EXPERIMENTAL METHODS IN THERMAL ENGINEERING

II Semester

Course Code: 19ME2205

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Course Outcomes: At the end of the course the student shall be able to

CO1: Identify the suitable instrument for measuring transport parameters and estimate error.
CO2: Select suitable range of pressure gauge and compute its dynamic response.
CO3: Distinguish different flow visualization methods and temperature measurements.
CO4: Determine thermal conductivity in solids, liquids and gases and radiation measurements.
CO5: Develop transfer function of given mechanical system by using concept of control system.

UNIT-I: **(10-Lectures)**

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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.

Learning outcomes: At the end of this unit, the student will be able to

1. Identify the static and dynamic characteristics of the instrument (L1)
2. List the various errors occurs in the instruments (L1)
3. Explain different transducers and their application (L2)

UNIT-II: **(10-Lectures)**

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

Learning outcomes: At the end of this unit, the student will be able to

1. Discuss dynamic response considerations of an instrument (L2)
2. Classify different pressure gauges and their application (L4)
3. Explain the working and application of pressure gauges (L2)

UNIT-III: **(10-Lectures)**

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.

Learning outcomes: At the end of this unit, the student will be able to

1. Explain about various flow measurement devices and their applications (L2)
2. Discuss various temperature measurement devices and their utility (L2)
3. Outline the temperature measurement in high - speed flows (L4)

UNIT-IV: **(10-Lectures)**

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.

Learning outcomes: At the end of this unit, the student will be able to

1. Explain various methods for measuring thermal conductivity of solids, liquids and gases (L2)
2. Discuss the measurement of humidity and heat transfer measurement (L2)
3. Summarize the various solar radiation measurement techniques. (L2)

UNIT-V: **(10-Lectures)**

Review of open and closed loop control systems and servomechanisms, transfer functions of mechanical systems, input and output systems.

Learning outcomes: At the end of this unit, the student will be able to

1. Discuss open and closed loop control systems (L2)
2. Explain the servomechanisms (L2)
3. Develop transfer functions for a given mechanical systems (L6)

TEXT BOOKS:

1. J.P. Holman, *Experimental Methods for Engineers*, Seventh Edition, Tata McGraw-Hill, 2007.

REFERENCE BOOKS:

1. V. Prebrashensky, *Measurement and Instrumentation in Heat Engineering*, Vol.1, MIR Publishers, 1980.
2. Raman C.S. Sharma and G.R. Mani V.S.V., *Instrumentation Devices and Systems*, 2nd Edition, Tata McGraw-Hill., 2001.
3. A.S. Morris, *Principles of Measurements and Instrumentation*, 3rd Edition, Butterworth-Heinemann, 2001.