SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B. Tech. Year II: Semester – 4

Subject Name: Industrial Measurement I **Subject Code: BTIC13401**

Type of course: PCC

Prerequisite (if any): Engineering Physics, Basic Electrical Engineering

List of Courses where this course will be prerequisite: Industrial Measurement II, Process Control, Control System Components

Rationale: Industrial Instrumentation is a unique part of industry that deals with the measuring of variables that influence materials production and equipment during the development of a product. Every Instrument engineers have to deal with various types of Instruments in the working environment. This course describes the working principles of these measuring instruments.

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

Content:

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

Sr. No.	Content	Total Hrs	Module Weightage
1	**INTRODUCTION OF MEASUREMENTS: BRIEF OVERVIEW** Concepts and terminology of measurement system, transducer, sensor, range and span, classification of transducers, Selection of Transducer, static and dynamic characteristics, selection criteria, sources of errors and their statistical analysis, standards and calibration.	5	**6%**
2	**TEMPERATURE MEASUREMENT:** Temperature scales, classification of temperature sensors, standards, working principle, types, materials, design criterion: Non electrical sensors (thermometer, thermostat), electrical sensors: RTD resistance measurement with Wheatstone Bridge Circuits: two – wire circuit, three – wire circuit, four – wire measurement circuit, RTD resistance measurement with Constant Current Source -Thermister, Thermocouples-laws of thermocouple-fabrication of industrial thermocouples-signal conditioning -cold junction compensation-special techniques for measuring high temperature using thermocouples-Radiation methods of temperature measurement (RTD, thermocouple, thermistor), radiation sensors (pyrometers), Temperature switch.	**10**	**21%**
3	**PRESSURE MEASUREMENT:** Definition, pressure scale, standards, working principle, types, materials: Manometers, elastic type pressure gauges-Bourdon tube bellows-diaphragms- Bell Gauge – Measurement of pressure using Electrical transducer as secondary transducer- vacuum pressure measurement-Mechanical gauges-Mcleod gauge-thermal conductivity gauges Ionization gauge cold cathode and hot cathode types. Differential pressure measurement, -flapper-nozzle assembly. Dead Weight Piston Gauges, Pressure switch.	**10**	**21%**
4	**LEVEL MEASUREMENT:** Standards, working principle, types, materials, installation, calibration: float, displacers, bubbler, and DP- cell, ultrasonic, capacitive, microwave, radar, radioactive type, laser type transducers, level gages, resistance, thermal, TDR/ PDS type, solid level detectors, fiber optic level detectors, Level switches, DP transmitter, calibration, zero elevation and zero suppression, level measurement of closed vessels.	**10**	**21%**
5	**FLOW MEASUREMENT:** Types, selection, installation, calibration, types of flow: Importance of flow measurement, mechanical flow meters: variable head type flow meters- variable area flow	**10**	**21%**

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	meters, mass flow meters, electrical flow meters- EM flow meter –turbine flow meter- ultrasonic flow meter, vortex flow meter, Direct and Indirect methods-open channel & solid flow measurement, flow switches.		

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	20	20	**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	Instrument Engineers' Handbook ISBN: 9788181478054	2010	4th edition
2	Handbook of Applied Instrumentation	D. M. Considine and Sidney David Ross,	McGraw – Hill Publicaiton ISBN: 978-0-07-012424-0	1964	

3	Encyclopedia of Instrumentation and Control	Douglas M. Considine, Douglas Considine	Kriege Publication Co ISBN: SBN-13: 978-0-07-012424-0, ISBN: 0-07-012424-8	1971	
4	Instrumentation Reference Book	Walt Boyes, Butterworth	Heinemann Publisher ISBN-13: 978-0-7506-8308-1, ISBN: 0-7506-8308-2	2010	4th edition
5	Introduction to Instrumentation and Control	A. K. Ghosh,	PHI publications ISBN-13: 978-81-203-1626-3, ISBN: 81-203-1626-6	2004	4th edition
6	Industrial Instrumentation	K. Krishnaswamy and S. Vijayachitra	New Age International Publication. ISBN-13: 978-81-224-2750-9, ISBN: 81-224-2750-2	2010	2nd edition
7	Measurement Systems: Application and Design	E. D. Doeblin,	McGraw Hill Publication		2nd edition

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8	Industrial Instrumentation & Control	S. K. Singh	Published 2003 by Tata Mcgraw-Hill Education 978-0-07-048290-6, ISBN: 0-07-048290-X	2003	2nd edition

Course Outcomes: After successfully completing this course, the student will be able to,

Sr. No.	CO statement	Marks % weight age
CO-1	work with basic measurement principles of temperature, level, pressure and flow sensors	25%
CO-2	identify the type of sensor and their relevant specifications, which can be use in a particular process parameter measurement selection	25%
CO-3	define various measurement terms, resolution, sensitivity, accuracy , precision to classify measurement errors and characteristics of measurement systems	20%
CO4	calibrate the various instruments and also they knows to application of the instrument in various fields	20%
CO-5	List various standards used for selection of transducers/sensors	10%

Mapping with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	3	2	3	3	0	3	2	3	0	0	1	3	1	1
CO-2	3	3	0	3	0	2	3	0	3	0	1	0	2	3	1

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CO-3	**2**	**3**	**0**	**3**	**3**	**0**	**3**	**2**	**3**	**1**	**0**	**1**	**3**	**1**	**3**
CO-4	**3**	**0**	**3**	**0**	**0**	**1**	**2**	**0**	**3**	**0**	**0**	**1**	**3**	**1**	**1**
CO-5	**0**	**1**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**1**	**3**	**2**	**0**	**0**

List of Open learning website:

1. https://onlinecourses.nptel.ac.in/noc22_me08/preview

- It covers major topics of the syllabus.

2. https://onlinecourses.nptel.ac.in/noc21_ee32/preview

- It covers major topics of the syllabus.

3. https://www.isa.org

- It covers major topics of the syllabus.

List of Open Source Software: not applicable

FOR LAB SESSIONS:

List of Experiments:

1. Characterization of Thermocouples.(J/T/K/R/S) Equipment: Oven, thermocouples, Multimeter, thermocouple reference table, Thermocouple

2. Characterization of RTD (PT100) Equipment: Oven, PT100 probe, RTD simulator, Temperature indicator, Multimeter

3. Measurement of flow using rotameter Equipment: Rotameter

4. Measurement of flow using DP cell Equipment: Differential Pressure Transmitter, or Manometer etc.

5. Flow coefficient of Orifice: Orifice installed in a pipe of a liquid fluid, Manometer or DPT.

6. Flow Coefficient of Venturi: Venturi installed in a pipe of a liquid fluid, Manometer or DPT.

7. Measurement of Level using Capacitance type of Level Sensor

8. Calibration of pressure gauge using dead weight pressure tester and preparation of report Equipment: Dead weight pressure tester setup, Standard weight set.

9. Measurement of pressure using well type manometer

10. Measurement and control pressure with pressure switch

11. Measurement of flow with pitot tube flow meter

12. To control back pressure using flapper-nozzle assembly.

Major Equipment Needed:

Specified with list of experiments: Dead weight tester, universal calibrator, Temperature bath, Voltage/ current Simulator, RTD/ Thermocouple calibrators, Flow meters, flapper-nozzle etc.