



SECOND SEMESTER 2018-2019

Course Handout Part II

Date: 07-01-2019

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 : Dr. Vikranth Kumar Surasani
Instructors : Dr. Vikranth Kumar Surasani
Prof. Balaji Krishnamurthy

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. **Course Description:** Dynamic modeling and simulation of momentum, energy, mass transfer and reacting systems; analysis of the dynamic behavior 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.

Textbooks:

1. Seborg, D. E., Edgar, T. F. and Mellichamp, D.A., "Process Dynamics and Control", 2nd Ed., John Wiley and Sons, 2004.
2. B. Wayne Bequette, "Process Control: Modeling, Design and Simulation" Prentice-Hall. Inc

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	Chapter in the Text Book
1-2	Introduction to process control	Need of process control, process control strategies, process control activities	T1-Chap 1, T2-Chap 1
3-5	Theoretical models of chemical process	Modeling principles, dynamic models, degrees of freedom analysis, solution of dynamic models	T1-Chap 2 T2:-Chap 2
6	Laplace Transforms	Solution of differential equation	T1-Chap 3 T2-Chap 3
7-8	Transfer	Development and properties of transfer functions, linearization of	T1-Chap. 4



	functions	non-linear models,	T2-Chap. 3
9-11	First and second order processes	Response of first and second order processes	T1-Chap. 5 T2-Chap. 3
12-14	Dynamics response of more complicated systems	Dynamic response of higher order systems	T1-Chap. 6 T2-Chap. 3
15-16	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	T1-Chap. 7 T2-Chap. 4
17-19	Feedback control	Concept & type of feedback control, block diagram representation, response of it, PID controller	T1-Chap. 8 T2-Chap. 5
20	Control system instrumentation	Transducers, transmitters, final control elements	T1-Chap. 9
21-22	Overview of Control system design	Influence of process design on process control, degrees of freedom for process control, Selection of variables	T1-Chap. 10
23-24	Dynamic behavior and stability of closed loop system	Closed loop representation, transfer functions, stability analysis	T1-Chap. 11 T2-Chap. 6
25-26	PID controller design and tuning	Performance criterion, controller tuning relations	T1-Chap. 12 T2-Chap. 6
27-31	Frequency response analysis	Bode, Nyquist, Gain and Phase margin, closed-loop frequency response, stability of closed loop system; Matlab control tool box.	T1-Chap. 14 T2-Chap. 7
32-35	Feedforward and ratio control	Ratio control, feed forward controller design based on steady state and dynamics equation, feedforward-feed-back controller	T1-Chap. 10 T2-Chap. 15
36-40	Enhanced single-loop control	Cascade control, time-delay compensation, inferential control, adaptive control	T1-Chap. 16 T2-Chap. 10

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Midsem Test	90 min	30	13/3 9.00 - 10.30AM	(30 %) CB (Require Matlab Simulink)
Class Tests (min 4)	20 min	15		CB (Require MATLAB Simulink)
2 assignments		10		OB (Require MATLAB Simulink)
Comprehensive Exam	3 hours	45	06/05	(15% OB+30% CB) (Require MATLAB Simulink)



Notes:

1. **Closed Book Test:** No reference material of any kind will be permitted inside the exam hall.
2. **Open Book Exam:** Use of any printed / written reference material (books and notebooks) will be permitted inside the exam hall. Computers/mobile of any kind will not be allowed inside the exam hall. Use of calculators will be allowed in all exams. No exchange of any material will be allowed.
3. Some of the tutorial sessions will be conducted in the CAD Laboratory for accommodating **MATLAB & Simulink**.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable

Chamber Consultation Hour: To be announced in the class.

Notices: All notices concerning this course will be displayed on the Chemical Engineering Notice Boards and CMS portal.

Make-up Policy: Make-up is granted only for genuine cases with valid justification and prior permission of Instructor-in-charge.

INSTRUCTOR-IN-CHARGE
Dr. Vikranth K Surasani

