



Course Syllabus
Gyanmanjari Diploma Engineering College
Semester-4(Diploma)

Subject: Measurement and Metrology- DETME14210

Type of course: Major

Prerequisite: Physics

Rationale: Students should possess basic mathematics skills for calculations related to dimensions and tolerances, as well as a foundational understanding of physics to grasp the principles affecting measurements, such as force and temperature. Familiarity with engineering drawing and CAD is necessary for interpreting technical specifications, while knowledge of basic measurement techniques with instruments like calipers and micrometers is essential for understanding accuracy and precision. Additionally, introductory engineering principles provide context for applying measurement systems in real-world scenarios, and computer skills are important for data analysis and reporting. Optional knowledge in electronics and prior coursework in mechanical engineering can further enhance their understanding of measurement technologies and applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
CI	T	P	C	Theory Marks		Practical Marks		CA	
				ESE	MSE	V	P	ALA	
3	-	2	4	60	30	10	20	30	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.



Course Content:

Sr. No	Course content	Hrs	% Weightage
1	Fundamentals of Measurement and Standards: Introduction to Measurement, Importance of measurement in engineering, Methods of measurement, Generalized measuring systems and elements, Measurement Standards, Material standards, wavelength standards, and sub-standards, Factors affecting the selection of measuring instruments, Terms in Measurement, Accuracy, precision, and related concepts, Measurement Errors, Types of errors and their impact on results, Introduction to Measuring Instruments, Vernier instruments, gauges, and their applications, Measuring Instruments and Techniques, Thread and Angular Measurements, Thread measurement techniques and tools, Instruments for angular measurement: sine bars, bevel protractors, clinometers, coordinate Measuring Machines (CMM), Features, working principles, and applications, Introduction to Gears and Screw Threads, Gear terminologies, tooth thickness measurement, and rolling tests, Screw thread measurement: major, minor, and effective diameters	15	35
2	Transducers and Strain Gauges: Transducers, Characteristics and classifications, Piezoelectric transducers and their applications, Strain Measurement, Types of strain gauges and their mounting, Strain gauge rosettes and applications, Force, Torque, and Pressure Measurement, Instruments: dynamometers, McLeod gauge, and other tools Applied Measurements: Speed measurement using tachometers, Flow measurement using rotameters and turbine meters, Temperature measurement using resistance thermometers and optical pyrometers	12	25
3	Limits, Fits and Tolerances: Limits, Fits, and Tolerances, Definitions, hole and shaft basis systems, selective assembly, and interchangeability, Taylor's Principle, Concept and applications in manufacturing, Testing of Machine Tools, Geometrical checks and alignment testing	9	20
4	Gear Measurement and Testing: Errors in gears, inspection methods, and machine tool testing procedures, Advanced Measuring Techniques, Floating carriage micrometers, thread gauge micrometers, and dynamometers	9	20



Continuous Assessment (ALA):

Sr. No	Active Learning Activities	Marks
1	Build Your Own Measurement Device: Students design and construct a simple, functional measurement tool using common materials. They test and compare their devices to professional instruments for accuracy and precision. Upload its photographs on GMIU web portal.	10
2	Quality Control Simulation: In this activity, students act as quality inspectors, measuring objects with various tools to detect dimensional errors and defects, similar to what would be done in a manufacturing setting. Upload report on GMIU web portal.	10
3	Metrology Olympics: Students compete in a series of metrology-related tasks that test their precision, speed, and accuracy using tools like Vernier calipers, micrometers, and slip gauges. Points are awarded based on performance. Upload Assessment report on the GMIU web portal.	10
Total		30

Suggested Specification table with Marks (Theory): 60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	15%	30%	25%	15%	10%	5%

Course Outcome:

After learning the course, the students should be able to:	
CO1	Overview of measurement principles, standards, instruments, errors, and advanced techniques like CMM and gear measurement.
CO2	Outline transducers, strain gauges, force measurement instruments, and applied measurement techniques for speed, flow, and temperature.
CO3	Describe the principles of limits, fits, tolerances, Taylor's principle, and machine tool testing methods.
CO4	Discuss Gear errors, inspection methods, machine tool testing, and advanced techniques like micrometers and dynamometers.



List of Practical:

Sr. No	Descriptions	Unit No.	Hrs
1	Measurement of Wire Diameter Using Micrometer: Measure the diameter of a wire using a micrometer and compare it with a digital micrometer.	2	04
2	Measurement of Machined Surface Angle: Measure the angle of the machined surface using a sine bar with slip gauges.	2	04
3	Calibration of Pressure Gauge: Perform calibration of a pressure gauge.	2	02
4	Measurement of V-Block/Taper Shank/Dovetail Angle: Measure the angle of a V-block, taper shank of a drill, or dovetail using a universal bevel protractor.	3	02
5	Measurement of Ground MS Flat/Cylindrical Bush Dimensions: Measure the dimensions of ground MS flat or cylindrical bush using a Vernier caliper and compare it with digital/dial Vernier caliper.	3	02
6	Measurement of V-Thread Geometrical Dimensions: Measure the geometrical dimensions of a V-thread using a thread Vernier gauge.	3	04
7	Measurement of MS Plate Thickness: Measure the thickness of ground MS plates using slip gauges.	3	04
8	Digital Measurement Using Laser Interferometer: Measure dimensions digitally using a laser interferometer.	3	02
9	Data Acquisition and Cloud Transfer in Metrology: Acquire measurement data and transfer it to the cloud for analysis.	4	04
10	Dimensional Inspection Using Digital Twin Setup: Perform dimensional inspection using a digital twin setup.	4	02
		Total	30

Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment. Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.



Reference Books:

- [1] "Engineering Metrology and Measurements" by P. N. Rao, Publication: Tata McGraw-Hill Education
- [2] "Metrology: Principles and Applications" by J. M. D. Coombes, Publication: Newnes (Elsevier)
- [3] "Introduction to Measurement and Instrumentation" by A. K. Ghosh, Publication: PHI Learning
- [4] "Measurement Systems: Application and Design" by E. A. Doebelin and D. N. Manik, Publication: McGraw-Hill Education
- [5] "Digital Measurement Techniques" by K. J. M. Wong, Publication: CRC Press
- [6] "Applied Metrology for Manufacturing Engineering" by J. C. Wang, Publication: Springer

