

Subject Code: 01ME0504
Subject Name: Metrology
B.Tech. III Year – (Sem-5) Mechanical Engineering
Type of course: Programme core

Pre requisite: Nil

Teaching Scheme:

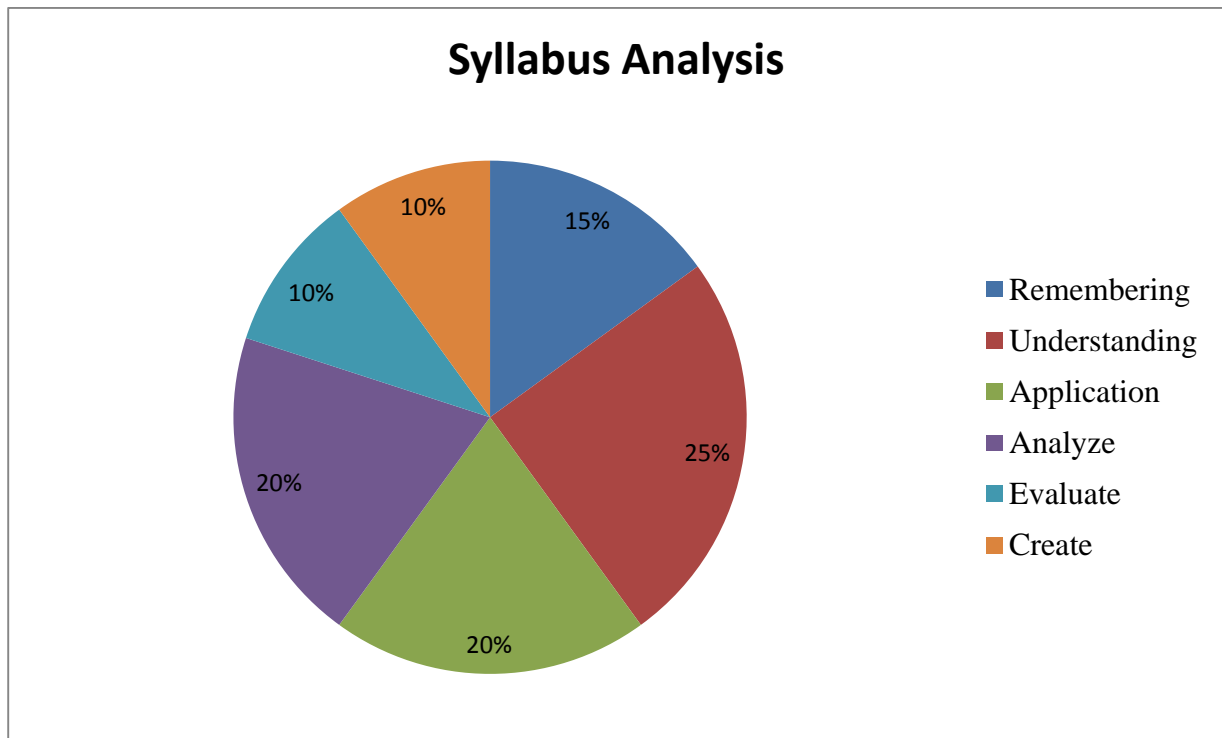
Teaching Scheme			Credits	Examination Marks					Total Marks
L	T	P		C	Theory Marks			Practical Marks	
			E		I	CSE	Viva	TW	
3	0	2	4	50	30	20	25	25	150

Detailed Syllabus:

Sr. No	Name of Module and Detail	Teaching Hours	Module Weightage (%)
1.	Basics of Metrology and Measurement: Meaning, Necessity and Objectives of Metrology, Standards of Measurement, Elements of Measuring System, Methods of Measurement, Static Performance Characteristics, Dynamic Performance Characteristics, Precision and Accuracy, Sources of Errors, Selection and Care of instruments, Standardizing organizations	06	12
2.	Liner and Angular Measurements: *(Introduction & classification of Linear Measuring Instruments, Least count, working principle, Vernier Height Gauge, Vernier Depth Gauge, Micrometres, slip gauges, Dial indicators-construction & working), comparators, calibration of various linear measuring instruments; Introduction, Working principle & construction of Angular Measuring instruments like Bevel Protractors, Sine bars, Taper Measuring instruments: Measurement of taper shafts & holes.	07	14
3.	Measurement of Motion and Force: Motion Measurement of displacement, velocity, acceleration and vibrations by potentiometer, strain gauges, seismic pickups, velocity pickups and acceleration pickups, calibration of pickups. Force Torque and shaft power measurement, Basic method of force	06	14

