



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF MECHANICAL ENGINEERING

III Year - I Semester		L	T	P	C
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MECHANICAL MEASUREMENTS & METROLOGY					

Course objectives: The students will learn

1. Inspection of engineering parts with various precision instruments
2. Design of part, tolerances and fits
3. Principles of measuring instruments and gauges and their uses
4. Evaluation and inspection of surface roughness
5. Inspection of spur gear and thread elements
6. The methods of measurement of displacement, speed, acceleration, vibration, stress and strain, force, torque and power.

UNIT – I

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.

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

UNIT-II

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.

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

MEASUREMENT OF ACCELERATION AND VIBRATION: Different simple instruments – principles of seismic instruments – Vibrometer and accelerometer using this principle.

UNIT-III

SYSTEMS OF LIMITS AND FITS: Introduction, nominal size, tolerance, limits, deviations, fits -Unilateral and bilateral tolerance system, hole and shaft basis systems- interchangeability, deterministic & statistical tolerances, selective assembly. International standard system of tolerances, selection of limits and tolerances for correct functioning.

LIMIT GAUGES:

Taylor's principle – design of go and no go gauges; plug, ring, snap, gap, taper, profile and position gauges.

UNIT-IV

LINEAR MEASUREMENT: Length standards, end standards, slip gauges- calibration of the slip gauges, dial indicators, micrometers.

MEASUREMENT OF ANGLES AND TAPERS:



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Different methods – bevel protractor, angle slip gauges- angle dekkor- spirit levels- sine bar- sine table, rollers and spheres used to measure angles and tapers.

OPTICAL MEASURING INSTRUMENTS: Tools maker's microscope and uses - autocollimators, optical projector, optical flats and their uses. Interferometry- Interference of light, Michelson's interferometer, NPL flatness interferometer, and NPL gauge interferometer.

COMPARATORS: Types - mechanical, optical , electrical and electronic, pneumatic comparators and their uses.

UNIT-V

SURFACE ROUGHNESS MEASUREMENT: Differences between surface roughness and surface waviness –Numerical assessment of surface finish-CLA, Rt., R.M.S. Rz, R10 values, Method of measurement of surface finish – Profilograph, Talysurf, ISI symbols for indication of surface finish.

GEAR MEASUREMENT: Nomenclature of gear tooth, tooth thickness measurement with gear tooth vernier & flange micro meter, pitch measurement, total composite error and tooth to tooth composite errors, rolling gear tester, involute profile checking.

SCREW THREAD MEASUREMENT: Elements of measurement – errors in screw threads- concept of virtual effective diameter, measurement of effective diameter, angle of thread and thread pitch, and profile thread gauges.

FLATNESS MEASUREMENT:

Measurement of flatness of surfaces- instruments used- straight edges- surface plates – auto collimator.

Text Books:

1. Engineering Metrology / R.K.Jain / Khanna Publishers
2. Measurement Systems: Applications & design / D.S Kumar/

References:

1. Measurement systems: Application and design/Doeblin 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
- 5.Engineering Metrology / Mahajan / Dhanpat Rai Publishers
6. Engineering Metrology / I.C.Gupta / Dhanpat Rai Publishers
7. Precision Engineering in Manufacturing / R.L.Murthy / New Age
8. Engineering Metrology and Measurements / NV Raghavendra, L Krishna murthy/ Oxford publishers.
9. Engineering Metrology / KL Narayana/Scitech publishers

Course outcomes: Students will be able to

CO1: Describe the construction and working principles of measuring instruments for measurement of displacement and speed and select appropriate instrument for a given application.

CO2: Describe the construction and working principles of measuring instruments for strain, force, Torque, power, acceleration and Vibration and select appropriate instrument for a given application.

CO3: Explain shaft basis system and hole basis systems for fits and represent tolerances for a given fit as per the shaft basis system and hole basis system and design limit gauges based on the tolerances for quality check in mass production.



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CO4: Explain methods for linear, angle and flatness measurements and select a suitable method and its relevant instrument for a given application.

CO5: To measure the threads, gear tooth profiles, surface roughness and flatness using appropriate instruments and analyze the data.