

ME413 Metrology										
L	T	P	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC/GEC		15/25	25	20/25	40/50	-

**Objectives:** To enable the students to understand the basics of metrology, line and end standards, comparators. To understand the concepts of sine bar and measurement of surface texture.

Syllabus		Contact Hours
<b>Unit-1</b>	<p><b>Principles of measurement:</b> Definition of Metrology, difference between precision and accuracy. Sources of errors: Controllable and Random Errors, Effects of Environment and Temperature, Effects of support, alignment errors, application of Least Square principles, errors in measurement of a quality which is function of other variables.</p> <p><b>Length Standards:</b> Line standards, end standards and wavelength standards, transfer from line standards to end standards. Numericals based on line standards. Slip gauges – its use and care, methods of building different heights using different sets of slip gauges.</p> <p><b>Limits, fits and tolerances:</b> Various definitions, IS919-1963, different types of fits and methods to provide these fits. Numerical to calculate the limits, fits and tolerances as per IS 919- 1993. ISO system of limits and fits; Gauges and its types, limit gauges – plug and ring gauges. Gauge Design – Taylor’s Principle, wear allowance on gauges. Different methods of giving tolerances on gauges, Numericals.</p>	<b>6</b>
<b>Unit-2</b>	<p><b>Comparators:</b> Characteristics, Uses, Limitation, Advantages and Disadvantages. Mechanical Comparators: Johanson Mikrokator and Sigma Mechanical Comparator. Mechanical - optical comparator. Electrical and electronic comparators. Pneumatic comparators – Systems of Pneumatic gauging: Flow type and back pressure type, different type of sensitivities and overall magnification. Solex Pneumatic gauge and differential comparators. Numericals.</p>	<b>8</b>
<b>Unit-3</b>	<p><b>Angular Measurement:</b> Sine Bar – different types of sine bars, use of sine bars in conjunction with slip gauges, precautions and calibration of sine bars. Use of angle gauges, spirit level, errors in use of sine bars. Numericals. Principle and working of Micro-optic autocollimator. Circular Division: dividing head and circular tables, circular division by precision Polygons. Caliper Principle, Calibration of polygons. Numerical based on circular division.</p> <p><b>Straightness and flatness:</b> Definition of Straightness and Flatness error. Determination of straightness error of straight edge with the help of spirit level and auto collimator. Determination of flatness error of a surface plate with the help of spirit level or auto collimator. Numericals.</p>	<b>8</b>
<b>Unit-4</b>	<p><b>Screw Thread Measurement:</b> Errors in threads, Measurement of elements of screw threads – major diameter, minor diameter, pitch, flank angle and effective diameter (Two and three wire methods). Effect of errors in pitch and flank angles and its mathematical derivation.</p> <p><b>Gear Measurement:</b> Measurement of tooth thickness – Gear tooth verniercaliper, Constant chord method, base tangent method and derivation of mathematical formulae for each method. Test plugs method for checking pitch diameter and tooth spacing. Measurement of Gear Pitch, Parkinson Gear Tester. Numericals.</p>	<b>6</b>
<b>Unit-5</b>	<p><b>Machine Tool Alignment:</b> Machine tool tests and alignment tests on lathe. Alignment tests on milling machine. Alignment tests on a radial drilling machine.</p>	<b>8</b>

	<b>Interferometry:</b> Principle of measurement, Interferometry applied to flatness testing, surface contour tests, optical flats, testing of parallelism of a surface with the help of optical flat. Quantitative estimate of error in parallelism, Flatness Interferometer, NPL Gauge length interferometer for checking the error in slip gauges. Numericals based on Interferometry.	
<b>Unit-6</b>	<b>Surface texture:</b> Introduction, different types of irregularities, standard measures for assessment and measurement of surface finish.	<b>6</b>
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<b>Reference Book:</b>	
1	Engineering Metrology”, R.K. Jain, Khanna Publishers, Delhi. ISBN-13-9788174091536
2	Engineering Metrology, I.C. Gupta, Dhanpat Rai Publications, Delhi ISBN: Released: 9788189928452
3	Metrology for Engineers”, F.W. Galyer & C.R. Shotbolt, “ELBS edition. ISBN-13: 978-0304318445
4	Fundamentals of Mechanical Inspection”, R. Jenkins, McGraw Hill. (OCoLC) 600502978
5	“Fundamentals of Dimensional Metrology”, C. Dotson ISBN-13: 9781418020620. Cengage Learning
6	A.S.T.M.E., “Handbook of Industrial Metrology”, Prentice Hall. ISBN: 9783527406661

### Course Outcomes

CO1	Understanding about Metrology, Principles of measurement, Sources of errors, Length Standards: Line standards, end standards and wavelength Standards, along with Slip gauges, its use and care as well as Limits, fits and tolerances
CO2	To understand the principle, types and application of Comparators along with their Characteristics, Limitation and Advantages & Disadvantages.
CO3	To understand the principle, types and instruments of Angular as well as Straightness and flatness.
CO4	To enable the students to understand about the parameters of Screw Thread and Gears, their Measurements and Errors.
CO5	To understand about various Machine tool tests and Alignment tests on Lathe, Milling machines and Drilling machines. Also about principle of Interferometry and its application in Metrology.
CO6	To understand different types of irregularities, standard measures for assessment and measurement of surface finish.

### CO-PO/PSO Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	2	3	2	3	2	3	2	-	-
CO2	3	2	3	2	2	3	2	3	2	2	3	3	3	-	2
CO3	2	3	3	2	3	2	2	2	2	3	2	3	2	-	2
CO4	3	3	3	3	2	3	3	2	3	2	2	3	2	-	2
CO5	2	2	3	2	3	2	3	2	2	2	2	2	2	-	2
CO6	3	3	3	2	2	2	2	3	3	2	3	3	2	-	2