



**MAULANA ABUL KALAM AZAD UNIVERSITY OF
TECHNOLOGY, WEST BENGAL**

Paper Code : AUE-603

METROLOGY & MEASUREMENT

Time Allotted : 3 Hours

Full Marks : 70

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. Choose the correct alternatives for the following :

10 × 1 = 10

i) Surface roughness on a drawing is represented by

- ☒ a) triangle b) circle
c) square d) rectangles.

ii) Bevel protector is used for

- ☒ a) angular measurement
b) linear measurement
c) height measurement
d) flatness measurement.

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[Turn over

iii) A sine bar is specified by

- a) weight of sine bar
☒ b) the centre distance
c) the size of the roller
d) the clearance between the roller and upper surface.

iv) The thread micrometer measures

- a) the major diameter of the thread
b) the minor diameter of the thread
☒ c) the effective diameter of the thread
d) the root diameter of the thread.

v) On a triple thread screw

- a) lead = pitch b) lead = 3 pitch
☒ c) lead = $\frac{1}{2}$ pitch d) lead = 9 pitch.

vi) Profile of a gear tooth can be checked by

- a) sine bar ☒ b) bench micrometer
c) optical pyrometer d) optical projector.

vii) Two slip gauges in precision measurement are joined by

- a) Assembling b) Sliding
c) Adhesion ☒ d) Wringing.

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viii) In measurement systems, which of the following are undesirable static characteristics ?

- a) Sensitivity and accuracy
- b) Drift, static error and dead zone
- ☒ c) Reproducibility and non-linearity
- d) Drift, static error, dead zone and non-linearity.

ix) The reading is recorded as 26.5420C. The reading has

- a) three significant figures
- ☒ b) five significant figures
- ☒ c) four significant figures
- d) none of these.

x) The transfer function of a system is defined as

- ☒ a) Ratio of Laplace transform of input to Laplace transform of output with initial condition not equal to zero
- ☒ b) Ratio of Laplace transform of output to Laplace transform of input with initial condition not equal to zero
- ☒ c) Ratio of Laplace transform of input to Laplace transform of output with all initial condition equal to zero
- ☒ d) Ratio of Laplace transform of output to Laplace transform of input with all initial condition equal to zero.

GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. What is the 'best size' wire ? Derive an expression for the same in terms of pitch and angle of thread.
- ☒ 3. Explain the features, principle and use of sine bar.
4. What are thermistors ? Explain different forms of construction. Draw the resistivity vs temperature characteristics and show that they have very high value of sensitivity compared to resistance temperature detector (RTD).
- ☒ 5. How do you measure displacement using capacitive transducer ? Draw neat diagram with working principle.
- ☒ 6. Describe construction, theory and working of thermocouples. What are the advantages and disadvantages of use of thermowell ?

GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

- ☒ 7. a) Why is it that the use of a sine bar is not recommended for angles larger than 45° if high accuracy is demanded ? How do you calibrate a precision polygon ?

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- b) Show, for a sine bar, that the error of angular setting θ arising from errors of the dimension l and h is given by :

$$\Delta\theta \text{ (radians)} = (\sec \theta / l) \Delta h - (\tan \theta / l) \Delta l$$

- c) If for a 100 mm sine bar, the setting error $\Delta\theta$ is not to exceed 15 seconds of arc when $\Delta l = +0.004$ mm and $\Delta h = -0.002$ mm, what is the maximum value of θ which the sine bar may be set ? (3 + 5) + 3 + 4
8. a) With a neat sketch, illustrate how the effective diameter of a screw thread may be checked using 2-wire system. What do you understand by Virtual Effective Diameter of a screw thread ? Show that for an ISO metric thread it is given by $VED = E + 1.732p + 0.0131p(\delta\theta_1 + \delta\theta_2)$.

The symbols have their usual meaning.

- b) The following data were obtained in an experiment for testing the dimension of a slip gauge with the help of a reference gauge and a pair of optical flat :
- Number of straight and equidistant fringes on each gauge = 10
 Width of each gauge = 20 mm
 Gap between the two gauges placed on optical flats = 50 mm
 Wavelength of light used = 0.00005 mm
 Dimension of the reference gauge = 25 mm
 Determine the dimension of the test gauge.

4 + 6 + 5

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9. a) Describe the gear tooth vernier caliper and explain how it is used to check gears. Calculate the settings for a straight spur gear having 50 teeth of module 3 mm.
- b) For a 20° pressure angle gear having 36 teeth and 4 mm module, calculate
- Plug size (plug diameter)
 - Distance over the plugs in opposite spaces
 - Distance over the plugs spaced 12 teeth apart.

10 + 5

10. a) What is meant by roughness and waviness of machine surface ?

- b) Describe the methods used for measuring surface finish.

- c) The measurements of surface roughness, height of 20 successive peaks and troughs were measured from a datum and were 35, 25, 40, 22, 35, 18, 42, 25, 35, 22, 36, 18, 42, 22, 32, 21, 37, 18, 35, 20 microns.

If these measurements were obtained over a length of 20 mm, determine the CLA and RMS value of the rough surface.

5 + 5 + 5

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11. a) Explain in brief the method of measuring a taper plug gauge by rollers, slip gauges and micrometer. What are the precautions to be taken during the measurement ?
- b) Derive an expression for the error likely to creep in the measurement of angle of taper by this method.
- c) Two taper plug gauges are being measured by this method. In both the cases, dimensions over rollers are measured at the height difference of 100 mm and these values are 80 mm and 8 mm respectively with a possible error of 0.005 mm. The angle of taper is 44° for the first and 4.5° for the second. Calculate the errors likely to creep in. What conclusion do you draw from this question ?

$$(3 + 2) + 5 + 5$$

12. Write short notes on any *three* of the following : 3×5

- i) Digital Read out (DRO) in machine
- ii) Resistance temperature detector (RTD)
- iii) Close loop control and its application
- iv) Legal metrology
- v) Calibration and traceability.