III B.Tech II Semester

15AME34 - METROLOGY AND INSTRUMENTATION

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Course objective:

Students will be able to understand the Limits and Fits, linear measurements and angular measurements, gauges, comparators, optical measuring methods, measurement of flatness and roughness of surface. And also learn about the screw thread and gear measuring methods, Alignment tests on machine tools. Students will be able to understand various transducers to measure displacement like Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers and also learn about Calibration procedure, temperature and pressure calibration methods, measurement of flow stress, strain measurements acceleration and vibration.

UNIT I

LIMITS, FITS And TOLERNCES : Introduction, Definitions, fits and their types - unilateral and bilateral tolerance system, hole and shaft basis systems - interchangeability and selective assembly. Indian standard system - International Standard organization system for plain work.

Limit Gauges And Gauge Design: Plug, Ring, Snap, Gap, Taper gauges. Taylor's principle.Design of Go and No Go gauges.

Comparators: Principle of Measurement with Mechanical, Optical, Electrical, Electronic, Pneumatic comparators and their uses.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand the Limits, Fits and Tolerance. Indian standard system - International Standard organization system.After completion of this unit students are able to study the different types of Comparators,

UNIT II

Linear Measurement: Length standard, line and end & wavelength standards, slip gauges - calibration of the slip gauges, Dial indicator, micrometers, vernier height gauges.

Measurement Of Angles And Tapers: Different methods - Bevel protractor - angle gauges - spirit levels - sine bar - Sine plate, rollers and spheres used to determine the tapers.

Flatness Measurement: Measurement of flatness of surfaces - straight edges- surface plates - optical flat and auto collimators, interferometer and their uses.

Learning outcome & Suggested Student Activities:

He will know the principles of working of the most commonly used instruments for measuring linear and angular measurements.Optical measuring instruments, flatness measurement methods and measuring methods of surface roughness.

UNIT III

Surface Roughness Measurement: Differences between surface roughness and surface waviness- Numerical assessment of surface finish - CLA, R.M.S Values - R_a , R_Z values, Methods of measurement of surface finish-profilograph, Talysurf, BIS symbols for indication of surface finish.

Screw Thread Measurement: Elements of measurement - errors in screw threads - measurement of effective diameter, angle of thread and thread pitch- profile thread gauges.

Gear Measurement: Gear measuring instruments, Gear tooth profile measurement. Measurement of diameter, pitch, pressure angle and tooth thickness.

Machine Tool Alignment Tests: Requirements of Machine Tool Alignment Tests, Alignment

tests on lathe, milling and drilling machine tools. Preparation of acceptance charts.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand, Screw thread elements and measuring methods, Gear tooth profile measurement, Alignment tests on lathe, milling and drilling machine tools.

UNIT IV

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 .

Stress & Strain Measurements: Various types - 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 Acceleration And Vibration: Different simple instruments - Principles of Seismic instruments - Vibrometer and accelerometer.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand working of various instruments used for measuring for displacement, stress, strain, speed, acceleration and vibration.

UNIT V

Measurment Of Temperature: Standards and calibration, thermal expansion methods, thermo electric sensors(thermocouples), Electrical Resistance sensors, Junction semiconductor sensors, Digital thermometers, Radiation methods.

Measurement Of Pressure And Sound: Standards and calibration, basic methods of pressure measurement, dead weight gauges and manometers, Elastic transducers, vibrating cylinder, resonant transducers, High and low pressure measurement.

Measurement Of Force, Torque, Power: Standards and calibration, Basic methods of Force Measurement, Torque measurement on rotating shafts, shaft power measurement(dynamometers), Vibrating wire force transducers.

Learning outcome & Suggested Student Activities:

After completion of this unit students are able to understand working of various instruments used for measuring for temperature, pressure, force, torque and power.

TEXT BOOKS:

1. Basic principles measurments and controle systems, S.Bhaskar, Anuradha Publications.
2. Mechanical Measurements ,Beckwith, Marangoni, Linehard, PHI.
3. Engineering Metrology, Mahajan, DhanpatRai, 2nd edition, 2013.
4. Engineering Metrology, R.K. Jain, Khanna Publishers, 20th edition, 2013.

REFERENCE BOOKS:

1. BIS standards on Limits & Fits.
2. Measurement systems: Application and design, Doeblin Earnest. O. Adaptation by Manik and Dhanesh, TMH,2012.
3. Fundamentals of Dimensional Metrology,Connie Dotson ,4e, Thomson.
4. Metrology & Measurement by Anand K Bewoor, vinay A kulkarni, McGrawHill, 2013.
5. Instrumentation, measurement &analysis, B.C.Nakra&KKChoudhary, TMH, 6th edition, 2011.

Web References:

- http://emtool box.nist.gov
- CambridgeViscosity.com/Viscometer
- www.e.FlukeCal.com/Calibration
- www.inscotemperature.com/
- www.solartronmetrology.com/
- http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv113-Page1.htm