



# SILVER OAK UNIVERSITY

## Engineering and Technology (M.Tech.)

Mechanical (I.C. Engine & Automobile Engineering)

**Subject Name: Experimental Techniques and Instrumentations in  
Automobile Engineering**

**Subject Code:**

**Semester: II**

### Prerequisite:

Mechanical measurement and metrology, Automobile Engineering

### Objective:

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	Evaluation Scheme				Total Marks
L	T	P	C	Internal		External		
				Th	Pr	Th	Pr	
3	0	2	4	40	20	60	30	150

### Content:

Unit No.	Course Contents	Teaching Hours	Weightage %
1	<b>Experimentation Planning:</b> 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	7	17
2	<b>Instrumentation &amp; Measurements:</b> 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	10	26

	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 thermo-physical properties, measurement of solar radiation		
3	<b>Advancement in measurements:</b> Data logging and acquisition, use of sensors for error reduction, elements of microcomputer interfacing, intelligent instruments and their use, Basics of P, PI, PID controllers, pneumatic and hydraulic controllers, electronic controllers	7	17
4	<b>Advanced measurement techniques and analysis:</b> Shadowgraph, Schlieren, Interferometer, Laser Doppler Anemometer, Hot wire Anemometer, Telemetry in measurement, Gas Analyzers, Smoke meters, gas chromatography, spectrometry	7	20
5	<b>Uncertainty in measurements:</b> 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	8	20

#### Course Outcome:

Sr. No.	CO statement	Unit No
<b>CO-1</b>	Discuss experimentation techniques for various thermal systems.	1,2
<b>CO-2</b>	Discuss the various instruments used for measuring different properties significant for evaluation of performance of thermal systems and to carry out uncertainty analysis.	2,5
<b>CO-3</b>	Appraise the computing facilities for measurement and acquisition of different properties.	3
<b>CO-4</b>	Appraise advanced measurement techniques and systems.	4

#### Teaching & Learning Methodology:-

The various methods or tools follows by the faculties to teach the above subject are:

- Chock and Board
- PPT
- Flip Class Room
- Video Animations

**List of Experiments/Tutorials:**

1. To calibrate and measure temperature using thermocouple, RTD.
2. To carry out calibration of pressure measuring devices: U-tube manometer, pressure gauge.
3. To measure the thermal conductivity of any fluid.
4. To carry out calibration of flow measuring devices: orifice meter and rotameter.
5. To measure the direct and diffuse solar radiation using pyranometer and pyrheliometer.
6. To study and familiar with data logging and acquisition system.
7. To develop a Gas Table (Isentropic flow, Normal shocks, Fanno flow, Rayleigh flow) for different  $\gamma$  values.
8. To study various electronics controllers used in thermal measurements.
9. To study and compare various advanced measurement techniques.
10. To perform experiment with any thermal system and to carry out uncertainty analysis for the same.

**Major Equipment:-**

- Calibration set-ups for various thermo-physical properties
- Pyranometer
- Pyrheliometer
- Gas chromatographer
- Gas analyzer
- Data acquisition system
- Interferometer
- Laser Doppler anemometer
- Hot-wire Anemometer

**Books Recommended-**

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 Goldstein - Techno vision
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.

**List of Open Source Software/learning website:**

1. <https://nptel.ac.in>
2. [www.asme.org/thermal\\_science](http://www.asme.org/thermal_science)