

## MECHANICAL MEASUREMENTS

**Course Code:13ME1125**

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### Course Educational Objectives:

To make the student to

- ❖ Impart the knowledge of basic engineering measurement systems for pressure, temperature, level, velocity, flow and vibration
- ❖ Introduce to electronic control systems associated with automatic control of measuring parameters.
- ❖ Apply the principles of measurement to engineering situations

### Course Outcomes:

Student will be able to

- ❖ Identify appropriate instrument for measurement of specific parameter.
- ❖ Calibrate the instruments
- ❖ State the applications, important features and limitations of various measuring instruments

### UNIT-I

**(12 Lectures)**

#### INTRODUCTION:

Definition – Basic principles of measurement – measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. Dynamic performance characteristics –sources of error, classification and elimination of error.

Measurement of force, torque and power: Elastic force meters, load cells, torsion meters, dynamometers.

### UNIT-II

**(12 Lectures)**

#### MEASUREMENT OF DISPLACEMENT:

Theory and construction of various transducers to measure displacement

– piezo electric, inductive, capacitance, resistance, ionization and photo electric transducers, calibration procedures.

#### **MEASUREMENT OF TEMPERATURE:**

Classification , ranges, various principles of measurement, expansion, electrical resistance, thermistor , thermocouple, pyrometers , temperature indicators.

### **UNIT-III**

**(12 Lectures)**

#### **MEASUREMENT OF PRESSURE :**

Units, classification , different principles used., manometers, piston, bourdon pressure gauges, bellows– diaphragm gauges. low pressure measurement – thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge, Knudsen gauge. calibration of pressure gauges.

Measurement of level : Direct method – indirect methods– capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – bubbler level indicators.

#### **FLOW MEASUREMENT:**

Rotameter, magnetic, ultrasonic, turbine flow meter, hot – wire anemometer, laser Doppler anemometer (LDA).

### **UNIT-IV**

**(12 Lectures)**

#### **MEASUREMENT OF SPEED:**

Mechanical tachometers, electrical tachometers, stroboscope, noncontact type of tachometer.

#### **MEASUREMENT OF VIBRATION:**

Different simple instruments, principles of seismic instruments – vibrometer and accelerometer using this principle.

#### **STRAIN MEASUREMENTS:**

Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, Strain gauge Rosettes. Strain gauge calibration.

### **UNIT-V**

**(12 Lectures)**

Measurement of humidity - Moisture content of gases, sling psychrometer, absorption psychrometer, dew point meter.

**ELEMENTS OF CONTROL SYSTEMS:**

Introduction, importance – classification – open and closed systems servomechanisms–examples with block diagrams–temperature, speed & position control systems.

**TEXT BOOK:**

1. D.S Kumar, “*Measurement Systems: Applications & design*”, 6<sup>th</sup> Edition, Metropolitan, 2002.

**REFERENCES:**

1. A.K.Sawhney, “*Mechanical Measurement and Instrumentation*”, 3<sup>rd</sup> Edition, Dhanpat Rai, 2004.
2. Holman, “*Experimental Methods for Engineers*”, 3<sup>rd</sup> Edition, McGraw-Hill, 2000.
3. B.C.Nakra & K.K.Choudhary, “*Instrumentation measurement & analysis*”, 4<sup>th</sup> Edition, TMH, 1999.

