WEST BENGAL UNIVERSITY OF TECHNOLOGY

AUE-603

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 *all* questions. 10×1 = 10

(i) 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

(ii) Two slip gauges in precision measurement are joined by
- (A) assembling
- (B) sliding
- (C) adhesion
- (D) wringing

(iii) Repeatability of measuring equipment is
- (A) the capability to indicate the same reading again for a given measurement
- (B) a measure of how close the reading is to the true size
- (C) difference between measured value and actual value
- (D) the smallest change in measure that can be measured

(iv) On a triple thread screw
- (A) lead = pitch
- (B) lead = 3 pitch
- (C) lead = $\frac{1}{2}$ pitch
- (D) lead = 9 pitch

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

(vi) The closeness of values indicated by an Instrument to the actual value is defined by
- (A) repeatability
- (B) reliability
- (C) uncertainty
- (D) accuracy

(vii) The deviation of measured value to the desired value is defined by
- (A) error
- (B) repeatability
- (C) hysteresis
- (D) resolution

(viii) Angle deckkor is one type of
- (A) autocollimator
- (B) optical square
- (C) clinometer
- (D) angle gauge

(ix) RTD is a/an
- (A) active transducer
- (B) passive transducer
- (C) inductive transducer
- (D) capacitive transducer

(x) In a LVDT, the two secondary windings are connected in differential to obtain
- (A) higher output voltage
- (B) the output voltage has a phase which can lead us a conclusion whether the displacement of the core took place from right to left or left to right.
- (C) in order to establish null or reference point for the displacement
- (D) both (B) and (C)

GROUP B
(Short Answer Type Questions)

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

2. What is a Load Cell? Explain its working principle.

3. What do you understand by a marking "1 Div =0.005 mm in 100 mm" found on a precision spirit level? Describe how the accuracy of the graduation on a spirit level can be checked?

4. Define the following terms
   (i) Accuracy,
   (ii) Precision,
   (iii) Calibration,
   (iv) Systematic error,
   (v) Random error.

5. How do you convert a moving coil ammeter to a voltmeter, draw circuit diagram with explanation.

6. Draw a schematic of a capacitive displacement transducer, what are the responsible parameters for measurement?

GROUP C
(Long Answer Type Questions)

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

7. (a) Write the methods to measure effective diameter of external thread. 5
   (b) Explain two wires method to measure the effective diameter of external thread. Draw a neat diagram. 5
   (c) Derive the relationship between the involutes function δ and pressure angle φ. Given δ = tan φ – φ. 5

8. (a) Explain in brief the method of measuring a taper plug gauge by rollers, slip gauges and micrometer. 3
   (b) What are the precautions to be taken during the measurement? 2
   (c) Derive an expression for the error likely to creep in the measurement of angle of taper by this method. 5
   (d) 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 conclusions do you draw from this question? 5

9. (a) Write down the working principle of autocollimator with a neat sketch. 5
   (b) In the measurement of surface roughness, heights 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 C.L.A. and R.M.S. values of the roughness. 5
   (c) For a 20 degree pressure angle gear having 36 teeth and 4 mm module, calculate: 5
   (i) Plug size
   (ii) Distance over the plugs in opposite spaces
   (iii) Distance over the plugs spaced 12 teeth apart.

10. (a) What is transducer? What are the different types of transducer and give examples of each type? What is the difference between sensor and transducer? 2+3+2
   (b) A platinum resistance thermometer is used to measure temperature between 0° and 200 °C. 8
   Given that the resistance at T °C is
   $R_t = R_o (1 + \alpha T + \beta T^2)$ and R_o = 100 ohm, R_{100} = 138.5 ohm, R_{200} = 175.83 ohm. Calculate the non linearity at 100 °C as percent of Full Scale Deflection.

11. Write short notes on any *three* of the following: 5+5+5
   (a) LVDT (Linear Variable Differential Transformer)
   (b) Piezoelectric transducers
   (c) Feedback.