SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology
Instrumentation and Control

B. Tech. III Semester-VI
Program: Honors- Control System and Sensor Technology

Subject Name: Advance Process Control **Subject Code: BTIC19622**

Type of course: Honors

Prerequisite (if any): Process Control, Industrial Measurement

List of Courses where this course will be prerequisite: Distributed Control System, Automation Systems

Rationale:
The purpose of this course is to provide an advanced treatment of the theory and practice of chemical process modeling and control. This course covers the advance process control techniques as Model Predictive Control, inferential control and adaptive control. This covers the techniques of controlling multi-variable and multi loop systems.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	0	2	5	60	25	15	30	20	150

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

BSC: basic science course /ESC: Engineering Science Course /HSM: Humanities and management /PCC: Professional Core course /PEC: professional Elective course /OEC: Open Elective course/ MD: mandatory noncredit course

Content:

Sr. No.	Content	Total Hrs	Module Weightage
1	**Introduction to advanced Control Schemes** Cascade, Feed-forward, ratio control,override control, split range control, valve position control	8	17%
2	**Statistical process control** SPC benefits, resources,tools,SPC charts	5	11%
3	**Multi variable control** Control loop interaction – general pairing problem, relative gain array and application, sensitivity. Multi-variable control – zeros and performance limitations, directional sensitivity and operability, decoupling,Multi-loop Control: Performance Analysis	8	18%
4	**Adapting single-loop control systems for non-linear processes** Analyzing a nonlinear process with linear feedback control,criteria for the deterministic modification of controller tuning,improving nonlinear process performance through cascade design	7	16%
5	**Inferential Control** Inferential control design criteria, Implementation issues	5	11%
6	**Level and Inventory control**	5	11%
7	**Single-Variable Model Predictive Control** The model predictive control structure,the IMC controller,The smith predictor,Algorithm Selection Guidelines	7	16%

Suggested Specification table with Marks (Theory): (For B Tech only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	**10%**	**10%**	**10%**	**10%**	**50%**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

Sr no	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Process Control Designing Processes and Control for Dynamic Performance	Thomas Marlin	Tata MC Graw Hill ISBN-13-**978-0070393622**	2012	2nd Edition
2	Process Control Systems	Shinskey	McGraw Hill,Singapore	1996	4th Edition
3	SPC : concepts, methodologies and tools	Zaidi, A.	Prentice Hall of India, ISBN:8120 309200 .	2003	
4	Process Systems analysis and Control,	D.R. Coughanour	McGraw-Hill,	1991.	2nd Edition
5	Advanced Process Control: Beyond Single Loop Control	Cecil L. Smith	Wiley,ISBN: 978-0-470-38197-7	2010	1st Edition

Course Outcomes:

After studying the subject, Student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain the concept of advanced control schemes used in process control.	20%
CO-2	design of controllers for interacting multivariable systems	20%
CO-3	Describe various statistical process control tools and techniques	20%
CO-4	Describe the techniques for inferential and nonlinear control system	20%
CO-5	Discuss the Model Predictive Control algorithm for control system with deadtime.	20%

How strongly Pos are addressed by each CO of a subject is indicated by level 1: Slight (Low)2: Moderate (Medium)3: Substantial (High)

Mapping CO-POs

	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**2**	**1**		**3**									**3**	**3**	**3**
CO2	**2**	**1**		**3**									**3**	**3**	**3**
CO3	**3**	**1**		**3**									**2**	**3**	**3**
CO4	**2**	**1**		**3**									**2**	**3**	**3**
CO5	**2**	**1**		**3**									**3**	**3**	**3**

List of Open learning website:

- https://nptel.ac.in/
- https://swayam.gov.in/

List of Open Source Software:

FOR LAB SESSIONS:

List of Experiments:

1. For given measurement data, apply statistical tools for analysis of them.
2. Draw various chart using measrument data and describe the chart.
3. PID tuning for cascade control system.
4. Use model predictive controller for linear plant, disturbance, and noise models to estimate the controller state and predict future plant outputs.
5. For a given transfer function matrix and RGA are given for a binary distillation tower. Discuss the integrity for the two loop pairings.
6. For a given Process Example of Binary distillation(ref. Thomas marlin) Calculate the RGA, RDG and tuning and Predict performance.
7. Design control system to minimize fuel consumption for a specified feed rate.where control objectives.: 1. Maintain TC at a desired value (set point) 2. Maintain feed flow at a desired value (set point) 3. Minimize the fuel to the fired heater

Major Equipment Needed: Computers, simulation software matlab/scilab,PC