FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Automobile Engineering)**

Semester: **IV**

Course Code: **202090404**

Course Title: **Measurement and Metrology**

Course Group: **Professional Core Course**

Course Objectives: The course is intended to strengthen the fundamentals of mechanical measurement of different physical and mechanical entities along with the concepts of interchangeability.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50 / 18	25 /9	50 / 17	25 / 9	150 / 53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Mechanical Measurement- An Introduction** Need and significance of measurement, generalized measurement system, Basic definitions: Hysteresis, Linearity, Resolution of measuring instruments, repeatability, accuracy, precision Threshold, Drift, zero stability, loading effect and system response. Measurement methods, Static performance characteristics, Errors and their classification. Uncertainty in measurement techniques. **Metrology:** Introduction, need of comparators, Basics understanding of Metrology, Need for Inspection, Accuracy and Precision, System of measurement, Material Standard, Wavelength Standards, Subdivision of standards, Line and End standards, Classification of standards and Traceability, calibration of End bars, standardization.	08

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2	**Linear and angular measurements** Linear Measurement Instruments: Vernier calliper, Micrometre, slip gauges, wringing of slip gauges, building of slip gauges (M87, M112). Optical flat, Limit gauges. Measurement of angles: sine bar, sine center, angle gauges, optical instruments for angular measurements, Auto collimator	**09**
3	**Limits, Fits, Tolerance** Principle of interchangeability, Definition of limits, fits, tolerances, hole basis system, shaft basis system, Classification of gauges, concept of design of gauges (Taylor's principles), types of gauges, calculations of allowances on gauges. Numerical problems	**06**
4	**Measurement of Force, Torque, Strain:** Direct methods and indirect methods of measurement Methods of Force measurement: load cells, cantilever beams, proving rings, differential transformers. Measurement of torque: Torsion bar dynamometer, servo-controlled dynamometer, absorption dynamometers. Power Measurements. Measurement of strain: Mechanical strain gauges, electrical strain gauges, material for strain gauges: gauge factors, theory of strain gauges and method of measurement, temperature compensation, bridge arrangement.	**08**
5	**Temperature Measurement:** Basics understanding of laws of thermodynamics, Concepts of thermometric property, resistance thermometers, thermocouple, law of thermocouple, materials used for construction, Liquid in glass thermometers, pyrometer, optical pyrometer, Thermistor, Bimetallic strip, calibrations.	**05**
6	**Comparators:** Functional requirements, classification of comparators, mechanical Comparators, Optical Comparators, Electrical Comparators, Pneumatic Comparators.	**04**
7	**Metrology of Surface finish:** Concepts and terminologies, Specification of surface, 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, Mecrin Instruments., Light Interference microscopes.	**05**

List of Practicals / Tutorials:

1	Basic understanding of Measurements and Metrology.
2	To study and calibrate the linear measuring instruments like Vernier caliper, Micrometer, and Vernier height gauge.
3	To measure taper angle of given work piece by Bevel protractor, sine bar and angle gauges.
4	To calculate the output power of water turbine using rope brake dynamometer.
5	To find the linear strain in a cantilever beam subjected to point loading at the free- end using half bridge circuit
6	To determine temperature with help of different temperature measuring instruments.
7	Calibration of RTD (Resistance Temperature Detector) using liquid in glass thermometer.
8	To determine the flash and fire point of lubricating oil using Pensky-Martens apparatus.

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9	To determine the Angular Speed Measurement using Stroboscope, and Analog Tachometer.
10	To Perform Surface Roughness measurements.

Reference Books:

1	Engineering Metrology and Measurement, N V Raghavendra and Krishnamurthy, Oxford University Press
2	A text book of Metrology, M. Mahajan, Dhanpatrai & Co.
3	Engineering Metrology and Measurements, Bentley, Pearson Education
4	Metrology and Measurement, Anand Bewoor & Vinay Kulkarni McGraw-Hill
5	Mechanical Measurements and Instrumentations, Er. R K Rajput, Kataria Publication (KATSON)
6	Mechanical Measurement & Control by D.S. Kumar
7	Industrial Instrumentation & Control by S K Singh, McGrawHill
8	Measurement Systems: Application and Design, Ernest O Doebelin and Dhanesh N Manik
9	Metrology for Engineers, J.F.W. Galyer and C.R. Shotbolt
10	Experimental Methods for Engineers, J P Holman, Mc Graw Hill

Supplementary learning Material:	
1	NPTEL Resources

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Industrial/ Field visits

Internal Evaluation :

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
20%	15%	10%	40%	15%	0%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

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Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Understand the concept of measurement and metrology	**20**
CO-2	Apply knowledge of linear and angular measurement instruments.	**30**
CO-3	Correlate the concept of limits, fits & tolerances.	**15**
CO-4	Utilize the concept of measurement of force, torque, strain, temperature, comparator	**20**
CO-5	Apply the basics of metrology and surface finish.	**15**

Curriculum Revision:	
Version:	2
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	
Next Review on (Month-Year):	June-2027

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