GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Subject Code : BE04000151
Subject Name : Industrial Measurment - 1

WEF Academic Year:	2025-2026
Semester:	4
Category of the Course:	Basic Science Course

Prerequisite:	Basic concept of Measurement
Rationale:	Industrial Instrumentation is an important 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 has to deal with various types of Instruments in the working environment. This course describes the working principles of these measuring instruments.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level*
01	To classify different types of sensors and transducers.	UN
02	To identify sensor for a particular application	AP
03	To analyze application and output of various sensors and transducers	AN
04	To explain smart sensors basics and its performance	EL
05	To build a product/ instrument system based on application or problem statement	CR

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Teaching and Examination Scheme:

Teaching-Learning Scheme (inHours perSemester)					Total Credits = TH/30	AssessmentPatternandMarks					Total Marks
						Theory		Tutorial/Practical			
L	T	P	PBL*	TH		ESE (E)	PA (M)	PA/ (I)	PBL (I)	ESE (V)	
45	0	30	15	90	03	70	30	20	30	50	200

- **Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.**

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, PA = Progressive Assessment, ESE = End-Semester Examination

Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	**Basics of transducers and its classification:** Definition and block diagram of instrumentation and measurement system, Characteristics of an instrument and its classification, Static characteristics: accuracy, precision, resolution, sensitivity, scale, threshold, hysteresis, drift, dead zone, repeatability, reproducibility and error and its classification, Dynamic Characteristics: Speed of response, lag, fidelity and error, Transducer and sensors and their difference and classification.	2	4
2	**Temperature Measurement:** Definition, Scales, Selection Criteria, Calibration, classification of different types of temperature sensors, Principle, Material of Construction, Construction, Working, Range, advantages, disadvantages and applications of Thermometer: Mercury and Digital, RTD, Thermocouple, Thermister, Bimetallic Thermometer, Pyrometers: Optical and Radiation.	8	18
3	**Pressure Measurement:** Definitions of pressure and its types, scales, selection criteria, calibration, classification of different type of pressure sensors, Principle, Material of Construction, Construction, Working, Range, advantages, disadvantages and applications of Manometers, Bourdon tube, bellows and diaphragm gauges, primary pressure measurement, secondary pressure measurement using LVDT and Capacitance and differential pressure measurement, vacuum pressure measurement: McLeod Gauge, Thermal conductivity gauges, ionization gauges and Knudsen gauges, Strain gauges and Load cell, dead weight tester.	8	18
4	**Level Measurement:** Definition, Scales, Selection Criteria, Calibration, classification of different types of level sensors, , Principle, Material of Construction, Construction, Working, Range, advantages, disadvantages and applications of Resistance, Inductance and Capacitance Level Measurement, Float, displacer and air purge bubbler type level measurement, Ultrasonic and radar level measurement, Nuclear radiation method of level measurement and its detectors like Geiger Muller, Ionization and scintillation counters, Solid Level Measurement.	8	18
5	**Flow Measurement:** Definition and classification of flow, Scales, Selection Criteria, Calibration, Principle, Material of Construction, Construction, Working, Range, advantages, disadvantages and applications of Head type: Orifice, Venturi,	8	18

	Pitot tube and flow nozzle, Area type: Roatameter and piston type, Mass flow meters: Turbine, Coriolis and calorimetric type, Positive displacement type: Nutating disc, rotary vane, Lobed impeller and reciprocating piston, Electrical types: Eletromagnetic, Ultrasonic and hotwire anemometer, Digital type: Vortex and flow marker type, Open channel type and Solid flow meters.		
6	**Smart Sensors:** Introduction, Primary Sensors, Excitation, Amplification, filters, Converters, Compensation: Non Linearity, Noise and Interference, Response time, drift, cross sensitivity, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface and The Automation	6	13
7	**Recent Trends in Sensor Technologies:** Introduction, Film Sensors: Thick Film Sensors and Thin Film Sensors, Semiconductor IC Technology - Standard Methods, Microelectromechanical systems (MEMS): Micromachining and some application examples and Nano Sensors	5	11
	Total	**45**	**100**

