

GUJARAT TECHNOLOGICAL UNIVERSITY

BE-4 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK

Subject Name & Code:

Mechanical Measurement and Metrology- 3141901

Unit 1: Introduction to Metrology, Linear and Angular Measurement

Repeated Questions:

1. **Define Metrology and list its objectives / Explain the role of measurement.**
 - Appeared in: **W25 (Q1a, 03 marks), S23 (Q1a, 03 marks)**
2. **Draw a block diagram of a generalized measurement system (GMS) and explain its elements.**
 - Appeared in: **W25 (Q1c, 07 marks), W24 (Q1b, 04 marks), W23 (Q2c, 07 marks), S25 (Q4c, 07 marks), S23 (Q2c, 07 marks), S22 (Q4c, 07 marks)**
3. **Differentiate between Line Standards and End Standards.**
 - Appeared in: **W25 (Q2b, 04 marks), W23 (Q1b, 04 marks), W22 (Q5a, 03 marks)**
4. **Explain wavelength standards.**
 - Appeared in: **W25 (Q1b, 04 marks)**
5. **Explain with a neat sketch the construction and working of an Auto Collimator. / Write a short note on Auto Collimator.**
 - Appeared in: **W25 (Q3c, 07 marks), W22 (Q1c, 07 marks), S25 (Q2c, 07 marks)**
6. **Explain the construction and working of a Vernier Height Gauge / Vernier Caliper.**
 - Appeared in: **W24 (Q1c, 07 marks), S22 (Q5c, 07 marks - Vernier Caliper)**
7. **What are Slip Gauges? Explain wringing and the manufacturing process of slip gauges. / Explain the role of Slip Gauges.**
 - Appeared in: **W25 (Q4c, 07 marks), S23 (Q2b, 04 marks)**
8. **Explain the use of a Sine Bar for angle measurement with a neat sketch. / Write a short note on Sine Bar.**
 - Appeared in: **W25 (Q4a, 03 marks), W23 (Q2c OR, 07 marks), S25 (Q2b, 04 marks), S23 (Q3c, 07 marks), S22 (Q2b, 04 marks - Diff. Sine bar & center)**

Other Important Questions:

1. **Define Accuracy, Precision, Repeatability, Resolution.**
 - Appeared in: **W23 (Q1a, 03 marks), S25 (Q1b, 04 marks - Acc. & Prec.), S22 (Q1b, 04 marks - Acc., Prec., Reprod., Repeat.)**
2. **Compare/ Differentiate between Systematic and Random Errors.**
 - Appeared in: **W25 (Q5a, 03 marks), W24 (Q4a OR, 03 marks), S25 (Q1b, 04 marks)**
3. **List/types of errors in measurement. Discuss systematic errors in brief.**
 - Appeared in: **W23 (Q1c, 07 marks), S23 (Q1c, 07 marks)**
4. **Define Calibration, Hysteresis, Threshold.**
 - Appeared in: **S25 (Q1a, 03 marks)**
5. **Define and explain: Sensitivity, Hysteresis, Range & Span, Accuracy & Precision.**
 - Appeared in: **W24 (Q3b OR, 04 marks)**
6. **Explain the various methods of measurement with examples.**
 - Appeared in: **S25 (Q1c, 07 marks)**
7. **Discuss the factors relating to the selection of instruments.**
 - Appeared in: **S22 (Q1a, 03 marks)**
8. **Define Transducer and Transfer Efficiency. Classify transducers in detail.**
 - Appeared in: **S22 (Q1c, 07 marks)**
9. **Compare Primary, Secondary, and Working Standards. / Define and differentiate between primary, secondary, and working standards.**
 - Appeared in: **W24 (Q1a, 03 marks), W22 (Q5a, 03 marks)**

