GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (COMPUTER AIDED PROCESS DESIGN) (16)

COMPUTERISED PROCESS CONTROL (CPC)

SUBJECT CODE: 2711603

SEMESTER: I

Type of course: Core-I (M.E.CAPD)

Prerequisite: --

Rationale: --

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (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	**Industrial Automation:** Overview, Introduction, Aims of plant automation, Computer-based plant automation concepts, Distributed computer control.	6	10
2	**Computers and Interfacing :** Introduction to Computers, Computer interfacing for data acquisition and control, Data acquisition and control by using std. add-on-cards.	6	10
3	**The Control of Chemical Process:** Characteristics and Associated Problems, Incentives for chemical process control, Design aspects and Hardware for a process control system.	6	10
4	**Distributed Digital Control Systems :** Advantages of DCC, Process control requirements of computers, Computer network - multi-mini computer architecture, peer-to-peer and server based networks, network topology, network adapter card, software; Selection of a suitable DICS, Interconnection of networks, Communication in distributed control systems, Logical topology, Ethernet card, Selection of operator interface, ERP and process control.	6	10
5	**Examples of Experimental Computer Control of Processes:** Computer Control of liquid level system, a heat exchanger, a fed batch fermentor, Temperature Control for plastic injection molding processes, On-line optimizing control of a distillation column.	6	10
6	**Control System & Controllers:** Dynamic Behavior First Order Control Systems, Multicapacity Control Systems, Analysis of Dynamic Behavior of Second Order Control Systems ,Block Diagram Algebra, Mechanism of Controllers and Control Valve, Dynamic Behavior of Controllers.	6	15
7	**Stability Analysis of Control Systems :** Stability for linear system, Routh-Hurwitz stability criterion,	6	10

	Limitations of the Routh test for stability, Root Locus diagram, Method of plotting the Root Locus diagram for negative feedback system.		
8	**Design of Control Systems using Frequency Response :** Frequency response of a first order system, Bode diagram, Bode diagram of first order system, First order systems in series, Bode diagram of second order system, Proportional controller; Bode diagrams for proportional derivative controller, proportional integral controller, proportional- integral-derivative controller & transportation lag parameter; The stability criterion, Phase and gain margins, Ziegler-Nichols optimum controller settings, Limitations of the Ziegler-Nichols method.	6	15
9	**Concepts of Measurement and Measuring Instruments :** Introduction, System configuration, Problem analysis, Basic characteristics of measuring devices, Calibration, Transducers and various Measuring Instruments for Process Control.	6	10

Reference Books:

1. Process Control Instrumentation Technology : Curtis Johnson, Prentice Hall India Pvt. Ltd.
2. Computer Control of Processes : M. Chidambaram, Narosa Publishing House
3. Process Control and Instrumentation : Prof. R. P. Vyas, Central Techno Publications, Nagpur
4. Chemical Process Control: George Stephanopoulos, Prentice Hall India Pvt. Ltd.
5. Process Instrumentation and Control : A. P. Kulkarni, Nirali Prakashan
6. Instrumentation Devices and Systems : C S Rangan, G R Sarma, V S V Mani; Tata McGrawhill

Course Outcome:

After learning the course the students should be able to:

1. Learn the Computer-based plant automation concepts.
2. Understand the Distributed computer control.
3. Design aspects and Hardware for a process control system.
4. Data acquisition and control by using std. add-on-cards.
5. Architect Computer network - multi-mini computer, peer-to-peer and server based networks, network topology, network adapter card.
6. Optimize the control of a distillation column.
7. Analyze Dynamic Behavior of Controllers.
8. Develop the method of plotting the Root Locus diagram for negative feedback system.
9. Configure the methods for measuring Instruments for Process Control.

List of Experiments:

Tutorials/Presentation/Practicals based on above topics.

Open Ended Problems:

1. Controller & Controlled Systems.
2. Non Linear Model Predictive Control of a High Purity Distillation Column.
3. Feedback Controller

Major Equipments:

Control Valve Characteristics, Temperature Control Trainer, Level control trainer, Interacting & Non Interacting system.

List of Open Source Software/learning website:

- www.mathworks.com/discovery/control-design-software.html
- www.eurotherm.com/products/
- www.ualberta.ca/CMENG/StudentGroups/ChESS/.../CPC%20Handout.pd...
- www.che.ttu.edu/pcoc/software/ppt_06/Chap01.PPT