

2PT03: MECHANICAL MEASUREMENT AND METROLOGY
CREDITS – 4 (LTP: 3, 0, 1)

Course Objective:

To introduce techniques and instrumentation used in mechanical measurement and Metrology

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE	CE	ESE	CE		
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	<p>Basic Concepts of Measurements: Introduction to measurement and measuring instruments, Methods of measurement, Modes of measurement, generalized measuring system and functional elements, instruments and its classifications, Sensors & Transducer and its classification, Static and dynamic performance characteristics of measurement devices, sources of error in measurement, classification and elimination of errors, calibration, uncertainty in measurements.</p>	05
2	<p>Measurement of Displacement, Velocity/Speed, Acceleration Force, Torque, Power and Strain: Working principal of Resistive potentiometer, Linear variable differential transducers, Electro Magnetic Transducers, Tachometers: Mechanical, Electrical, Photoelectric and Stroboscope, Accelerometers: Piezoelectric, Seismic, Strain gauge accelerometer.</p> <p>Hydraulic force meter, Pneumatic force meter, Strain gauge load cell, Cantilever beams, Proving rings, and Linear variable differential transformers.</p> <p>Measurement of torque and power: Prony brake dynamometer, Rope brake dynamometer, Hydraulic dynamometer, Eddy current dynamometer, Torsion bar dynamometer, Servo-controlled dynamometer.</p> <p>Measurement of strain: Mechanical strain gauges, electrical strain gauges, strain gauge: materials, gauge factors, theory of strain gauges and method of measurement, bridge arrangement, temperature compensation.</p>	08
3	<p>Temperature, Pressure and Flow Measurements : Methods of temperature Measurement; Expansion thermometers: Bi-metallic, Liquid in glass; Filled System thermometers; Electrical temperature measuring instrument: Thermocouples, RTD, Thermistors; Pyrometers; Calibration of temperature measuring instruments.</p>	09

Unit No.	Topics	Teaching Hours
	Pressure standards and methods of pressure measurement; Elastic pressure transducers; Measurement of Vacuum; Force balance pressure gauges; Electrical pressure transducers; Calibration of pressure measuring instruments.	
	Flow measurement: Rotameter, magnetic, ultrasonic, turbine flow meter, hot – wire anemometer, Laser Doppler Anemometer (LDA).	
4	Linear & Angular Measurements and comparators: Introduction to metrology, Standards of Measurement	08
	Linear measuring instruments: Classification, Least count, engineer’s steel rule, Calipers, Vernier caliper and types, Vernier height gauge, Vernier depth gauge, Micrometers, Types of micrometers, Bore gauge, Telescopic gauge, Slip gauges, Limit gauges, calibration of linear measuring instruments , Dial Gauge.	
	Angular and taper measuring instruments: Protractors, Sine bars, Sine centre, Angle gauges, Spirit level, Clinometers, Angle dekkor, Measurement of taper shafts and holes.	
	Functional Requirements, Classification, Mechanical Comparators, Mechanical Optical Comparators, Electrical Comparators, Pneumatic Comparators.	
5	Metrology of Gears & Screw threads and Surface finish: Measurement of tooth thickness:	08
	Gear tooth Vernier, Constant chord method, Addendum comparator method and Base tangent method, Measurement of tooth profile: Tool maker’s microscope, profile projector, Involute tester, Measurement of pitch, Measurement of run out, Lead and Backlash checking. Measurement of concentricity, Alignment of gears.	
	Screw Thread Measurement:	
	Errors in threads, screw thread gauges, measurement of element of the external and internal threads, thread calliper gauges.	
	Surface Metrology Concepts and terminology, Analysis of surface traces, Specification of surface Texture characteristics, and Method of measuring surface finish: Stylus system of measurement, Stylus probe instruments, Wave length, frequency and cut off, other methods for measuring surface roughness: Pneumatic method, Light Interference microscopes, Mecrin Instruments.	
6	Introduction to Advanced Metrology: Precision Instrumentation based on Laser Principals, Coordinate measuring machines (CMM): Structure, Modes of Operation, Probe, Operation and applications.	04
	Optical Measuring Techniques: Optical Square. Basics of Optical Interference and Interferometry, Optoelectronic measurements.	
Total		42

List of References:

1. D.S. Kumar, "*Mechanical Measurement & Control*", 4th Edition, Metropolitan Book Co, New Delhi, 2006.
2. B.C. Nakra and K.K. Choudhary, "*Instrumentation measurement and analysis*", 3rd Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2009.
3. A.K.Sawhney and Puneet Sawhney, "*Mechanical Measurement and Instrumentation and Control*", 12th Edition, Dhanpat Rai & Co, 2009.
4. S. K. Singh, "*Industrial Instrumentation and Control*", 3rd Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2009.
5. Thomas G. Beckwith, Roy D. Marangoni and John H. Lienhard V, "*Mechanical Measurements*" (6th Edition) 6th Edition, by, Published by Addison Wesley.
6. I C Gupta, "*Engineering Metrology*", Dhanpat Rai Publications.
7. Bentley, "*Engineering Metrology and Measurements*", Pearson Education.
8. J. P Halman, "*Experimental Methods for Engineers*", 8th Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2012.

Course Outcomes (COs):

At the end of this course students will be able to ...

1. Interpret characteristics of measuring instruments.
2. Apply measurement techniques for various physical quantities.
3. Use instruments for linear and angular measurement
4. Use devices for gear, screw threads and surface finish measurements.