10. **Explain the sources of errors in a Micrometer.**
 - Appeared in: S22 (Q2a, 03 marks)
11. **Describe the construction and working of a Vernier Micrometer with a neat sketch.**
 - Appeared in: W24 (Q3a OR, 03 marks)
12. **Explain different Angular Measuring Instruments.**
 - Appeared in: S23 (Q3a, 03 marks)
13. **Enlist different types of measurement. / Classify measuring instruments.**
 - Appeared in: S23 (Q2a, 03 marks)
14. **Explain the vernier principle.**
 - Appeared in: S22 (Q5c, 07 marks)
15. **State different types of linear measuring instruments.**
 - Appeared in: S23 (Q3b OR, 04 marks)
16. **What is the function of a Bevel Protractor?**
 - Appeared in: S23 (Q4b OR, 04 marks)
17. **List the desirable characteristics of a measuring instrument (from context: good accuracy in sine bar).**
 - Appeared in: W22 (Q4b, 04 marks)
18. **Define Joe Blocks and state the material used for its fabrication & its application.**
 - Appeared in: W22 (Q2a, 03 marks)

Unit 2: System of Limits, Fits, Tolerance and Gauging

Repeated Questions:

1. **Define Tolerance. Differentiate between Unilateral and Bilateral tolerance with examples.**
 - Appeared in: W25 (Q2a, 03 marks), W24 (Q3a, 03 marks), S23 (Q4a OR, 03 marks)
2. **Compare/Explain Hole Basis System and Shaft Basis System.**
 - Appeared in: W25 (Q3b, 04 marks), W24 (Q3b, 04 marks), S22 (Q2c, 07 marks), S23 (Q3b, 04 marks)
3. **Define Fit and explain its types (Clearance, Interference, Transition) with neat sketches.**
 - Appeared in: W25 (Q3b, 04 marks), W24 (Q3c, 07 marks), W22 (Q1b, 04 marks), S22 (Q2c OR, 07 marks), W23 (Q4c OR, 07 marks)
4. **Explain Plug Gauge and Ring Gauge.**
 - Appeared in: W25 (Q4b, 04 marks)
5. **List the characteristics of good comparators. / List desirable features of a comparator.**
 - Appeared in: W25 (Q4c, 07 marks), W22 (Q4a OR, 03 marks)
6. **Explain the construction and working of a Sigma Comparator with a neat diagram.**
 - Appeared in: S25 (Q2c OR, 07 marks), S22 (Q3b OR, 04 marks)
7. **Explain the construction and working of a Dial Indicator with a neat sketch. / Write a short note on Dial Indicator.**
 - Appeared in: W23 (Q2b, 04 marks), S23 (Q5c OR, 07 marks)
8. **Explain the principle and working of an LVDT (Linear Variable Differential Transformer).**
 - Appeared in: W23 (Q5b, 04 marks), S25 (Q4b, 04 marks), S22 (Q5a, 03 marks)

Other Important Questions:

1. **Why is wear allowance provided on GO gauges only? Justify.**
 - Appeared in: W25 (Q5a OR, 03 marks)
2. **Explain Taylor's principle of gauge design.**
 - Appeared in: (Implied in syllabus under "brief concept of design of gauges")
3. **Explain the construction and working of a Johnson Mikrokator.**
 - Appeared in: W25 (Q4c, 07 marks)
4. **Explain the working of Optical Comparators with a neat sketch.**
 - Appeared in: W22 (Q3b OR, 04 marks)
5. **Explain with a neat sketch the construction and working of the Zeiss Ultra Optimeter.**
 - Appeared in: W22 (Q3c OR, 07 marks)
6. **Explain the principle of electrical comparators.**
 - Appeared in: (From syllabus)
7. **Explain Pneumatic comparators (e.g., Back pressure gauge, Solex comparator).**
 - Appeared in: (From syllabus)
8. **List the applications of comparators.**
 - Appeared in: W25 (Q3a OR, 03 marks)
9. **Briefly explain comparators.**
 - Appeared in: W23 (Q5a OR, 03 marks)
10. **Explain Maximum Material Condition (MMC) and Least Material Condition (LMC) with a suitable example.**
 - Appeared in: S22 (Q3b, 04 marks)
11. **Explain the need for tolerance.**
 - Appeared in: W23 (Q4a, 03 marks)
12. **Define: Tolerances, Fits, Shaft basis system.**
 - Appeared in: S25 (Q2a, 03 marks)

