

### INSTRUMENTATION & CONTROL SYSTEMS

#### Course Objectives:

The course focuses on imparting the principles of measurement which includes the working mechanism of various sensors and devices, that are in use to measure the important physical variables of various mechatronic systems.

#### UNIT – I

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 Displacement:** Theory and construction of various transducers to measure displacement – piezo electric, inductive, capacitance, resistance, ionization and photo electric transducers, calibration procedures.

#### UNIT – II

**MEASUREMENT OF TEMPERATURE:** Classification – ranges – various principles of measurement – expansion, electrical resistance – thermister – thermocouple – pyrometers – temperature indicators.

**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.

#### UNIT – III

**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).

**MEASUREMENT OF SPEED :** Mechanical tachometers – electrical tachometers – stroboscope, noncontact type of tachometer

**Measurement of Acceleration and Vibration:** Different simple instruments – principles of seismic instruments – Vibrometer and accelerometer using this principle.

#### UNIT – IV

**STRESS 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.

## **UNIT – V**

**MEASUREMENT OF HUMIDITY** – Moisture content of gases, sling psychrometer, absorption psychrometer, dew point meter.

**MEASUREMENT OF FORCE, TORQUE AND POWER-** Elastic force meters, load cells, torsion meters, dynamometers.

## **UNIT – VI**

**ELEMENTS OF CONTROL SYSTEMS :** Introduction, importance – classification – open and closed systems, servomechanisms–examples with block diagrams–temperature, speed & position control systems.

### **Text Books:**

1. Measurement Systems: Applications & design / D.S Kumar/
2. Mechanical Measurements / BeckWith, Marangoni,Linehard, Pearson

### **References:**

1. Measurement systems: Application and design/Doebelin Earnest. O. Adaptation/ TMH
2. Experimental Methods for Engineers / J.P.Holman/McGraw Hill
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4. Instrumentation, measurement & analysis / B.C.Nakra & K.K.Choudhary/TMH

### **Course outcomes:**

After undergoing the course the student can select appropriate device for the measurement of parameters like temperature, pressure, speed, stress, humidity, flow velocity etc., and justify its use through characteristics and performance.