# SARVAJANIK UNIVERSITY
## Sarvajanik College of Engineering and Technology

**Bachelor of Technology (B. Tech.)**
**Instrumentation and Control**

## B. Tech. III Semester – V

**Subject Name: Advance Instrumentation for Process Control** **Subject Code: BTIC15604**

**Type of course:** Institute open Elective

**Prerequisite (if any):** concepts of physical measurements, Basics of sensors and measuring instruments, Mass Transfer Operation-I, Heat Transfer.

**List of Courses where this course will be prerequisite :** Process control, Basic calculation and Operation in Chemical Industries, Chemical Reaction Engineering-I

**Rationale:** In the process industries like petrochemical, chemical, cement, textile, power plant, pulp & paper, certain sub-processes are part of the main process stream. For continuous production, it is very much important to know the dynamic behavior of such process units and their control. The content of this subject focuses on such sub-processes and it's control

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**Teaching and Examination Scheme:**

| TEACHING SCHEME | | | | Theory Marks | | | Practical Marks | | Total |
|---|---|---|---|---|---|---|---|---|---|
| L | T | P | C | TEE | CA1 | CA2 | TEP | CA3 | |
| 2 | 0 | 2 | 4 | 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**

**Content:**

| Sr. No. | Content | Total Hrs | Module Weightage |
|---|---|---|---|
| 1 | **Instrumentation for Process Industries:** Introduction -Instrument symbols & Tag numbering system -wiring system, Chemical Process P&ID & its symbol. Process flow diagram, line sizing /numbering for different process control system. Control valve Terminology, types and control valve Characteristic. | 4 | 14% |



**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 non-credit course**

***w.e.f. AY 2021-22***

| | | | |
|---|---|---|---|
| **2** | **Signal Convertors**<br>Signal Converting Elements Pneumatic to electrical convertors, Electric to Pneumatic convertors | **4** | **14 %** |
| **3** | **Basic Control of Boiler**<br>Types of boiler, P&ID of boiler, single element, two element and three element boiler drum control. | **5** | **16 %** |
| **4** | **Basic Control of Chemical Reactors**<br>Types of reactions and reactors factors governing the conduct of reaction, P&ID of reactor control, flow control, temperature control, pH control. | **5** | **16 %** |
| **5** | **The Control of Distillation Column** P&ID of distillation system, different control strategies for distillation, column feed control, column pressure control, control of overhead and bottom composition, distillate reflux flow control. | **5** | **16 %** |
| **6** | **The Control of Heat exchanger:** Types of heat exchanger, P&ID of heat exchanger control, different control strategy for heat exchanger. | **4** | **14%** |
| **7** | **Introduction of SCADA,PLC and DCS system**<br>Basic block diagram of PLC, SCADA,DCS. Input output of PLC system. | **3** | **10%** |

**Suggested Specification table with Marks (Theory):**

| **Distribution of Theory Marks** | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **10 %** | **40 %** | **20 %** | **10 %** | **10 %** | **10 %** |

**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 Measurement and Analysis | B. G. Liptak | CRC Press<br>ISBN-978-0849310836 | 2003 | 4th Edition |
| 2 | Instrument Engineers Handbook of Process Control | Bela G Liptak , Chilton book co. | Butterworth-Heinemann<br>ISBN- 978-0750622554 | 2013 | 3rd Edition |
| 3 | Process Instrumentation and control Handbook | Considine, Mc-Graw | McGraw-Hill<br>ISBN -0070124280<br>ISBN- 978-0070124288 | **1974** | -- |

| | | | | | |
|---|---|---|---|---|---|
| 4 | Process Dynamics and Control | Dale E. Seborg, John Wiley & Sons | John Wiley & Sons ISBN-978-1-119-28591-5 | 2016 | 4th Edition |
| 5 | Process Control | Peter Harroitt | Tata-McGraw Hill, ISBN -0070993424 ISBN 978-0070993426 | **2017** | 5th Edition |
| 6 | Chemical Process Control | George Stephonopolous | Pearson Education India ISBN 9789332549463 ISBN 978-9332549463 | 2015 | First Edition |
| 7 | Programmable logic controller | Frank D. Petruzella | Mc Graw Hill ISBN13: 9781264163342 2023 | 2023 | 6th Edition |

**Course Outcomes:**
After learning the course the students should be able to:

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | Explain basic fundamentals of instrumentation and process | 25% |
| CO-2 | Select and employ control system components like transmitters, converters, scontrol valves for process loop setup | 25% |
| CO-3 | Apply relevant concept to design and analyse the process and instrumentation diagram (P&ID) for project engineering of process plants | 20% |
| CO-4 | Describe the hardware structure of PLC and interfacing of input-output modules, power supply and computer with PLC. | 10% |
| CO-5 | Select, design and apply control strategies to control the heat exchanger, Boiler, Chemical Reactor and Distillation Column | 20% |

**Mapping with POs:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-1** | 1 | 2 | | 2 | 2 | | | | | | 3 | | 3 | 3 | 3 |
| **CO-2** | | 2 | | | | 3 | 3 | | 2 | | 2 | | 2 | 2 | |
| **CO-3** | 1 | | 2 | | | 3 | | | | 1 | | | 2 | | 3 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO-4** | | 2 | | 3 | | | 3 | 3 | | | 3 | 3 | | 3 | |
| **CO-5** | 2 | | 1 | | 1 | | 3 | | 1 | | 2 | | 3 | | 1 |

**List of Open Source Software/learning website**:
http://www.nptel.ac.in/courses/105102089/9
http://nptel.ac.in/video.php
https://www.vlab.co.in

**List of Open Source Software: Not applicable**
**FOR LAB SESSIONS:**

## List of Experiments:

1. Study of Heat Exchanger control
2. Study of Boiler control
3. Study of Distillation Column
4. Study of flow control loop using PID controller
5. Study of Level Control loop using PID controller
6. Simulation study of cascade control preferably for chemical process.
7. Simulation study of feed-forward control preferably for chemical process.
8. Simulation study of ratio control preferably for chemical process.
9. Implement temperature control system with PID controller or ON OFF controller

Try to obtain the mathematical mode of Tubular heat exchanger with theoretical background and chemical/mechanical engineering. Propose a control strategy for the heat exchanger. Also discuss various issues in control of the heat exchanger.
Major Equipment:
Computers, simulation software, multi loop/ single loop control system, etc.