Unit 3: Measurement of Screw Thread and Gear

Repeated Questions:

1. **Explain the Three-Wire Method for measuring the effective diameter of a screw thread with a neat sketch.**
 - Appeared in: **W25 (Q3c OR, 07 marks), W23 (Q5c, 07 marks), S25 (Q3c, 07 marks), S22 (Q3c OR, 07 marks)**
2. **Discuss the elements/terminology of a screw thread with a neat sketch. / Give the classifications of threads.**
 - Appeared in: **W24 (Q2a, 03 marks), S25 (Q3a, 03 marks), W23 (Q2a, 03 marks)**
3. **Explain the construction and working of a Tool Maker's Microscope with a neat sketch. List its applications. / Write a short note on Tool Maker's Microscope.**
 - Appeared in: **W25 (Q2c, 07 marks), S23 (Q5b OR, 04 marks)**
4. **Explain gear tooth thickness measurement using a Gear Tooth Vernier Caliper (Chordal Thickness Method).**
 - Appeared in: **W25 (Q5c, 07 marks), W24 (Q3c OR, 07 marks), S22 (Q5c OR, 07 marks)**
5. **Name various methods for measurement of tooth thickness and explain any one. / Explain the Constant Chord Method for gear tooth measurement.**
 - Appeared in: **W22 (Q2c, 07 marks), S25 (Q3c OR, 07 marks)**
6. **Define/Explain gear terminology: (e.g., Pressure Angle, Module, Circular Pitch, Addendum, Dedendum, Base Circle, Pitch Diameter, etc.)**
 - Appeared in: **W25 (Q4a OR, 03 marks), W22 (Q3b, 04 marks), S25 (Q3a, 03 marks)**
7. **Explain Parkinson's Gear Tester with a neat sketch. / Write a short note on Parkinson Gear Tester.**
 - Appeared in: **W24 (Q2c, 07 marks), W23 (Q4b, 04 marks)**

Other Important Questions:

1. **Derive the expression for the best-size wire in the Two-Wire Method.**
 - Appeared in: **W23 (Q4c, 07 marks)**
2. **Compare one-wire, two-wire, and three-wire methods of measuring effective diameter.**
 - Appeared in: **W22 (Q5c, 07 marks)**
3. **Explain the common errors in threads.**
 - Appeared in: **S25 (Q3b, 04 marks)**
4. **Explain the following gear errors: Profile error, Pitch error, Errors in pressure angle, Tooth thickness error.**
 - Appeared in: **W24 (Q2b, 04 marks)**
5. **Derive an expression for gear tooth thickness using the chordal thickness method.**
 - Appeared in: **W23 (Q4b OR, 04 marks)**
6. **Compare involute and cycloidal gears.**
 - Appeared in: **S25 (Q3b OR, 04 marks)**
7. **Explain the Addendum Comparator method.**
 - Appeared in: **(From syllabus)**
8. **Explain the Base Tangent Method.**
 - Appeared in: **(From syllabus)**
9. **Explain the measurement of major diameter, minor diameter, and pitch of screw threads.**
 - Appeared in: **(From syllabus)**
10. **Explain Gear Roll Tester for composite error.**
 - Appeared in: **(From syllabus)**
11. **Draw a neat sketch of "Talysurf" and explain its working principle.**
 - Appeared in: **W24 (Q2c OR, 07 marks)**
12. **Describe briefly the most commonly used forms of gear tooth.**
 - Appeared in: **W22 (Q3a OR, 03 marks)**
13. **Enlist different types of threads and type of thread measuring instruments.**

- Appeared in: S23 (Q4b, 04 marks)
 - 14. **Explain any three elements of screw threads.**
 - Appeared in: S22 (Q5a OR, 03 marks)
 - 15. **List the primary reasons for surface irregularities.**
 - Appeared in: W23 (Q4a OR, 03 marks)
 - 16. **Define surface texture with necessary sketch.**
 - Appeared in: S22 (Q3a OR, 03 marks)
 - 17. **Write a short note on surface roughness symbols.**
 - Appeared in: S22 (Q3c, 07 marks)
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Unit 4: Measurement Systems and Basic Concepts of Measurement Methods

