SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology

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

B. Tech. - III Semester – V

Subject Name: Control System Components **Subject Code: BTIC13503**

Type of course: Professional Core Course

Prerequisite (if any): Industrial Measurement -1, Basic principles and laws of physics

List of Courses where this course will be prerequisite: Process dynamics and control, Process control, Building Automation, power plant instrumentation

Rationale: Today, plants are being built using the latest available electronic hardware, computer controls and advanced control concept; others are built with appropriate hardware for future conversion to computer control; and still others are built with conventional hardware (pneumatic or electronic) that would require, expensive modifications to convert to computer to control. Students of instrumentation & control engineering should understand the working, lay out and other aspects of equipment/system widely used in industries.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	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

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

Content:

Sr. No.	Content	Total Hrs	Module Weightage
1	**Basics of Instrumentation** Introduction -Instrument symbols & Tag numbering system -wiring system, process P&ID diagrams.	4	9%
2	**Control Centers & Panels** Electric Power Systems, Instrument Power Requirements, Instrument Power Distribution, Control Room Lighting, Communication Systems, Electrical Classifications, - Control Panel Types, Flat face Panels, Breakfront Panels, Consoles, Comparison Of Panel Types, Panel Layout, Face Layout, Rear Layout, Auxiliary Racks & Cabinets, Panel Piping & Tubing, - Air Headers, Tubing Runs, Panel Wiring, Nameplates & Tags, Painting, Graphic Displays - Control Room Layout Panel, Human engineering, Panel enclosure standard - Bid Specifications, Panel Inspections, Control center inspection.	8	18%
3	**Instrument Air System** Sizing criteria, Pressure level, Air supply source, - Compressor systems, positive displacement compressors, Dynamic compressors, Non lubricated compressor, Compressor cooling, Compressor control oil removal, General considerations, Refrigeration type, Necessity for dryers, Desiccant type, Design guideline criteria, Distribution systems, General layout, Header & branch sizing, Materials, take off & valving, Control room air supply, Case purging for electrical area classification.	8	18%
4	**Control Valves** Valve Terminology, Valve Capacity, Valve rangeability, - Valve type based on body Design: Globe Bodies, Angle, Needle, Ball, Eccentric Rotating, Plug, Butterfly, Diaphragm, Pinch, Drag - Flow Characteristic, Trim Design, Mechanical Feature - Actuator, Pneumatic Types, Electric Types, Electro Hydraulic Types - Positioner- Pneumatic, Electro Pneumatic, Positioner Features & accessories, - Control Valve Accessories. - Testing procedure of control valve - CV and Rangeability (Valve sizing- initial level). **Pressure Relieving Devices**	8	18%

	Relief valve, Safety valves and Rupture discs.		
5	**Signal Converting Elements** Pneumatic to electrical convertors, Electric to Pneumatic convertors, Voltage to Current convertor, Current to Voltage convertor, Frequency to voltage & Voltage to Frequency convertor.	**6**	**13%**
6	**Indicator Recorders and Annunciators** Indicators -Types of Indicators for various applications, Recorders - Types of recorders and It's merits and demerits, Annunciators- Function, Sequences displays, Types, Microprocessor for recording, announcing and indicating purpose.	**6**	**13%**
7	**Transmitter** Pneumatic Transmitter- Force balance & Motion Balance -Electronic Transmitter- 2- wire & 4-wire system - Smart Transmitter.	**5**	**11%**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20 %	**40 %**	**20 %**	**10 %**	**10 %**	**0 %**

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	Applied Instrumentation in the Process Industry	William andrews	Gulf Book Co. Publisher. ISBN-978-	1974	2nd Edition

	(Vol. I &II)		0872013933		
2	Process Control, Instrumentation Engineering hand book	B. G. Liptak	Butterworth-Heinemann ISBN-978-075062255	2013	3rd Edition
3	Process Control and Instrumentation Technology	Curtis Johnson	prentice Hall Of India Private Limited ISBN :-9788120309876	2001	4th Edition
4	Measurement Systems	E.O. Doebelin	McGraw Hill ISBN-978-0070173385	1990	4th Edition

Course Outcomes:

After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO1	Explain basic fundamentals of instrumentation and Control room design	20%
CO2	Select and employ control system components like transmitters, converters, safety valves for process loop setup	30%
CO3	Perform maintenance & calibration of final control elements and telemetry systems	15%
CO4	Identify the Plant hazards, select safety devices and apply protection methods for risk management	15%
CO5	Apply relevant concept to design and analyse the process and instrumentation diagram (P&ID) for project engineering of process plants	20%

Mapping with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	1		1		2				1	2	3	1	1
CO-2	2	1	1		2		1		1		2	2	3		1
CO-3	2	2	1		2		1		1		3	2	3	2	1
CO-4	2	2	1	1	3		2		1	1	2	3	2	1	1
CO-5	2	2	3	1	2		1		1	1	1	1	3	2	2

List of Open Source Software/learning website:
http://www.infocobuild.com/education/audio-video-courses/electronics/IndustrialAutomationControl-IIT-Kharagpur/lecture-01.html

List of Open Source Software: Not applicable

FOR LAB SESSIONS:

List of Experiments

1. Study of Basic instrumentation symbols.
2. Study of Tag numbering system.
3. Study of various control panel type with their front and rear layouts.
4. Study of instrument air system.
5. Study of various enclosure types (NEMA standards) used for instrument system.
6. Understanding of hazardous area classification and required protection method by specifying a sample product (Chemical/Petrochemical/Paper/Pulp/Sugar/Agro/Steel/Power, etc.)
7. Study of Control valve characteristics and calculating Cv for linear, quick opening and equal percentage control valve.
8. Study of various part of control valves including actuators and other accessories like positioner, hand wheel etc.

9. Study of flapper-nozzle system used in pneumatic transmitter/ controllers/ indicators.
10. Study of working and testing of indicators and recorders used to monitor various parameters.
11. Study of alarm annunciator and its various sequences
12. Study of working and calibration of transmitters using standard calibrating device
13. Study of working principle and calibration of current to pneumatic converter
14. Study of P/I, I/V, V/I, F/V and V/F converters

Major Equipment Needed: Charts for tag numbering system and standard symbols, Relevant ISA standards, Field instruments like transmitters, Control valve trainer, Control valve with positioned and other accessories, I/P converters, Customized control panel, etc. along with standard test and calibrating devices.