

**B.Tech IV Year I Semester**

**JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA**

**19AME71 – METROLOGY AND MEASUREMENTS**

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**Course Objectives:** The objectives of the course are to make the students learn about

- Introduce the basic concepts of metrology and measurement methods.
- Demonstrate the importance of metrology in manufacturing
- Explain the concepts of transducers and its practical applications.
- Expose with various measuring instruments

**UNIT – 1: Concept of Measurement**

**8 Hrs**

**Concept of Measurement:** General concept-generalized measurement system, units and standards, measuring instruments, sensitivity, readability, range of accuracy, precision, static and dynamic response, repeatability, systematic and random errors, correction, calibration, terminology and limits fits and tolerances, hole basis and shaft basis system, interchangeability.

**Limit Gauges And Gauge Design:** Plug, Ring, Snap, Gap, Taper gauges. Taylor's principle. Design of Go and No Go gauges.

**Linear and Angular Measurement:** Linear measuring instruments: Vernier instruments, micrometers, slip gauges, tool makers microscope. Comparators: Mechanical, pneumatic and electrical. Angular measurements: Sine bar, bevel protractor and angle dekkor, rollers and spheres used to determine the tapers.

**Learning Outcomes:**

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

- Identify important parameters in metrology. L3
- Differentiate interchangeability and selective assembly L4
- Select limits and tolerances for different assemblies. L1

**UNIT – II: Flatness Measurement & Surface Roughness Measurement**

**6 Hrs**

**Flatness Measurement:** Measurement of flatness – straight edges – surface plates, optical flat and autocollimators, interferometers and their applications.

**Surface Roughness Measurement:** Terminology systems, differences between surface roughness and surface waviness- Numerical assessment of surface finish - CLA, R,M,S Values-Ra , Rz values, Methods of measurement of surface finish-profilograph, talysurf, BIS symbols for indication of surface roughness.

**Learning Outcomes:**

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

- Inspect the flatness of surfaces. L4
- Recall the terms used in surface roughness measurement. L1
- Explain the factors affecting the surface finish in machining. L2
- Demonstrate the application of different surface measuring instruments. L2

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 Head  
 Mechanical Engineering Department,  
 JNTUA College of Engineering,  
 PULIVENDULA - 516 399.

**UNIT – III: Metrology of Screw Threads & Gear measurement****6Hrs****Metrology of Screw Threads:**

Screw thread measurements: Elements of threads, errors in screw threads, various methods for measuring external and internal screw threads, screw thread gauges.

**Gear Measurement:** Gear tooth terminology, measurement of gear elements-runout, lead, pitch backlash, profile, pressure angle, tooth thickness, diameter of gear, constant chord and base tangent method.

**Learning Outcomes:**

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

- Identify the errors in screw threads. L3
- Explain the principles of gear measuring instruments L2
- Select the tools and methods for measuring screw thread, gear profiles. L1

**UNIT – IV: Measurement of Displacement & Strain****6 Hrs**

**Measurement of Displacement:** Theory and construction of various transducers to measure displacement - Piezo electric, inductive, capacitance, resistance, ionization and photoelectric transducers, calibration procedures.

**Measurements of Strain:** Various types of electrical strain gauges, gauge factor, method of usage of resistance strain gauge for bending, compressive and tensile strains, usage for measuring torque, strain gauge rosettes.

**Learning Outcomes:**

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

- List various types of transducers used for the measurement of displacement. L1
- Explain the static and dynamic characteristics of transducers. L3
- Classify the transducers with respect to change in resistance, capacitance and inductance L4
- Experiment with measurement of strain L3

**UNIT – V: Replacement and Maintenance Analysis****6 Hrs**

**Measurement of Force:** Direct method - analytical balance, platform balance; elastic members – load cells, cantilever beams and proving rings.

**Measurement of Torque:** Torsion bar dynamometer, servo controlled dynamometer and absorption dynamometer.

**Measurement of Pressure:** Standards and calibration, basic methods of pressure measurement, dead weight gauges and manometers, High and low pressure measurement, Elastic transducers.

**Learning Outcomes:**

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

- Identify various types of transducers used for the measurement of force, torque and pressure L3
- Explain methods of measurement of force, torque and pressure L2
- Develop the techniques for calibration of force, torque and pressure measuring devices L3

**Text Books:**

1. Beckwith, Marangoni, Linehard, Mechanical Measurements, 6/e, PHI, 2013.
2. R.K. Jain, Engineering Metrology, 20/e, Khanna Publishers, 2013.

**Reference Books:**

1. Mahajan, Engineering Metrology, 2/e, Dhanpat Rai, 2013.
2. S.Bhaskar, Basic Principles - Measurements and Control Systems, Anuradha Publications, 2014.
3. Anand K Bewoor & Vinay A Kulkarni, Metrology & Measurement, 15/e, McGrawHill, 2015.

**Course Outcomes:**

At the end of this Course the student will be able to

- List various measuring instruments used in metrology. L4
- Examine geometry of screw threads and gear profiles. L4
- Measure force, torque and pressure. L5
- Calibrate various measuring instruments. L4

  
Head  
Mechanical Engineering Department,  
JNTUA College of Engineering,  
PULIVENDULA - 516 390.