	measurements, Load Cell, Proving Ring, differential transformers, torque measurement on rotating shaft, shaft power measurement by dynamometers.		
4.	Measurement of Pressure Basic method of pressure measurement, dead weight gauges and manometers, elastic transducers and force balance transducer.	03	10
5.	Temperature Measurement: Measurement of temperature by liquid – in – glass thermometers, pressure thermometers, thermocouples, their calibration, resistance thermometer, bimetallic thermometer, thermistors, radiation and optical pyrometers.	04	10
6.	Metrology of Gears and screw threads: Gear tooth terminology, Sources of errors in manufacturing of gears, Measurement of tooth thickness: Gear tooth vernier, Constant chord method, Addendum comparator method and Base tangent method, Measurement of tooth profile: Tool maker's microscope or 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.	07	18
7.	Metrology of Surface finish: 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, Mecin Instruments.	06	12
8.	Miscellaneous Metrology: Precision Instrumentation based on Laser Principals, Coordinate measuring machines: Structure, Modes of Operation, Probe, Operation and applications. Optical Measuring Techniques: Tool Maker's Microscope, Profile Projector, Optical Square. Basics of Optical Interference and Interferometry, Optoelectronic measurements,	04	10
	Total	43	100%

* **Highlighted topics should be covered during lab session only.**


Text Books:

- 1.R.K. Jain, Khanna Publishers - A Text Book of Engineering Metrology
- 2.M.Mahajan, DhanpatRai, New Delhi - A Text Book of Metrology
- 3.D.S. Kumar, Metropolitan book Co. - Mechanical Measurement & Control
- 4.R.K.Rajput, S.K.Kataria& Sons. - Mechanical measurement and instrumentation

Reference Books:

- 1.Engineering Metrology and Measurement, N V Raghavendra and Krishnamurthy, Oxford University Press,
2. Engineering Metrology and Measurements, Bentley, Pearson Education
3. Theory and Design for Mechanical Measurements, 3rd Edition, Richard S Figliola, Donald E Beasley, Wiley India
4. Metrology and Measurement, Anand Bewoor & Vinay Kulkarni McGraw-Hill
5. Doebelin's Measurement Systems Ernest Doebelin, Dhanesh Manik McGraw-Hill
6. Instrumentation, Measurement and Analysis, B.C. Nakra, K.K. Chaudhry McGraw-Hill
7. A Text book of Engineering Metrology, I C Gupta, Dhanpat Rai Publications
8. A course in Mechanical Measurements and Instrumentation, A K Sawhney, Dhanpat Rai Publications
9. Mechanical Measurements and Instrumentations, Er. R K Rajput, Kataria Publication(KATSON)
10. Mechanical Measurement and Metrology by R K Jain, Khanna Publisher Mechanical Measurement & Control by D.S. Kumar.
11. Industrial Instrumentation & Control by S K Singh, McGrawHill
12. Mechanical Measurements by Beckwith & Buck, Narosa publishing House
13. Thomas G. Beckwith, Pearson Edu. - Mechanical Measurement

List of Experiments:

1. Basic understanding of measurements and metrology: concepts, application, advantage and future aspects
2. Performance on linear measurements using Vernier Calliper, Vernier height gauge, and Micrometer.
3. Performance on Angular Measurement using Bevel protector and Sine bar.
4. Performance on Temperature measurements and check different characteristics of measurements and also do calibration
5. Performance on force/torque measurements and check different characteristics of measurements and also do calibration
6. Performance on Speed/Velocity, acceleration measurements.
7. Performance on surface measurements
8. Performance on measurements of gears and screw threads

Important Equipment Used:

1. Temperature Measurements Equipments
2. Force Measurements Equipments
3. Surface Measurements Equipments
4. Linear/Angular Measurements Equipments
5. Tachometers
6. Gears/Screw Threads Measurements Equipments

Course Outcome:**After successful completion of course student will be able to:**

- CO1: Understand the basic concept of Metrology & to select instrument for particular measurement. Describing the calibration of instrument
- CO2: Demonstration of various instrument for hands on experience.
- CO3: Application of various measuring instrument in industry & day to day life
- CO4: Analysing the error in measurement & measuring instruments
- CO5: Discriminate the various methods of measurement
- CO6: Describe the use of advanced measuring instrument

Design based Problems (DP)/ Open Ended Problem:

1. Students may be asked for Calibration of temperature measuring devices.
2. Students may be asked to prepare and perform experiments on linear and angular measurements
3. Students may be asked to prepare and perform experiments on Displacement, Speed/Velocity and acceleration measurement.

List of Open Source Software/learning website:

1. www.nptel.ac.in
2. www.mitutoyo.com
3. www.taylor-hobson.com