METROLOGY AND MEASUREMENT
(MECH 2105)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

    (i) Depth of a hole can be measured by
        (a) Sine bar   (b) Profile projector
        (c) Vernier Bevel Protector   (d) Pneumatic Gauge.

    (ii) Main scale reading of a micrometer is 11 mm and reading on the thimble is 34. The pitch of the spindle screw is 0.50 mm and number of divisions on the thimble is 50. The actual measurement is
        (a) 11.54 mm   (b) 11.34 mm
        (c) 10.66 mm   (d) 10.56 mm.

    (iii) LVDT is usually used for measuring
        (a) strain   (b) pressure
        (c) surface finish   (d) displacement.

    (iv) The quickest way to check if a hole is within tolerance is to use
        (a) a 'GO - NO GO' plug gauge   (b) a micrometer
        (c) a Vernier calliper   (d) a 'GO - NO GO' snap gauge.

    (v) Most accurate measurement of gear teeth is done by measuring
        (a) tooth thickness at PCD
        (b) pressure angle at PCD
        (c) span over a number of teeth
        (d) addendum & dedendum circle dia.

    (vi) The two slip gauges in precision measurement are joined by
        (a) assembling   (b) sliding
        (c) adhesion   (d) wringing.

    (vii) Interference fringes are observed to measure
        (a) parallelism   (b) roundness
        (c) flatness   (d) cylindricity.

    (viii) The ratio of the infinitesimal change in output to the infinitesimal change in input is called
        (a) Sensitivity   (b) Resolution
        (c) Threshold   (d) Accuracy.

    (ix) If the Fit between a shaft and hole is designated as H7/g6, assembly will have
        (a) interference fit   (b) transition fit
        (c) clearance fit   (d) cannot be ascertained.

    (x) Symbol "inverted triangle" is used in engineering drawings for representing
        (a) Shape of a component   (b) Surface Flatness
        (c) Hardness   (d) Surface roughness.

Group – B

2. (a) Define the following and explain with a sketch how these can be measured:
        (i)   Roundness
        (ii) Parallelism
        (iii) Perpendicularity

    (b) Explain with a sketch how a sine bar is used to measure an acute angle of a component. Name 2 (two) limitations of sine bar.

    (c) A 200 mm sine bar is used to measure angle of a component. Slip gauges having total height of 51.764 mm is put under the sine bar roller to make the top surface of the component horizontal. Calculate the angle of the component.

                   6 + 3 + 3 = 12

3. (a) Explain with a sketch what does a gear tooth vernier measure and how the measurement is done.

    (b) Explain with a sketch what does a tooth span micrometer measure and how the measurement is done.

    (c) What is an 'Optical Flat'? Explain with a sketch how an 'Optical Flat' is used to measure flatness of a surface.

                   4 + 4 + (1 + 3) = 12

Group – C

4. (a) Briefly explain with neat sketch the working principle of cook optical comparator.

(b) 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.

6 + (4 + 2) = 12

5. (a) Calculate
   (i) the limits of tolerance of shaft
   (ii) the limits of tolerance of hole
   (iii) the allowance
   for a 28 mm shaft and hole pair designated H8d9 type of fit. Size 28 mm falls in the diameter step 18 to 30 mm. (Take $i = 0.45 D^{1/3} + 0.001D$ microns, IT8 = 25i and IT9 = 40i. Fundamental deviation of "d" type shaft is $-16D^{0.44}$ microns.)

   (b) A 30 mm diameter hole is made on a turret lathe according to the limits 30.035 mm and 30 mm. A shaft having diameter limits 30.055 mm & 30.050 mm is fitted into the whole. Indicate the type of fit and maximum & minimum clearance / interference by a sketch.

   (c) Calculate the dimension of "GO" end and "NO GO" end of a plug gauge for inspecting the diameter of a hole having dimension 40 +0.025 / +0.005 mm.

   6 + 3 + 3 = 12

Group – D

6. (a) Explain the difference between Accuracy & Precision of an instrument.

   (b) Explain the difference between Sensitivity & Threshold of an instrument.

   (c) What is Frequency Response, Amplitude response & Slew Rate of an instrument?

   3 + 3 + 6 = 12

7. (a) Identify the parameters (i) lay (ii) waviness (iii) roughness and (iv) sampling length of an actual "surface texture" through a neat sketch.

   (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: 45, 42, 40, 35, 35 μm
   Valleys: 30, 25, 25, 24, 18 μm
   If the sampling length is 5 mm, determine the R_Z and RMS value of the surface roughness.

   4 + (4 + 4) = 12

Group – E

8. (a) Explain the disappearing filament principle of optical pyrometer with neat sketch.

   (b) Explain with neat sketches the construction, working principle and relationship between the differential output voltage and position of the core in a LVDT.

   5 + (2 + 3 + 2) = 12

9. (a) Describe the laws of thermocouple. How the Seebeck voltage can be used for measuring temperature?

   (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.

   (3 + 3) + (2 + 4) = 12