

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (THERMAL ENGINEERING) (21)

EXPERIMENTAL TECHNIQUES AND INSTRUMENTATIONS IN THERMAL
ENGINEERING

SUBJECT CODE: 2722105

SEMESTER: II

Type of course: Core subject

Prerequisite: -- Fluid Mechanics, Thermodynamics & Mechanical measurements

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

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)			
					ESE	OEP	PA	RP		
3	0	2#	4	70	30	20	10	10	10	150

Content:

Sr. No	Content	Total Hrs	% Weightage
1	Experimentation Planning: Planning 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	08	15
2	Instrumentation & Measurements: Fundamental elements of a measuring instrument, static and dynamic characteristics, principles of temperature measurement, calibration of thermocouple, RTD, Orifice plate and Pressure gauge, design of temperature measuring instruments, thermo positive elements, thermocouples in series & parallel, pyrometry, steady state and transient methods of measuring heat flux, measurement of thermal radiation and associated parameters, measurement of turbulence, measurement of thermal conductivity of solids, liquids and gases, measurement of thermophysical properties	15	30
3	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	20
4	Advanced measurement techniques and analysis: Shadowgraph, Schlieren, Interferometer, Laser Doppler Anemometer, Hot wire Anemometer, Telemetry in measurement, Orsat apparatus, Gas Analyzers, Smoke meters, gas chromatography, spectrometry	08	20
5	Uncertainty in measurements: Errors in instruments, Analysis of experimental data and determination of overall uncertainties in experimental investigation, uncertainties in measurement of measurable	06	15

	parameters like pressure, temperature, flow etc. under various conditions		
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Reference Books:

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

Course Outcome:

After learning the course the students should be able to:

- Understand the basic concept of engineering experimentation.
- Acknowledge, access and analysis various experimental techniques.
- Carry out Error and uncertainty analysis of thermal system.

List of Experiments:

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

Open Ended Problems:

1. Case studies in Thermal Engineering, Open access journal, Elsevier.
2. Case studies of Thermal Power Plant from Instrumentation point of view

List of Open Source Software/learning website:

www.asme.org/thermal_science

npTEL.ac.in

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.