop control	Cascade control, time-delay compensation, inferential control, adaptive control	16
39-42	Digital sampling, filtering and control	Signal processing, data filtering, tuning of digital PID controllers, minimum variance control	17

Evaluation Schedule:

EC no.	Evaluation component	Duration (min)	Weightage (%)	Date and time	Nature of component
1	Mid-Semester Examination	90	30	07/03/2020 (2:00 PM – 3:30 PM)	Closed Book
2	Surprise Quizzes/ Assignments /Attendance		30		Open Book
3	Comprehensive examination	180	40	05/05/2020 (FN)	Closed / Open Book

Chamber Consultation Hour: It will be announced in the class.

Notices: Notices, if any, related to the course will be uploaded on the Moodle.

Make-up: There will be no make-up for evaluation components/assignments/projects conducted in the class during lecture hour. Make-up for mid-semester and comprehensive examination will be granted only for genuine medical cases after producing related certificates/documents. Prior permission of IC is compulsory for all make-up cases.

Instructor-In-Charge
(CHE F342)