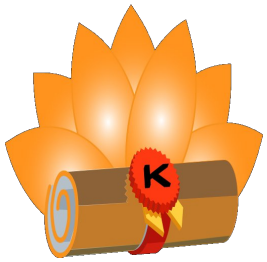
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Measurements & Metrology — Complete Syllabus

BTEUP Diploma in Mechanical Engineering • 3rd Semester • Session 2026–27

Subject 3.5 (Practicum) • Total 100 Marks • 3 Credits

About this document ·· urements & Metrology is a practicum subject (2 lectures + 3 practical periods a week) with an external theory paper of 60 marks in 3 hours and 40 internal practical marks. The syllabus has two units (14 periods each); both are covered here, completely, in the official order.

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Examination Scheme

Code	Paper	Type	L – P	Credits	Internal	External	Total
3.5	Measurements & Metrology	Practicum	2 – 3	3	Practical 40	Theory 60 (3 hrs)	100
Measurements & Metrology Total				**3**	**40**	**60**	**100**

What This Subject Aims To Do

To develop the skills required to measure linear and angular dimensions accurately, to select the right instrument for the job, and to understand modern measurement technology — comparators, coordinate measuring machines and lasers — so that parts are made to size, quality is controlled, and interchangeability is maintained. By the end you should be able to: classify measuring instruments by their application; select the appropriate instrument for linear dimensions; select the appropriate instrument for angular dimensions; explain the instruments used in measuring screw threads and gears; and discuss the applications of CMM and laser technology in metrology.

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Unit-Wise Complete Topic List

Unit	Topic	Periods	Marks Share
1	Linear Measurements and Comparators	14	—
2	Angular Measurements, CMM, Surface & Advanced Metrology	14	—

Note: the official syllabus gives periods only (14 + 14 = 28 periods); no marks-distribution table or unit weightages are given, so none are shown here.

Unit I — Linear Measurements and Comparators (14 Periods)

Topics: Basics of Metrology: Scope of Metrology, basic units, important terminology, Measurement — Need, Process, Role in quality control; Factors affecting measurement — SWIPE; international standardization, the Bureau of Indian Standards, important elements of measurements, methods of measurements. Precision, accuracy, factors affecting the accuracy of the measuring system, general rules for accurate measurements, precautions for use of instruments so as to avoid inaccuracy in measurements, reliability. Measurement uncertainty, systematic error and random error (compared), Selection of measuring instruments, Calibration of measuring instruments. Linear Measurements: Linear Measuring Instruments — Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, bore gauge, Gauge blocks — Use and precautions, slip gauges. Comparator: Comparators — Working and advantages, Types — Mechanical and Pneumatic Comparators.

In simple words: The foundations: what measurement is, why it matters for quality, what can go wrong with it (errors, SWIPE), and the instruments for measuring length — vernier caliper, micrometer, height gauge, bore gauge and slip gauges — plus comparators, which check parts against a standard instead of measuring them directly.

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Unit II — Angular Measurements, CMM, Surface & Advanced Metrology (14 Periods)

Topics: Angular Measurements: Angular measuring instruments, Bevel protractor, Angle gauges, Precision level, Sine bar, Autocollimator. Optomechanical measurements using a measuring microscope and Profile projector. Measurement of Screw threads — Single element measurements, Pitch Diameter, Lead, Pitch. Measurement of Gears — purpose, Analytical measurement, Runout, Pitch variation, Tooth profile, Tooth thickness, Lead. Coordinate Measuring Machine: Basic concept of CMM, Types of CMM, Constructional features, Probes, Accessories, Software, Applications. Advanced Metrology: Basic concepts of lasers, types of lasers, Laser and LED based distance measuring instruments.

In simple words: Angles and advanced tools: the sine bar, bevel protractor and autocollimator for angles; how screw threads and gears are measured; the coordinate measuring machine (CMM), which finds a part's shape from the coordinates of points on its surface; and lasers and LED instruments for measuring distance without touching the part.

Practical Work

- Vernier caliper (5 hrs) — measure the dimensions of a ground MS flat / cylindrical bush using a vernier caliper; compare the results with a digital vernier caliper.
- Outside micrometer (5 hrs) — measure the diameter of a wire using a micrometer; compare the results with a digital outside micrometer.
- Inside micrometer (4 hrs) — measure the inside diameter of the bore of a bush / cylindrical component using an inside micrometer; compare the results with a digital inside micrometer.
- Slip gauges (4 hrs) — measure the thickness of ground MS plates using slip gauges.
- Vernier height gauge — measure the height of gauge blocks or parallel bars using a vernier height gauge.
- Mechanical comparator (4 hrs) — find out the measurement of a given component and compare with a standard component using a mechanical comparator and slip gauge.
- Universal bevel protractor (4 hrs) — measure the angle of a V-block / taper shank of a drill / dovetail using a universal bevel protractor.
- Sine bar (4 hrs) — measure the angle of a machined surface using a sine bar with slip gauges.
- Screw thread micrometer (4 hrs) — measure the geometrical dimensions of a V-thread using a screw thread micrometer.
- Profile projector (4 hrs) — measurement of a profile using a profile projector.

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What You Will Be Able To Do (Learning Outcomes)

- Classify the measuring instruments based on their applications.
- Select the appropriate instrument for linear dimensions.
- Select the appropriate instrument for angular dimensions.
- Explain various instruments used in measuring screw threads and gears.
- Discuss the applications of CMM and laser technology in metrology.

Reference Books (as listed in the syllabus)

- R. K. Jain, Engineering Metrology, 22nd Edition, Khanna Publishers, 2022.
- N. V. Raghavendra and L. Krishnamurthy, Engineering Metrology and Measurements, Oxford University Press India, 2013.
- R. K. Rajput, Engineering Metrology and Instrumentation, S.K. Kataria & Sons, 2nd Edition, 2013.
- Samir Mekid, Metrology and Instrumentation: Practical Applications for Engineering and Manufacturing, John Wiley & Sons, Inc., 2021.
- Anand K. Bewoor & Vinay A. Kulkarni, Metrology & Measurement, Tata McGraw-Hill, 2009.
- Rega Rajendra, Principles of Engineering Metrology, Jaico Publishing House, 2008.

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Source: BTEUP IRDT Kanpur NEP-2020 curriculum for Diploma in Mechanical Engineering (Automobile), effective session 2025-26 (subject 3.5, pp. 22–25); the same 3rd-semester list applies to Mechanical (Production).. Topic lists follow the official syllabus; short explanations are the author's own plain-English summaries, not syllabus text. Please confirm with your own polytechnic for any local changes.