



BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

INSTRUCTION DIVISION

FIRST SEMESTER 2015-2016

Course Handout (Part II)

Date: 03/08/2015

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 : AJAYA KUMAR PANI

Course Description

Process identification and adaptive control; Model predictive control structures; Model-based control structures; Multivariable control; 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: Mohanta, H.K. Patle, D.S., and Pani, A.K. "Advanced Process Control," Lecture Notes for the Course CHE C473: Advanced Process Control, Educational Development Division, BITS Pilani (Rajasthan), 2010.
T2: Bequette, B. W. "Process Control: Modeling, Design, and Simulation," Prentice-Hall of India Private Limited, New Delhi, 1st ed., 2003.
T3: Seborg, D. E., Edgar, T. F., and Mellichamp, D. A. "Process Dynamics and Control," John Wiley & Sons, Inc., New Jersey, 2nd ed., 2004.

Reference Books:

- R1: Marlin T.E., "Process Control", Tata McGraw Hill, 2nd Edition, 2000
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	Basic process control and MATLAB Application	Review of basic process control system, Use of MATLAB for modeling, closed loop simulation	Class notes



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9 – 11	PID Controller Tuning	Closed-loop oscillation-based tuning, Tuning rules for FOPTD processes, Direct synthesis	4 (T1)
12 – 14	Enhanced Single Loop Control	Cascade Control, Smith Predictor, Soft sensor and Inferential Control, Override Control.	5, 15 (T1)
15 – 16	Feedforward and Ratio Control	Feedforward Control, Ratio control.	6 (T1)
17 – 20	Sampling and z-Transforms	Clamping, Impulse modulation, z-Transform, Digital PID control	7 (T1)
21 – 23	Process Identification	Empirical models, First- and Second-Order Models.	1 (T1)
24 – 28	Artificial Neural Network	Linear and Nonlinear Transformation. Back Propagation algorithm	2 (T1)
29 – 31	Fuzzy logic control	Fuzzy sets, Fuzzy variables, Fuzzy Logic Control	8 (T1)
32 – 34	Control-Loop Interactions	General pairing problem, Relative Gain Array, Application of RGA, RGA and sensitivity	13 (T2)
35 – 37	Model Predictive Control	Optimization problem, Dynamic Matrix Control, Model Algorithmic Control	9 (T1)
38-40	State Estimation	Controllability and Observability; Kalman filter estimator.	13-14 (T1)
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	90	10/10 2:00 - 3:30 PM	Closed and Open Book
2	Projects	-	70		Continuous
3	Class participation	-	20		Continuous
4	Comprehensive examination	180	120	14/12 FN	Closed and Open Book

Chamber consultation hour: Tuesday 5 PM to 6 PM

Make-up policy: Make-up will be granted only when one attends more than 75% classes and has genuine reason(s) for not appearing in the regular test.

Notices: All notices concerning this course will be uploaded in the on-campus Learning Management System, <http://nalanda.bits-pilani.ac.in/>

Instructor-in-charge
CHE F471



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