

B. E. MECHANICAL ENGINEERING			
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)			
SEMESTER - III			
MECHANICAL MEASUREMENTS AND METROLOGY			
Course Code	18ME36B/46B	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: <ul style="list-style-type: none"> To understand the concept of metrology and standards of measurement. To equip with knowledge of limits, fits, tolerances and gauging To acquire knowledge of linear and Angular measurements, Screw thread and gear measurement & comparators. To understand the knowledge of measurement systems and methods with emphasis on different Transducers, intermediate modifying and terminating devices. To understand the measurement of Force, Torque, Pressure, Temperature and Strain. 			
Module-1			
Introduction to Metrology: Definition, objectives of metrology, Material Standards, Wavelength Standards, Classification of standards, Line and End standards, Calibration of End bars. Numerical examples. Liner measurement and angular measurements: Slip gauges-Indian standards on slip gauges, Adjustable slip gauges, Wringing of slip gauges, Problems on building of slip gauges (M87, M112), Measurement of angle-sine bar, Sine centre, Angle gauges, Optical instruments for angular measurements. Autocollimator-Applications for measuring straightness and squareness.			
Module-2			
System of Limits, Fits, Tolerance and Gauging: Definitions, Tolerance, Tolerance analysis (addition & subtraction of tolerances) Inter changeability & Selective assembly. Class & grade of tolerance, Fits, Types of fits, Numerical on limits, fit and tolerance. Hole base system & shaft base system. Taylor's principle, Types of limit gauges, Numerical on limit gauge design. Comparators: Functional requirements, Classification, Mechanical- Johnson Mikrokator, Sigma comparators, Dial indicator, Electrical comparators, LVDT, Pneumatic comparators- Principle of back pressure, Solex			
Module-3			
Measurement of screw thread and gear: Terminology of screw threads, Measurement of major diameter, Minor diameter, Pitch, Angle and Effective diameter of screw threads by 2- wire and 3-wire methods, Best size wire. Screw thread gauges, Toolmaker's microscope. Gear tooth Measurements: Tooth thickness measurement using constant chord method, Addendum, Comparator method and Base tangent method, Measurement of pitch, Concentricity, Run out and In volute profile. Gear roll tester for composite error.			
Module-4			
Measurement system and basic concepts of measurement methods: Definition, Significance of measurement, Generalized measurement system, Static characteristics- Accuracy, Precision, Calibration, Threshold, Sensitivity, Hysteresis, Repeatability, Linearity, Loading effect, Dynamic characteristics- System response, Time delay. Errors in measurement, Classification of errors. Transducers: Transfer efficiency, Primary and Secondary transducers, Electrical transducers, Mechanical, Electronic transducers, Relative comparison of each type of transducers. Intermediate Modifying and Terminating Devices: Mechanical systems, Inherent problems, Electrical intermediate modifying devices, Input circuitry, Ballast circuit, Electronic amplifiers. Terminating devices, Cathode ray oscilloscope, Oscillographs.			
Module-5			

Applied mechanical measurement: Measurement of force, Torque, Pressure, Types of Dynamometers, Absorption dynamometer, Prony brake and Rope brake dynamometer, and Power Measuring Instruments. Use of elastic members, Bridgeman gauge, McLeod gauge, Pirani gauge.

Measurement of strain and temperature: Theory of strain gauges, Types, Electrical resistance strain gauge, Preparation and mounting of Strain gauges, Gauge factor, Methods of strain measurement, temperature compensation, Resistance thermometers, Thermocouple, Law of thermocouple, Pyrometer, Optical pyrometer.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Understand the objectives of metrology, methods of measurement, standards of measurement & various measurement parameters.

CO2: Explain tolerance, limits of size, fits, geometric and position tolerances, gauges and their design

CO3: Understand the working principle of different types of comparators.

CO3: Describe measurement of major & minor diameter, pitch, angle and effective diameter of screw threads.


CO4: Explain measurement systems, transducers, intermediate modifying devices and terminating devices..

CO5: Describe functioning of force, torque, pressure, strain and temperature measuring devices.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Mechanical Measurements	Beckwith Marangoni and Lienhard	Pearson Education	6th Ed., 2006
2	Instrumentation, Measurement and Analysis	B C Nakra, K K Chaudhry	McGraw-Hill	4th Edition
3	Engineering Metrology	R.K. Jain	Khanna Publishers	2009
Reference Books				
1	Engineering Metrology and Measurements	Bentley	Pearson Education	
2	Theory and Design for Mechanical Measurements, III edition	Richard S Figliola, Donald E Beasley	WILEY India Publishers	
3	Engineering Metrology	Gupta I.C	Dhanpat Rai Publications	
4	Deoblin's Measurement system,	Ernest Deoblin, Dhanesh manick	McGraw-Hill	
5	Engineering Metrology and Measurements	N.V.Raghavendra and L. Krishnamurthy	Oxford University Press.	


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