

**MEASUREMENT AND METROLOGY
(MEC2206)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) Depth of a hole can be measured by
 - (a) Sine bar
 - (b) Profile projector
 - (c) Vernier Bevel Protector
 - (d) Pneumatic Gauge.
- (ii) A 100mm sine bar is used to measure angle of a component. Slip gauges having total height of 25 mm is put under the sine bar roller to make the top surface of the component horizontal. The angle of the component in degree is
 - (a) 13.25
 - (b) 14.48
 - (c) 12.27
 - (d) 9.67
- (iii) Thread angle of a screw can be best measured by
 - (a) Sine bar
 - (b) Profile projector
 - (c) Vernier Bevel Protractor
 - (d) Pneumatic Gauge.
- (iv) The quickest way to check if a shaft is within tolerance is to use
 - (a) A 'GO - NO GO' plug gauge
 - (b) Height gauge
 - (c) Slip gauge
 - (d) A 'GO - NO GO' snap gauge
- (v) If the Fit between a shaft and hole is required to be close clearance fit, the dimension of the hole / shaft should be tolerated as
 - (a) H7/d6
 - (b) H7/m6
 - (c) H7/g6
 - (d) M7/h6
- (vi) Interference fringes are observed to measure
 - (a) Parallelism
 - (b) Roundness
 - (c) Flatness
 - (d) Cylindricity
- (vii) Symbol "inverted triangle" is used in engineering drawings for representing
 - (a) Shape of a component
 - (b) Surface Flatness
 - (c) Hardness
 - (d) Surface roughness.
- (viii) "Piezoelectric cell" is used for measuring
 - (a) Force
 - (b) Temperature
 - (c) Surface finish
 - (d) Displacement.

- (ix) The thermoelectric phenomenon where a temperature difference between two dissimilar materials (conductors or semiconductors) generates a voltage difference, leading to the flow of electric current, is called the
 (a) Thomson effect (b) Rankine effect
 (c) Seebeck effect (d) Carnot effect
- (x) Displacement could be measured by
 (a) Optical pyrometer (b) LVDT
 (c) Piezoelectric cell (d) Thermocouple

Fill in the blanks with the correct word

- (xi) Main scale reading of a micrometer is 14 mm and reading on the thimble is 39. The pitch of the spindle screw is 0.50 mm and number of divisions on the thimble is 50. The actual measurement is _____.
- (xii) If the Fit between a shaft and hole is designated as H7/g6, assembly will have ____ fit.
- (xiii) Bourdon gauge is used for the measurement of _____.
- (xiv) Optical pyrometer” is used for measuring _____
- (xv) Lower limit of hole in mass production can be quickly checked by _____ gauge.

Group - B

2. (a) Describe briefly the working principle of a dial indicator operated by gear and pinion mechanism and use it to measure roundness of a cylindrical work piece.
 [(CO2)(Understand/LOCQ)]
- (b) Describe briefly the working principle of a back pressure bourdon gauge pneumatic comparator and use it to check straightness of a plate.
 [(CO2)(Understand/LOCQ)]
6 + 6 = 12
3. (a) Explain with a sketch how a sine bar is used to measure an acute angle of a component. A 200 mm sine bar is used to measure angle of a component. Slip gauges having total height of 51.764 mm are put under the sine bar roller to make the top surface of the component horizontal. Calculate the angle of the component.
 [(CO1) (Apply/IOCQ)]
- (b) Briefly explain with a neat sketch the working principle of the cook optical comparator.
 [(CO2) (Understand/LOCQ)]
6 + 6 = 12

Group - C

4. (a) Differentiate between Accuracy and precision. [(CO2) (Analyze/IOCQ)]
- (b) The following limits are specified for a hole shaft assembly.

$$\text{Hole} = 70 \begin{matrix} +0.07 \\ -0.00 \end{matrix} \quad \text{Shaft} = 70 \begin{matrix} -0.008 \\ -0.040 \end{matrix}$$
 Determine the followings:
 (i) Basic size, Tolerance of shaft and hole.

(ii) Maximum and minimum clearance, allowance.

[[CO3] (Apply/IOCQ)]

6 + (3 + 3) = 12

5. (a) Calculate the limits of tolerance, allowance, fundamental deviation and show it in a figure for 45 mm shaft and hole pair designed as 45 H8/d9 type of fit. Size 45 mm falls in the diameter step 30 and 50 mm. Take " $i = (0.45 \sqrt[3]{D} + 0.001 D)$ " microns, IT8 = 25*i*, IT9 = 40*i*. Fundamental deviations for "d type" shaft is $(-16 D^{0.44})$ microns.
[[CO3] (Evaluate/HOCQ)]
- (b) Explain the use of "Plug gauge" in industry.
[[CO3] (Understand/LOCQ)]
- 8 + 4 = 12**

Group - D

6. (a) Explain with sketch how the following can be measured and by using which instruments for a lathe
(i) The machine is levelled with respect to horizontal plane.
(ii) Radial run out of the headstock spindle.
[[CO4] (Evaluate/HOCQ)]
- (b) Define flaws, roughness and sampling length of a surface with neat sketch.
[[CO4] (Remember/LOCQ)]
- (3 + 3) + 6 = 12**
7. (a) How to measure parallelism and Cylindricity using "dial indicator"?
[[CO4] (Evaluate/HOCQ)]
- (b) In the measurement of surface roughness, absolute value of height/ depth of 10 successive peaks and valleys measured from a datum as follows:
Peaks: 41, 32, 40, 35, 38 μm
Valleys: 30, 25, 27, 24, 18 μm
If the sampling length is 10 mm, determine the Ra and RMS value of the surface roughness.
[[CO4] (Evaluate/HOCQ)]
- 6 + 6 = 12**

Group - E

8. (a) Describe the laws of thermocouple. How the Seebeck voltage can be used for measuring temperature?
[[CO6] (Evaluate/HOCQ)]
- (b) Draw the basic circuit diagram and cross-sectional view of a Linear Variable Differential Transformer and explain how it functions.
[[CO6] (Evaluate/HOCQ)]
- (3 + 3) + 6 = 12**
9. (a) Explain the working principle of an "Optical pyrometer" with neat sketch.
[[CO6] (Understand/LOCQ)]
- (b) What is "gauge factor" of a strain gauge? Explain the working principle of a strain gauge type load cell arrangement and corresponding circuit diagram.
[[CO6] (Understand/LOCQ)]
- 6 + (2 + 4) = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	42	19	39

