



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3170112

SUBJECT NAME: Experimental Techniques

B.E. 7th SEMESTER

Type of course: Open Elective Course III

Prerequisite: Mechanics of Solid, Thermodynamics & Mechanical measurements

Rationale The course is designed to provide the fundamental knowledge of experimentation techniques, related instruments used for thermal engineering applications and fluid mechanics.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	<p>Introduction to Experimental Methods:</p> <p>Basic concepts, Calibration, Dimensions, Units, Standards, Systems of dimensions, System of units, Unit conversion table. Objective of experiments, various stages in experimental investigations; preliminary, intermediate and final, steady state and transient techniques, selection of measuring devices based on static, dynamic characteristics and allowable uncertainties, basics of TAGUCHI method for design of experiments</p>	08
2	<p>Measurements & Instruments:</p> <p>Basic concept of dynamic measurements. System response and distortion, Impedance matching, Dimensional measurement Gauge blocks, The pneumatic displacement gauge,</p> <p>Pressure Measurements:</p> <p>Manometers, The aneroid barometer, Diaphragm and Bellows Gauges, Introduction to low pressure measurements</p> <p>Flow Measurements:</p> <p>Orifice plate/ venturimeter, rotameter, Thermal Anemometry (hot wire/hot film), Hot wire anemometer, Laser Doppler anemometry, Measurement of velocity components by 3 holes and 4 holes probes, Particle image velocimetry (PIV)</p> <p>Temperature Measurements: Resistance Temperature Detectors (RTD), Thermistors, Thermocouples, Temperature measurement by Radiation, The optical pyrometer, calibration of thermocouple, RTD, steady state and transient methods of measuring heat flux, measurement of thermal radiation and associated parameters, measurement of thermal conductivity of solids, liquids and gases, measurement of thermophysical properties, Constant temperature hot-wire anemometer, LDA</p> <p>Measurement of pitch angle and Torque:</p> <p>torque by dynamometers, strain gauge, transducers</p>	16
3	<p>Advanced measurement techniques and analysis:</p> <p>Shadowgraph, Schlieren, Interferometer, Telemetry in measurement, Orsat Gas Analyzers, Smoke meters, gas chromatography, spectrometry</p>	05



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4	Advancement in measurements: Data logging and acquisition, use of sensors for error reduction, elements of micro computer interfacing, intelligent instruments and their use, Basics of P, PI, PID controllers, pneumatic and hydraulic controllers, electronic controllers	08
5	Uncertainty in measurements: Errors in instruments, Analysis of experimental data and determination of overall uncertainties in experimental investigation, uncertainties in measurement of measurable parameters like pressure, temperature, flow etc. under various conditions	08

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
5%	25%	30%	25 %	10%	5%

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:

1. Experimental Methods for Engineers - J P Holman - McGraw-Hill
2. Principles of Measurements and Instrumentation- Morris AS - Prentice Hall of India
1. Experimentation and Uncertainty Analysis for Engineers - Huge W Coleman, W Glenn Steele - John Wiley & Sons.
2. Mechanical Measurements - Buck & Beckwith - Pearson
3. Measurement systems, Application and Design - E O Doebelin - McGraw-Hill
4. Measurements and Instrumentation in Heat Engineering - Prebrashensky V, Volume I &II, MIR Publishers
5. Instrumentation Devices and Systems - Raman C S, Sharma G R, Mani V S N - McGraw-Hill
6. Measurement Techniques in Heat Transfer - E R G Eckert and Goldsteen - Technovision
7. Mechanical and Industrial Measurements - R K Jain - Khanna Publishers

Course Outcome:

After learning the course the students should be able to:

Sr.No.	CO statement	Marks % weightage
CO-1	Understand Objective, motive sources and variables of experiments	25
CO-2	Understand the basic concept and working principles of measuring instruments	35
CO-3	Learn about the sources of errors occurred in experiments	20
CO-4	Carry out Error and uncertainty analysis of experimental system	20

List of Experiments:



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1. To carry out calibration and temperature measurement of thermocouple, RTD.
2. To carry out Uncertainty analysis in temperature measurement
3. To carry out calibration of pressure measuring devices: U-tube manometer, pressure gauge.
4. To carry out Uncertainty analysis in pressure measurement.
5. To carry out calibration of flow measuring devices: orifice meter and rotameter.
6. To carry out Uncertainty analysis in flow measurement.
7. To carry out exhaust gas analysis with gas chromatographer.
8. To study and familiar with Data logging and acquisition system.
9. To study various electronics controllers used in thermal measurements.
10. To study and compare various advanced measurement techniques

List of Open Source Software/learning website:

<https://nptel.ac.in>