

GUJARAT TECHNOLOGICAL UNIVERSITY

INSTRUMENTATION & CONTROL ENGINEERING (17)

INDUSTRIAL MEASUREMENT I

SUBJECT CODE: 2141705

B.E. 4th Semester

Type of course: Core Engineering

Prerequisite: There is no prerequisite knowledge required for this course.

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			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
				PA	ALA	ESE	OEP			
3	0	2	5	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	INTRODUCTION OF MEASUREMENTS : - Definition of Instrumentation. - Static char. : - Accuracy, precision, resolution, Sensitivity, Scale, threshold, Hysteresis, Drift, dead zone, repeatability, Linearity, etc. - Dynamic characteristics: Speed of Response, lag, errors, fidelity, Response of 1st & 2nd order system. - Types of errors etc., - Terminology and Specifications of instruments, - Measurement standards :- Time, frequency, Voltage, Current, 3-15 psi etc., ANSI, ASME, ADA, BS, DIN, CSMR, FCI, API, ISI, and introduction Reliability and safety.	5	6%
2	Transducers: Classification Electrical Transducer- Resistance, capacitance, inductance type , piezoelectric, transduction, etc. Mechanical transducers, Selection of Transducer	5	10%
3	TEMPERATURE MEASUREMENT: Types, Selection, Installation, Calibration Temperature measurement using physical parameter-Electrical type temperature sensor-RTD, RTD resistance measurement with Wheatstone Bridge Circuits: two – wire circuit, three – wire circuit, four – wire measurement circuit, RTD resistance	10	21%

	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		
4	PRESSURE MEASUREMENT: Types, Selection, Installation, Calibration , Units of pressure-manometers-different types-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. Piston type pressure measurement; Dead Weight Piston Gauges	10	21%
5	LEVEL MEASUREMENT: Types, Selection, Installation, Calibration, Electrical methods-Resistive, Inductive & Capacitive-Measurement of Level using Gamma rays-Ultrasonic Methods- Measurement of Liquid level using Float type-Displacer type-Air-Purge system, Solid Level measurement-Hydrostatic types. Level Switches.	10	21%
6	FLOW MEASUREMENT : Types, Selection, Installation, Calibration, Types of flow; Units of flow – volumetric and mass flow ; Importance of flow measurement , Mechanical Flow meters: Variable head type flowmeters- variable area flowmeters, Mass flow meters, Electrical flow meters- EM flowmeter –turbine flowmeter- Ultrasonic flowmeter-Vortex flowmeter- Direct and Indirect methods-open-channel & solid flow measurement- Flow Meter Selection and Designs.	10	21%

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
21	21	21	7	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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:

1. Instrument Engineers’ Handbook: Process Measurement and Analysis by B. G Liptak.
2. Handbook of Applied Instrumentation by D. M. Considine and Sidney David Ross, McGraw – Hill Publicaiton.
3. Encyclopedia of Instrumentation and Control by D. M. Considine, Kriege Publication Co.
4. Instrumentation Reference Book by Walt Boyes, Butterworth – Heinemann Publisher.
5. Introduction to Instrumentation and Control by A. K. Ghosh, 4th edition, PHI publications
6. Industrial Instrumentation by K. Krishnaswamy and S. Vijayachitra, New Age International Publication.

7. Measurement Systems: Application and Design by E. D. Doebelin, McGraw – Hill Publication

Course Outcome:

- After learning the course the students should be able to learn basic measurement principles of temperature, level, pressure and flow sensors.
- Student should be able to define various measurement terms, and to state and define resolution, sensitivity, accuracy and precision etc, and to classify measurement errors
- Students should be able to identify the type of sensor and their relevant specification .etc which can be use in a particular process parameter measurement selection.

List of Experiments:

1. Characterization of Thermocouples.(J/T/K/R/S)

Equipment: Oven, thermocouples, Multimeter, thermocouple reference table, Thermocouple simulator,

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.

Major Equipment: specified with list of experiments: Dead weight tester, universal calibrator, Temperature bath, Voltage/ current Simulator, RTD/ Thermocouple calibrators, Flow meters, etc.

List of Open Source Software/learning website:

<http://nptel.ac.in/video.php?subjectId=108105064>

http://www.onlinevideolecture.com/electrical-engineering/nptel-iit-kharagpur/industrial-instrumentation/?course_id=514

<https://www.isa.org>

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.