

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (30)

ADVANCED PROCESS CONTROL

SUBJECT CODE: 2723009

SEMESTER: II

Type of course: Chemical Engineering

Prerequisite: Basics of Process Control at undergraduate level.

Rationale: Advanced process control is concerned with the usage of techniques for control of digital systems, systems operating under constraints, optimal control that takes into account control efforts and control of multivariate processes.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
		ESE			OEP	PA	RP			
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction: Review of dynamic behavior of linear systems and control system design for linear closed loop systems, Laplace Transforms	3	5
2	Analysis and Design of Advanced Control Systems: Feedback control of systems with large dead time, Cascade control, Feedforward control, Ratio control, Feedforward-Feedback control, Adaptive control, Inferential Control.	15	28
3	Discrete- Time control systems: Sampling and Z-Transform, Open-Loop and Closed-Loop response, Stability analysis of discrete-time control systems. Disc	10	18
4	Multiple-Input, Multiple-Output (MIMO) Systems: Introduction to MIMO systems, degrees of freedom and number of controlled and manipulated variables, generation of alternative loop configurations, extension to interacting systems.	12	23
5	Analysis of Nonlinear Control Systems: Examples of nonlinear Systems, Methods of Phase-Plane analysis.	10	18
6	Design of control systems for complete plant: Case Studies	4	8

Reference Books:

1. Chemical Process Control: George Stephanopoulos, Prentice Hall India Pvt. Ltd.
2. Process Systems Analysis and Control: Donald Coughanowr, McGraw-Hill, Inc.

3. Process Control and Instrumentation: Prof. R. P. Vyas, Central Techno Publications, Nagpur
4. Process Dynamics and Control: D. E. Seborg, T. F. Edgar, D. A. Mellichamp, Wiley.
5. Control System Design: Graham C. Goodwin, Stefan F. Graebe, Mario E. Salgado, Prentice Hall

Course Outcome:

After learning the course the students should be able to:

- Analyze and design advanced control systems.
- Understand industrial applications of control theory.
- Learn the complex control techniques.
- Identify, formulate and solve problems for control system design of complete chemical plant.

List of Experiments: (Any Five)

1. Dynamic behavior of a Pneumatic control valve
2. Temperature control using PID controller
3. Pressure control using PID controller
4. Characterization of a control valve
5. Tuning of controller parameters
6. Dynamics of higher order systems
7. Hydraulic Trainer

Design based Problems (DP)/Open Ended Problem:

The practical work at masters must be largely consisting of OEP. In each case a sample set may be provided and the faculty member may be empowered to select appropriate problems for practical work. At the end of semester before submission of marks of PA and term work, the faculty member will upload the three best problems done by the students during the practical hours. The title area of project with practical problem along with the complete details and names of the students and name of the supervisor, branch and name of the college be specified so that this information can be published from GTU website.

Open Ended projects in Advanced Process Control may include

- Working, non working models of different control valves
- PID diagrams case studies
- Laboratory scale closed loop control system design using PID controllers etc.

Major Equipments:

- Pneumatic Control Valve
- PID controllers
- Single stage heat exchange process with controller
- Hydraulic Trainer

List of Open Source Software/learning website:

- NPTEL lecture series
- Literature available on Process Control
- MIT Open course lecture on Process Control

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website