ME-504

METROLOGY AND MEASUREMENT

Time Allotted: 3 Hours | Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP A
(Multiple Choice Type Questions)

1. Answer any *ten* questions. 10×1 = 10

(i) Which of the following is the correct way of designing fit?
(A) H8/g7 (B) g7/H8 (C) 50H8/g7 (D) H8/g7-50

(ii) Surface roughness on a drawing is represented by
(A) triangle (B) circles (C) square (D) Rectangles

(iii) A feeler gauge is used to check
(A) radius (B) screw pitch
(C) surface roughness (D) thickness of clearance

(iv) Which type of fit H7/F8 is
(A) clearance fit (B) transition fit (C) interference fit (D) none of these

(v) Pitch diameter of thread is measured by
(A) slide calipers (B) micrometer
(C) thread micrometer (D) none of these

(vi) The calibration of strain gauge circuit is carried out by
(A) healing the active gauge to known temperature
(B) applying the known voltage across the dummy gauge
(C) applying a known mechanical strain on the active gauge
(D) shunting a known resistance across a dummy gauge

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(vii) Profile of a gear tooth can be checked by
(A) sine bar (B) bench micrometer
(C) optical pyrometer (D) optical projector

(viii) A ball bearing is usually mounted on a shaft with
(A) interference fit (B) clearance fit
(C) very loose fit (D) none of these

(ix) Calibration of an instrument is done to
(A) enhance its accuracy
(B) improve response time of the instrument
(C) establish relationship between displayed value with actual input value
(D) none of these

(x) External taper can be accurately measured with the help of
(A) sine bar and slip gauges (B) dividing head
(C) combination set (D) clinometers

(xi) The purpose of ratchet in micrometer is
(A) to lock a dimension
(B) to impart blow motion
(C) to maintain sufficient and uniform measuring pressure
(D) none of these

(xii) The least count of a metric vernier caliper having 25 divisions on a vernier scale, matching with 24 divisions of main scale (1 main scale division = 0.5mm) is
(A) 0.05mm (B) 0.01mm (C) 0.001mm (D) 0.002mm

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. 3×5 = 15

2. (a) What is selective assembly? Explain its advantages. 2
(b) Distinguish between controllable error and random error. 3

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3. A 30 mm diameter hole is made on a turret lathe according to the limits 30.035 mm and 30 mm. The following two grades of shaft are used to fit in the whole (a) diameter 29.955 mm and 29.924 mm,(b) diameter 30.055 mm and 30.050 mm. Calculate the maximum tolerance, clearance and indicate the type of fit in each case by a sketch. 5

4. Explain why it is not preferable to use sine bar for measuring angle more than 45°? 5

5. Compute the slip gauge block combinations to build the following dimensions: 2+3
(i) 18.09, (ii) 113.385
The slip gauge set M 38 consists of the following:

Range (mm)	Steps (mm)	Pieces
1.005		01
1.01— 1.09	0.01	09
1.1—1.9	0.1	09
1.0 — 9.0	1.0	09
10.0 — 100.0	10.0	10

6. Four length bars of basic length 100 mm are to be calibrated using a calibrated length bar of 400 mm whose actual length is 399.9992 mm. It was also found that lengths of bars B, C and D in comparison to A are +0.0003 mm, –0.0002 mm and +0.0004 mm respectively and the length of all the four bars put together in comparison to the standard calibrated bar is +0.0003 mm longer. Determine the actual dimensions of all the four end bars. 5

GROUP C
(Long Answer Type Questions)

Answer any *three* questions. 3×15 = 45

7. (a) The following 10 observations in degree Celsius were recorded when measuring a temperature: 41.7, 42.0, 41.8, 42.0, 42.1, 41.9, 42.0, 41.9, 42.5 and 41.8. Calculate (a) arithmetic mean, (b) standard deviation, (c) probable error of one reading, (d) probable error of the mean, (e) range. 8

(b) Differentiate between the terms "Threshold" and "Resolution" giving suitable examples. 3

(c) What is drift? Explain different types of drifts with sketches of input-output relationships in each case. 4

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8.(a) For a certain thermistor, the thermistor constant beta = 3240 K and the resistance at 27 degree celsius is known to be 1050 ohms. The thermistor is used for temperature measurement and the resistance measurement is as 2330 ohms. Find the measured temperature. 6

(b) State the principles of interference of light. Also describe how this principle has been adopted for checking flatness of any object. What are the specifications of an optical flat? 3+4+2

9.(a) What do you mean by MML and LML? 2

(b) A 200 mm sine bar is to be set to an angle of 32°5'6". Find the length of the gauge block required using any appropriate set of gauge block. 7

(c) What is a comparator? Explain its use and essential parts. 3+3

10.(a) Explain with neat sketches the construction and principle of working of a LVDT? 8

(b) A steel cantilever is 0.25m long, 20mm wide and 4mm thick. 2+5

(i) Calculate the value of deflection at the free end for the cantilever when a force of 25 N is applied at this end. The modulus of elasticity for steel is 200 GN/m^2

(ii) An LVDT with a sensitivity of 0.05 V/mm is used for the measurement of deflection. The voltage is read on a 10 V voltmeter having 100 divisions. Two tenths of a division can be read with certainty. Calculate the minimum and maximum value of force that can be measured with this arrangement.

11.(a) Show that the gauge factor F of a resistance strain gauge is given by: 6

$$[F = 1 + 2\mu + \{(\partial\rho/\rho) / (\partial L/L)\}]$$

where μ is the Poisson's ratio, ρ is the resistivity of the material of wire of strain gauge, and L is the length of the wire.

(b) Explain the construction and working of Gear tooth vernier. 5

(c) In the measurement of surface roughness, heights of 20 successive peaks and valleys measured from a datum are as follows: 45, 25, 40, 25, 35, 16, 40, 22, 25, 34, 25, 40, 20, 36, 28, 18, 20, 25, 30, 38. If these measurements were made over a length of 20mm, determine C.L.A and R.M.S value of the surface. 4

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