

## MECHANICAL MEASUREMENTS & METROLOGY

**Course Code: 15ME1142**

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### Course outcomes:

At the end of the Course, the Student will be able to:

- CO 1** Identify appropriate elements of a measurement system and select instruments for displacement measurement.
- CO 2** Select instruments for temperature, pressure and flow measurement.
- CO 3** Apply the principles of speed, acceleration and stress measurement to develop simple prototype instrumentation setup.
- CO 4** Explain the concept of existing systems of limits and fits and theory of linear, and angular measurement.
- CO 5** Describe surface roughness measurement, screw thread measurement and gear measurement.

### UNIT-I

(10 Lectures)

#### INTRODUCTION TO MEASUREMENT SYSTEM:

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–piezoelectric, inductive, capacitance, resistance, ionization and photo electric transducers

**UNIT-II****(10 Lectures)****MEASUREMENT OF TEMPERATURE:**

Classification, various principles of measurement-expansion, electrical resistance, thermistor, thermocouple, pyrometers

**MEASUREMENT OF PRESSURE:**

Units, classification, different principles used, bourdon pressure gauges, bellows, diaphragm gauges. Low pressure measurement – thermal conductivity gauges, Mcleod pressure gauge

**FLOW MEASUREMENT:**

Rotameter, magnetic, ultrasonic, turbineflowmeter, hot-wireanemometer

**UNIT-III****(10 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 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-IV****(10 Lectures)****SYSTEMS OF LIMITS AND FITS:**

Introduction, nominal size, tolerance limits, deviations, allowance, fits and their types–unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian standard Institution system, International standard system, Taylors principle, Plug, ring and snap gauges(qualitative treatment).

**LINEAR, ANGULAR AND OPTICAL MEASURING INSTRUMENTS:**

Slip gauges, dial test indicator, bevel protractor ,angle slip gauges,

sine bar, spirit levels, Tool maker's microscope, Auto collimator, optical flat, N.P.L. Flatness interferometer

## UNIT-V

(10 Lectures)

### FORM MEASUREMENT:

Principles and Methods of straightness – Flatness measurement, Roundness measurement – Applications.

### SURFACE ROUGHNESS MEASUREMENT:

Differences between surface roughness and surface waviness, numerical assessment of surface finish– CLA, R.M.S Values, Rz value, Tomlinson's surface meter, Talysurf

### SCREW THREAD MEASUREMENT:

Elements of measurement–errors in screw threads–measurement of effective diameter, angle of thread and thread pitch

### GEAR MEASUREMENT:

Gear measuring instruments, gear tooth profile measurement, measurement pitch and tooth thickness

### TEXT BOOKS:

1. D.S Kumar, "Measurement Systems: Applications & design", 6<sup>th</sup> Edition, Metropolitan, 2002.
2. I C Gupta, "Engineering Metrology", 5<sup>th</sup> Edition, Danapath Rai & Co, 2008.

### REFERENCES:

1. R.K. Jain, "Engineering Metrology". 20<sup>th</sup> Edition, Khanna Publishers, 2007.
2. M. Mahajan, "Engineering Metrology", Dhanapat Rai publications, 2007.
3. A.K.Sawhney, "Mechanical Measurement and Instrumentation", 3<sup>rd</sup> Edition, Dhanpat Rai, 2004.
4. Holman, "Experimental Methods for Engineers", 3<sup>rd</sup> Edition, McGraw-Hill, 2000.