GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Chemical Engineering

Course / Subject Code: DI03005011

Course / Subject Name : Basics of Process Instrumentations

w. e. f. Academic Year:	2024-25
Semester:	3rd
Category of the Course:	ESC

Prerequisite:	Student should have knowledge regarding importance of difference physical properties
Rationale:	The course aims to provide students with a comprehensive understanding of process instrument. Diploma chemical engineer has to ensure smooth and proper operation Use of measuring devices for the measurement of parameters like temperature, pressure, flow, level, viscosity, specific gravity, humidity are necessary for controlling chemical plant for producing materials of desired quality and to maintain plant safety. It covers the operational principles of different measuring devices for variables like temperature, level, pressure, flow and basic concept of process control. Hence the course has been designed to develop these competencies and its associated cognitive, practical and effective domain learning out comes.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Understand the Role of Instrumentation in Chemical Plants	R, U
02	Apply Measurement Techniques for Temperature, Pressure, Level and Fluid Properties	A
03	Demonstrate Knowledge of Calibration and Selection Criteria for Measuring Instruments	A
04	Differentiate Between Various Process Control Systems	R, U
05	Understand Industrial Automation Systems and Their Applications	R, U, A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	0	3	70	30	0	0	100

Legends: L-Lecture; T-Tutorial/Teacher Guided Theory Practice; P-Practical; C-Credit, CA - Continuous Assessment; ESE-End Semester Examination.

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
Unit – I Introduction to Process Instrumentation	1.1 Importance of instrumentation in chemical plant 1.2 Classification of instruments 1.3 Basic elements of instruments 1.4 Static and dynamic characteristics 1.5 Selection criteria for various measuring devices in chemical industry for: 1.5.1 Temperature 1.5.2 Pressure 1.5.3 Level 1.5.4 Flow 1.6 Calibration of Instrumentation	7	16
Unit – II Temperature Measurement Devices	2.1 Introduction to Temperature Measurement Devices 2.2 Different Temperature scale 2.3 Definition of thermometer 2.4 Principle, Construction & Working of : 2.4.1 Mercury in glass thermometer 2.4.2 Bi-metallic thermometer 2.4.3 Pressure Spring thermometer 2.4.4 Resistance thermometer 2.5 Principles of thermoelectricity 2.5.1 See-back effect 2.5.2 Peltier effect and 2.5.3 Thomson effect 2.6 Industrial thermocouple: their principle, construction, working range 2.7 Principle, Construction & Working of Pyrometers: 2.7.1 Radiation Pyrometer 2.7.2 Optical Pyrometer	7	16
Unit –III Pressure Measurement Devices	3.1 Introduction to Pressure Measurement Devices 3.2 Principle, construction, and working of various Pressure Gauges 3.2.1 Diaphragm Gauge 3.2.2 Bourdon tube Gauge 3.2.3 Dead weight Gauge 3.2.4 Strain Gauge	7	16

	3.2.5 Capsule Pressure Gauge 3.2.6 Absolute Pressure Gauge 3.2.7 Differential Pressure Gauge 3.2.8 Bellows Pressure Gauge 3.2.9 Manometer Pressure Gauge 3.2.10 Piezometer Pressure Gauge		
Unit –IV Level Measurement Devices	4.1 Introduction to Level Measurement Devices 4.2 Classify and Explain level measuring devices 4.3 Direct level measuring devices 4.3.1 Probe and tape 4.3.2 Sight glass 4.3.3 Floats 4.4 Indirect level measuring devices. 4.4.1 Air trap box method 4.4.2 Diaphragm box method 4.4.3 Bellow system	6	16
Unit -V Fluid Properties Measurement Devices	5.1 Introduction 5.2 Viscosity Measurement 5.2.1 Capillary tube 5.2.2 Rotating cylinder 5.2.3 Torsion viscometer 5.3 Specific gravity Measurement 5.3.1 Hydrometer 5.4 Humidity measurement 5.4.1 Hair hygrometer 5.5 Flow measurement 5.5.1 Target meter, 5.5.2 Vortex Shredding meter, 5.5.3 Turbine meter	7	16
Unit-VI Basic Process Control	6.1 Importance of Process control 6.2 Requirement of a good control system 6.2 Control system with its Block diagram. 6.3 Define: Set point, Error, Disturbances, Manipulated variable, Controlled variable 6.4 Servo and regulatory control problem 6.5 Feedback and feed forward control system. 6.6 Open loop and Closed loop system 6.7 Various types of Controllers 6.7.1 Proportional Controller 6.7.2 Proportional Integrative Controller	11	20

	6.7.3 Proportional Integrative and Derivative Controller 6.8 Definition of SCADA, DCS PLC 6.9 Application area of SCADA, DCS, PLC 6.10 Advantages and disadvantages of SCADA, DCS, PLC		
	Total	**45**	**100% (70 Marks)**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
30	**34**	**36**	**-**	**-**	**-**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

Sr. No	Title of Book	Author	Publication with place, year and ISBN
1	Fundamentals of Industrial Instrumentation and Process Control	William C. Dunn	Mc-Graw-Hill (2005)
2	Industrial Instrumentation and Control	S.K. Singh	3rd edition, McGraw-Hill (2008)
3	Process Control and Instrumentation	R. P. Vyas	Denett & Co. (2015)
4	Industrial Instrumentation	Donald .P. Eckman	John Wiley & Sons Inc, New York (2019)
5	Instrument Engineers' Handbook, Volume 1: Process Measurement and Analysis	Bela G. Liptak (Editor)	5th edition, CRC Press (2016)

(b) Open source software and website:

1. Students can refer to video lectures available on the websites including NPTEL.
2. https://www.tec-science.com/thermodynamics/temperature/how-does-a-bimetallic-strip-thermometer-work/ (Bimetallic thermometer animation)
3. http://users.telenet.be/instrumentatie/temperature/temperature-scales.html (Temperature scales)

4. https://en.wikipedia.org/wiki/Thermometer (Thermometer)
5. https://instrumentationtools.com/bimetallic-thermometer/ (bimetallic thermometer)
6. https://www.thermocoupleinfo.com/#:~:text=A%20Thermocouple%20is%20a%20sensor,temperature%2C%20a%20voltage%20is%20created. (Types of thermocouples)
7. https://circuitglobe.com/resistance-thermometer.html (Resistance thermometer)
8. https://www.jms-se.com/rtd.php (RTD)
9. https://www.instrumentationtoolbox.com/2011/01/sensors-used-in-industrial_25.html (Thermowell)
10. https://www.jms-se.com/thermowell.php (Thermowell types)
11. https://circuitglobe.com/optical-pyrometer.html (optical pyrometer)

Suggested Activities for Students: Other than the classroom and laboratory learning, following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

Following is the list of proposed student activities like:

1. Assignments
2. Technical Quiz/MCQ Test
3. Presentation on some course topic
4. I-net based assignments

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