Repeated Questions:

- 1. Explain the principle of Electrical Strain Gauges.**
 - Appeared in: **W23 (Q5b OR, 04 marks), W24 (Q5b, 04 marks), S25 (Q5b, 04 marks), S22 (Q5b OR, 04 marks)**
- 2. Explain the construction and working of a Thermocouple with a neat sketch. / Write a short note on Thermocouple.**
 - Appeared in: **W24 (Q4b, 04 marks), W22 (Q3c, 07 marks), S25 (Q5c, 07 marks), S23 (Q2c OR, 07 marks)**
- 3. Explain the construction and working of an Optical Pyrometer.**
 - Appeared in: **W25 (Q5c OR, 07 marks), W24 (Q4c OR, 07 marks), W25 (Q4b OR, 04 marks - how to measure)**
- 4. Write a short note on Coordinate Measuring Machine (CMM). / List advantages and applications of CMM.**
 - Appeared in: **W25 (Q5b, 04 marks), W23 (Q5c, 07 marks), S25 (Q4b OR, 04 marks), S23 (Q5c OR, 07 marks)**
- 5. Explain the working of a McLeod Gauge for pressure measurement with a diagram.**
 - Appeared in: **W23 (Q3c OR, 07 marks), W24 (Q5c OR, 07 marks)**
- 6. Define and explain: Sensitivity, Hysteresis, Range & Span, Accuracy & Precision, Threshold, Calibration, Linearity, etc.**
 - Appeared in: **S25 (Q1a, 03 marks), W24 (Q3b OR, 04 marks), W23 (Q1a, 03 marks)**
- 7. What is a Transducer? Classify transducers. / Explain different types of transducers.**
 - Appeared in: **S25 (Q4a, 03 marks), S22 (Q1c, 07 marks)**
- 8. Explain Cathode Ray Oscilloscope (CRO) / Oscillographs.**
 - Appeared in: **S25 (Q4c OR, 07 marks)**

Other Important Questions:

- 1. Explain the working principle of a Bimetallic Strip.**
 - Appeared in: **W24 (Q4a, 03 marks)**
- 2. Describe the construction and working of a Resistance Temperature Detector (RTD).**
 - Appeared in: **W24 (Q4c, 07 marks)**
- 3. Explain the principle of a Thermocouple. State the laws of thermocouples.**
 - Appeared in: **W23 (Q3b, 04 marks)**
- 4. Explain application of series and parallel connection in thermocouple.**
 - Appeared in: **W24 (Q4b, 04 marks)**
- 5. Explain Liquid-in-Glass Thermometer.**
 - Appeared in: **W24 (Q4b OR, 04 marks)**
- 6. Explain the International Temperature Scale with all the important standard points.**
 - Appeared in: **S22 (Q4a, 03 marks)**
- 7. Define Temperature Compensation. Explain temperature compensation in liquid-filled thermometer.**
 - Appeared in: **S22 (Q4a OR, 03 marks)**
- 8. Explain the Wheatstone bridge circuit for strain measurement.**
 - Appeared in: **(From syllabus)**
- 9. What is Gauge Factor? Explain its importance.**
 - Appeared in: **S25 (Q5a, 03 marks)**
- 10. Explain Strain Gauge Sensitivity Factor with its significance.**
 - Appeared in: **S22 (Q3a, 03 marks)**
- 11. State desirable characteristics of a strain gauge.**
 - Appeared in: **W22 (Q4a, 03 marks)**
- 12. List types of strain gauge and explain working of any one with neat sketch.**
 - Appeared in: **W22 (Q4b OR, 04 marks)**
- 13. Explain the principle of LASER. State the advantages of LASER.**

