

AE-312: Metrology										
L	T	P	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** This course aims to introduce the student with principles of measurement, types of standards, limits, fits, tolerances; measurement of angle, screw threads, gear measurement and testing on machines.

AE-312: Metrology		Contact Hours
Unit-1	<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. Length Standards: Line standards, end standards and wavelength standards, transfer from line standards to end standards. Numerical based on-line standards. Slip gauges – its use and care, methods of building different heights using different sets of slip gauges. Limits, fits and tolerances: Various definitions, IS 919:1963, 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.	8
Unit-2	<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.	6
Unit-3	<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. Numerical. Principle and working of Microoptic autocollimator. Circular Division: dividing head and circular tables, circular division by precision Polygons. Caliper Principle, Calibration of polygons. Numerical based on circular division. Straightness and flatness: 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	6
Unit-4	<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.	8
Unit-5	<b>Gear Measurement:</b> Measurement of tooth thickness – Gear tooth Vernier caliper, 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	8
Unit-6	<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. Interferometry: 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. Surface texture: Introduction, different types of irregularities, standard measures for assessment and measurement of surface finish.	6
<b>Total</b>		<b>42</b>

Reference Books:	
1	R.K. Jain, “Engineering Metrology”, Khanna Publishers, Delhi, BN 10: 817409153X ISBN 13: 9788174091536
2	I.C. Gupta, “Engineering Metrology”, Dhanpat Rai Publications, Delhi, ISBN-10- 8189928457
3	F.W. Galyer & C.R. Shotbolt, “Metrology for Engineers”, ELBS edition., ISBN-10: 0304318442/ISBN-13: 978-0304318445
4	R. Jenkins, “Fundamentals of Mechanical Inspection”, Tata, McGraw Hill,
5	C. Dotson, R. Harlow, R. Thompson, “Fundamentals of Dimensional Metrology”, Thomson Asia Pte Ltd., Singapore 6. A.S.T.M.E., “Handbook of Industrial Metrology”, Prentice Hall, ISBN-10: 1418020621 ISBN-13: 978-1418020620

#### Course Outcomes

CO1	To understand Principles of measurement, standards, measuring instruments.
CO2	To understand comparators and its types with comparison
CO3	To understand angular measuring instruments and its error calculations
CO4	To understand screw thread measuring methods and its error
CO5	To understand Gear measuring methods.
CO6	To understand Machine Tool Alignment and quantitative analysis of errors.

#### 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	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2