Reference Book:

1. Instrument Engineers' Handbook: Process Measurement and Analysis by B. G Liptak.
2. Principles of Industrial Instrumentation by D. Patranabis, McGraw – Hill Publication.
3. Sensors and Transducers by D. Patranabis, Second Edition, PHI Publication
4. Handbook of Applied Instrumentation by D. M. Considine and Sidney David Ross, McGraw – Hill Publication.
5. Encyclopedia of Instrumentation and Control by D. M. Considine, Kriege Publication Co.
6. Instrumentation Reference Book by Walt Boyes, Butterworth – Heinemann Publisher.
7. Industrial Instrumentation by K. Krishnaswamy and S. Vijayachitra, New Age International Publication.
8. Measurement Systems: Application and Design by E. O. Doeblin, McGraw – Hill Publication
9. Understanding smart sensor by Randy Frank, Artech House.

Suggested Course Practical List:

1. To study about the bourdon tube gauge for pressure measurement.
2. To perform pressure measurement using calibrated pressure Sensor
3. To perform temperature measurement using an IC sensor as temperature
4. To perform temperature measurement using RTD as temperature transducer along with its signal Conditioning.
5. To perform temperature measurement using Thermister as temperature transducer.
6. To perform Temperature measurement using Thermocouple as temperature transducer.
7. To perform temperature measurement using a Radiation type pyrometer
8. To perform level measurement using capacitance method.
9. To measure flow of stream using Orifice Plate using VLab Simulator.
10. To test and calibrate a given pressure gauge using dead weight tester.

List of Laboratory/Learning Resources Required:

1) DTE Common Lab manual
2) Virtual Laboratory (vlab.co.in)
3) NPTEL/ MOOC Swayam Portal

Activities suggested under Problem Based Learning:

Sr. No.	Name of the activity	No. of hours per activity	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit=5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations Based on industry/lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation=5h Total= 10h	Report/presentation based on the video learning outcomes.
3.	Assignment writing. Numerical Based assignment is preferable.	5 assignments of 2h each. Total= 10h	Based on the assignment submitted.
4.	Problem solving/Coding using C, C++, Python, SCILAB, MATLAB,MS-EXCEL or any Other relevant software	5 small coding-based assignment of 2h each. Total = 10h	Based on the coding solution submitted.
5.	Self-learning on-line course	Minimum duration of the course should be 10h.	Examination based assessment At the end of course. Based on the certificate produced.
6.	Complex problem solving	Maximum 2problem. Study of the problem and solution finding, Total= 10h	Based on the depth of the Solution submitted.
7	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation =5h Total= 10h	Based on quiz/report submitted
8	Discussion on research paper Based on relevant subject	5 research paper =20 h	Summarize research paper and Evaluation critical parameters
9.	Poster/chart/power point preparation on technical topics	Duration=6h	Based on poster/chart Preparation and presentation skills
10	Working/non-working model on technical topics	Working=12h Non-working=8 h	Based on inter department/external evaluation

11	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/any other issue	Duration=15hfor industrial exposure Problem identification and tentative solution = 10 h Total = 20 h	Based on evaluation of critical problems and solutions
12	Group Discussion on emerging/trending technical topics based on subject	Duration=1h each	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation=5h Total= 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Application/Software development	Duration=10h	Depending on the complexity of the Application/Software
15	Online Technical Quizzes/Simulations	Multiple quizzes summing up to 10h	Based on quiz scores and reflection report after each quiz.
16	Patent Search and Innovation Gap Identification	10h(Search + Report)	Based on number of relevant patents analyzed and Identification of innovation scope.

Note:

- All the suggested activity should be related to the subject.
- Subject coordinator shall identify activities from above list as per the subject needs, they also declare list of activities wise hours, evaluation scheme and rubrics to students at the start of semester.
- The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.

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