- Appeared in: S25 (Q4a OR, 03 marks), S22 (Q4b, 04 marks)
- 14. **Explain the principle of LASER-based Interferometer.**
 - Appeared in: S22 (Q4b, 04 marks)
- 15. **Explain with a neat sketch the working of any one interferometer.**
 - Appeared in: W23 (Q5c OR, 07 marks), W22 (Q2c OR, 07 marks)
- 16. **Explain advances in metrology (related to LASER and CMM).**
 - Appeared in: (From syllabus)
- 17. **Explain different types of amplifiers (Optical, Electronic).**
 - Appeared in: W23 (Q5a, 03 marks - Optical Amplifier)
- 18. **Mention any three advantages of electrical intermediate modifying devices.**
 - Appeared in: W23 (Q5a OR, 03 marks)
- 19. **Define and explain: Threshold, Calibration, Hysteresis.**
 - Appeared in: S25 (Q1a, 03 marks)
- 20. **What is the function of a Radiation Pyrometer?**
 - Appeared in: S23 (Q5b, 04 marks)
- 21. **Enlist the temperature measuring instruments.**
 - Appeared in: S23 (Q5a, 03 marks)

Unit 5: Force, Torque, Pressure, Strain and Temperature Measurement

Repeated Questions:

1. **Explain the construction and working of a Rope Brake Dynamometer. List its advantages and limitations. / Write a short note on Rope Brake Dynamometer.**
 - Appeared in: W25 (Q2c OR, 07 marks), W23 (Q3c, 07 marks), S25 (Q5c OR, 07 marks), W22 (Q5c OR, 07 marks)
2. **Explain the construction and working of a Bourdon Tube Pressure Gauge.**
 - Appeared in: W25 (Q5b OR, 04 marks)
3. **Classify instruments for pressure measurement. / Give the classification of instruments for pressure measurement.**
 - Appeared in: W23 (Q3a, 03 marks), S25 (Q5a OR, 03 marks)
4. **Explain the construction and working of a Proving Ring type Load Cell. / Write a short note on proving ring type load cell.**
 - Appeared in: W24 (Q5b OR, 04 marks)
5. **Explain Prony Brake Dynamometer. / Write a short note on Prony Brake Dynamometer.**
 - Appeared in: S22 (Q5b OR, 04 marks)

Other Important Questions:

1. **What is the function of Dynamometers? Enlist different types of Dynamometers and explain any one.**
 - Appeared in: S23 (Q3c OR, 07 marks)
2. **Explain the working of an Eddy Current Dynamometer with a neat sketch.**
 - Appeared in: W22 (Q5b OR, 04 marks)
3. **Explain Hydraulic Load Cell.**
 - Appeared in: W23 (Q3a OR, 03 marks)
4. **Explain any one method used for force measurement.**
 - Appeared in: S25 (Q5b OR, 04 marks)
5. **State the operating principle of a Pressure Gauge & Pressure Transducer.**
 - Appeared in: W22 (Q3a, 03 marks)
6. **Explain the principle of a Pitot Tube.**
 - Appeared in: (From syllabus)
7. **Explain the use of elastic members in pressure measurement (Bourdon tube, diaphragm, bellows).**
 - Appeared in: (From syllabus)
8. **Explain the Bridgeman Gauge.**
 - Appeared in: (From syllabus)
9. **Explain the Pirani Gauge.**
 - Appeared in: (From syllabus)
10. **What unit is used to measure Vacuum? Explain any one instrument used to measure vacuum.**
 - Appeared in: S22 (Q4c OR, 07 marks)
11. **Explain Temperature Compensation in strain gauges.**
 - Appeared in: (From syllabus - Wheatstone bridge)
12. **Explain the orientation of strain gauges for force and torque measurement.**
 - Appeared in: (From syllabus)
13. **Explain strain gauge-based load cells and torque sensors.**
 - Appeared in: (From syllabus)
14. **A platinum resistance thermometer has a resistance of $100\ \Omega$ at 25°C . Find its resistance at 65°C if the temperature co-efficient of platinum is $0.0039\ \text{C}^{-1}$. If the thermometer has a resistance of $150\ \Omega$, calculate the temperature.**
 - Appeared in: W23 (Q3b OR, 04 marks) - Numerical Question

15. **Explain the working principle of a thermometer.**
 - Appeared in: S23 (Q4c OR, 07 marks)
16. **Enlist different types of gear measuring instruments.**
 - Appeared in: S23 (Q5a OR, 03 marks)
