Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Mechanical Engineering

Subject Code : PC-ME404	**Category:** Professional Core courses
Subject Name : Metrology & Instrumentation	**Semester** : Fourth
L-T-P : **3-1-0**	**Credit:4**
Pre-Requisites: No-prerequisite	

Objectives:

1. To understand the working of linear and angular measuring instruments.
2. To familiarize with the working of optical measuring instruments and fundamentals of limits and limit gauges.
3. To give basic idea about various methods for measurement of screw thread and surface finish parameters.
4. To give an exposure to advanced measuring devices and machine tool metrology.
5. To provide students an overview of mechanical measurement systems and principle of instruments for motion and dimension measurement.
6. To provide basic idea about working principle and applications of devices for measurement of force and torque; strain and stress and temperature.

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	Concept of measurement:-Introduction to Metrology; Need for high precision measurements; Terminologies in Measurement- Precision, accuracy, sensitivity, calibration, resolution. Errors in Measurement, types of errors, Abbe's Principle. Basic standards of length- Line standard, End standards, Wavelength standard; Various Shop floor standards. Linear Measurement – Slip gauges, wringing, grades; Surface plate; Dial indicators; Height gauges and Vernier calliper; screw gauge. Comparators- mechanical, electrical, optical and pneumatic. Angular Measurement – Bevel protractor; Sine Bar, principle and use of sine bar, sine centre; Angle gauges. Sprit level; Angle Dekkor; Clinometers.	8
2	Limits and Limit gauges – Making to suit, selective assembly, systems of limits and fits; Types of fits; Hole basis system and Shaft basis system. Tolerance, allowance and deviation (as per BIS). Limit Gauges – GO and NO GO gauges; types of limit gauges. Gauge design - Taylor's principle of gauging; Gauge tolerance, disposition of gauge tolerance, wear allowance. Optical Measuring Instruments: - Benefits of light waves as standards; Monochromatic light; Principle of Interference. Interference band, optical flat, surface measurement. Interferometers – NPL, Pitter-NPL, auto collimator.	8
3	Screw thread measurement – Screw thread terminology; Measurement of major diameter; root diameter; pitch; effective diameter with two wire method and three wire method. Measurement of flank angle and form by profile projector and microscope. Measurement of surface texture –	8

	roughness and waviness; Analysis of surface traces, peak to valley height, R.M.S. value, Centre Line Average and Ra value, Rt, Rz etc. Methods of measuring surface roughness – Stylus probe, Tomlinson surface meter, Talysurf; surface roughness measurement – assessment length, roughness width cut-off, sampling length and evaluation length.	
4	Introduction to Digital Measurement– significance of Digital measurement; methods; Classification. Stages in generalized measuring system– Sensor-Transducer stage, Signal-Conditioning stage, Readout-Recording stage; Types of input quantities; Active and Passive transducers. Performance characteristic of measuring devices. Drift, Resolution, Threshold, Hysteresis, Static calibration. Dynamic characteristics- different order systems and their response-, Measuring lag, Fidelity, Dynamic error; Transducers– Working, Classification of transducers. Motion and Dimension measurement – LVDT – Principle, applications, advantages and limitations.	8
5	Strain and Stress Measurement- Electrical resistance strain gauge-Principle, operation. Measurement of Force and Torque– Strain-Gauge Load Cells, Hydraulic and Pneumatic load cells– force measurement using piezoelectric quartz crystal. Torque Measurement– Dynamometers– Mechanical, Hydraulic and Electrical. Vibration measurement– Vibrometers and Accelerometers. Temperature Measurement– Use of Thermal Expansion– Liquid-in-glass thermometers, Bimetallic strip thermometer, Pressure thermometers. Thermocouples– Resistance Temperature Detectors (RTD); Thermistors; Pyrometers.	8

Course Outcomes:

Upon successful completion of the course, student will have

1. Understand the working of linear and angular measuring instruments.
2. Know the fundamentals of limits and limit gauges, various methods for measurement of screw thread and surface roughness parameters and the working of optical measuring instruments.
3. Acquire an overview of mechanical measurement systems and principle of instruments for motion and dimension measurement.
4. Get basic idea about working principle and applications of devices for measurement of force and torque; strain and stress and temperature.

Text Books:

1. Anand K Bewoor, Vinay A Kulkarni, Metrology & Measurement, McGraw-Hill, 2009
2. Ernest O. Doebelin, Dhanesh N. Manik, Measurement Systems Application and Design, McGraw-Hill, 2004
3. Galyer J.F.W., Schotbolt C.R., Metrology for Engineers, ELBS,1990
4. Thomas G. Beckwith, John H. L., Roy D. M., Mechanical Measurements, 6/E, Pearson Prentice Hall, 2007
5. R.K. Rajput, Mechanical Measurements & Instrumentation, S.K.Kataria & Sons.