MEASUREMENTS IN THERMAL ENGINEERING

Course Code: 13ME2309 **L P C**
4 0 3

Pre requisites: basic instrumentation, fluid mechanics, and heat transfer

Course Educational Objectives:
To make the student
1. introduce to analyze experimental error, static and dynamic characteristics of instruments
2. learn the working of various measuring instruments used in the field of thermal engineering
3. learn the measurement of properties like thermal conductivity of solids, liquids and gases
4. learn the measurement of transport properties like diffusion, convective heat transfer
5. introduce to electronic control systems associated with automatically controlling the measuring parameters.
6. introduce to applications and important features of various measuring instruments

Course Outcomes:
The student will be able to
1. use appropriate instrument for measurement of specific parameter
2. analyze experimental error, Static and Dynamic characteristics of instruments
3. use appropriate instrument measurement of transport properties
4. practically apply the principles of measurement to engineering applications / projects.

UNIT-I
Instrument classification, static and dynamic characteristics of instruments, experimental error analysis, systematic and random errors, statistical analysis, uncertainty, reliability of instruments,
Variable resistance transducers, capacitive transducers, piezoelectric transducers, photoconductive transducers, photovoltaic cells, ionization transducers, Hall effect transducers.

UNIT-II

Dynamic response considerations, Bridgman gauge, McLeod gauge, Pirani thermal conductivity gauge, Knudsen gauge, Alphatron.

UNIT-III

Flow measurement by drag effects; hot-wire anemometers, magnetic flow meters, flow visualization methods, interferometer, Laser Doppler anemometer.

Temperature measurement by mechanical effect, temperature measurement by radiation, transient response of thermal systems, thermocouple compensation, temperature measurements in high- speed flow.

UNIT-IV

Thermal conductivity measurement of solids, liquids, and gases, measurement of gas diffusion, convection heat transfer measurements, humidity measurements, heat-flux meters.

Detection of thermal radiation, measurement of emissivity, reflectivity and transmissivity, solar radiation measurement.

UNIT-V

Review of open and closed loop control systems and servo mechanisms, Transfer functions of Mechanical Systems, input and output systems.

TEXT BOOK:

1. Holman, J.P., "*Experimental methods for engineers"*, Tata McGraw-Hill, 7th Edition, 2007.

REFERENCES:

1. Prebrashensky. V., "*Measurement and Instrumentation in Heat Engineering"*, Vol.1, MIR Publishers, 1980.

2. Raman, C.S. Sharma, G.R., Mani, V.S.V., "*Instrumentation Devices and Systems",* 2nd Edition, Tata McGraw-Hill., 2001.

3. Morris. A.S, "*Principles of Measurements and Instrumentation"*, 3rd Edition, Butterworth-Heinemann, 2001.