BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
INSTRUCTION DIVISION
FIRST SEMESTER 2016 -2017
Course Handout (Part II)

Date: 02/08/2016

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 F471
Course Title : Advanced Process Control
Instructor-in-Charge : Srinivas Appari

Course Description

Process identification and adaptive control; Model predictive control structures; Model-based control structures; State estimations; Intelligent control; Synthesis of control systems – some case studies.

Scope and Objective

This course is designed to study different important advanced control methodologies that are able to solve efficiently many industrial challenges. It covers the synthesis of several advanced control schemes supported by the process dynamics and simulation. The primary objective of this study is to select and to develop a suitable advanced control technique for achieving excellent closed-loop process responses.

Text Books:

T1: Bequette, B. W. "Process Control: Modeling, Design, and Simulation," Prentice-Hall of India Private Limited, New Delhi, 1st ed., 2003.
T2: Mohanta, H.K. Patle, D.S., and Pani, A.K. "Advanaced Process Control," Lecture Notes for the Course CHE C473: Advanced Process Control, Educational Development Division, BITS Pilani (Rajasthan), 2010.

Reference Books:

R1: Seborg, D. E., Edgar, T. F. and Mellichamp, D.A., "Process Dynamics and Control", 3rd Ed., John Wiley and Sons, 2011.
R2: Chidambaram, M. "Computer Control of Processes," Narosa Publishing House, New Delhi, 1st ed., 2002.
R3: Ogunnaike, B. A. and Ray, W. H. "Process Dynamics, Modeling, and Control," Oxford University Press, New York, 1st ed., 1994.
R4: Ray, W.H. "Advanced Process Control," McGraw-Hill Book Company, New York, 1981.

Course Plan:

Lecture No.	Learning objectives	Topics to be covered	Reference Chap/Sec.(Book)
1 – 8	Simulation of process control systems	Numerical integration using MATLAB, Introduction to SIMULINK	Module 1 & 2 (T1)

9 – 11	PID Controller Tuning	Closed-loop oscillation-based tuning, Tuning rules for FOPTD processes, Direct synthesis	6 (T1)
	Internal Model Control (IMC)	IMC Background, IMC Structure, IMC Design Procedure, IMC-Based PID Procedure	8,9 (T1)
12 – 14	Cascade and Feedforward Control	Cascade Control, Cascade IMC, Feedforward Control, Feedforward controller design, Feedforward control in the IMC Structure, Nonlinear PID Control	10,11 (T1)
15 – 16	Ratio, Selective and Split-range control	Ratio control, Selective and Override control, Split-Range Control	12 (T1)
17 – 20	Control-Loop Interaction	General pairing problem, Relative Gain Array, Application of RGA, RGA and sensitivity, Decoupling	13,14 (T1)
Mid-Semester Test			
21 – 23	Sampling and z-Transforms	Clamping, Impulse modulation, z-Transform, Digital PID control	7 (T2)
24 – 28	Process Identification	Empirical models, First- and Second-Order Models.	1 (T2)
29 – 31	Artificial Neural Network	Linear and Nonlinear Transformation. Back Propagation algorithm	2 (T2)
32 – 34	Fuzzy logic control	Fuzzy sets, Fuzzy variables, Fuzzy Logic Control	8 (T2)
35 – 37	Model Predictive Control	Optimization problem, Dynamic Matrix Control, Model Algorithmic Control	16 (T1)
38-40	State Estimation	Controllability and Observability; Kalman filter estimator.	13-14 (T2)
Self Study	Model Reference Adaptive Control, Globally Linearized Control, Generic Model Control, Statistical Process Control; Introduction to LabView		

Evaluation Scheme:

EC No.	Evaluation component (EC)	Duration (Minutes)	Weightage (Marks)	Date and time	Nature of component
1	Mid Semester Test	90	30%	<TEST_1>	CB+OB
2	Assignments -5	-	20%	-	Continuous
3	Project	-	10%	-	Continuous
4	Comprehensive examination	180	40%	<TEST_C>	CB+OB

Chamber consultation hour: To be announced in the class.
Make-up policy: Make-up will be granted only for the genuine cases.
Notices: All notices concerning this course will be displayed in the Chemical Engineering.

Instructor-in-charge
CHE F471