

B.Tech/ME/3<sup>rd</sup> Sem/MECH-2105/2015

2015

METROLOGY AND MEASUREMENT

(MECH 2105)

Time Alloted : 3 Hours

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one 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 alternatives 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) 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

- iii) For the same surface, value of Ra  
(a) Is always greater than Rrms  
(b) Is always less than Rrms  
(c) Is always equal to Rrms  
(d) Can be less than or equal to Rrms
- iv) Dial Gauge is a  
(a) Mechanical Comparator  
(b) Height Measuring Device  
(c) Pneumatic Comparator  
(d) Electrical comparator
- v) Which one of the following is NOT a derived unit of measurement  
(a) Energy (b) Force  
(c) Power (d) Temperature
- vi) Disadvantage of an Orifice meter is  
(a) it is very expensive  
(b) pressure drop is high  
(c) both point (a) and (b)  
(d) None of the above
- vii) Surface roughness on a drawing is represented by  
(a) Circles (b) Triangles  
(c) Squares (d) Rectangles
- viii) A 'GO - NO GO' plug gauge is used for  
(a) Assessing if a shaft will fit into a whole  
(b) Plugging a hole to stop liquid flow  
(c) Measuring actual diameter of a hole  
(d) Checking if the hole is within tolerance

- ix) Calibration of an instrument is done to
- Enhance its accuracy
  - Improve response time of the instrument
  - Establish relationship between displayed value and the actual input value
  - None of the above
- x) A ball bearing is usually mounted on a shaft with
- Interference fit
  - Clearance fit
  - Very loose fit
  - Can be any of the above three

**GROUP - B**

2. (a) The smallest division on the main scale of the vernier instrument is 1 mm. Ten divisions on the vernier scale correspond to the nine divisions on the main scale. Determine –
- Whether the vernier scale is forward or backward.
  - What is the least count of the instrument?
  - If the main scale reads 13 mm and the 5th division on the vernier scale coincides with a division on the main scale, what is the value of the dimension being measured?
- (b) What are the limitations of sine bars?
- (c) A 100mm sine bar is to be set up to measure an angle of 30, determine the total height of slip gauges needed for the measurement. **6+3+3 = 12**

3. (a) What is a gear tooth vernier? Explain with a sketch what does it measure and how the measurement is done.
- (b) What is a tooth span micrometer? Explain with a sketch what does it measure and how the measurement is done
- (c) Derive the expression for the measured span over 'N' number of teeth of a spur gear having module m, total no. of teeth Z, pressure angle  $\alpha$ . **4+4+4 = 12**

**GROUP - C**

4. (a) Explain with a sketch how OD & Thickness of a disc can be measured simultaneously using Dial Guages.
- (b) Explain with sketch how parallelism is measured using dial gauge.
- (c) Explain with a sketch the working principle of a Back Pressure Bourdon Gauge comparator.
- (d) Explain with sketch how a pneumatic gauge can be used for measuring bore taper. **3+2+5+2 = 12**
5. (a) Tolerance on a 40 mm diameter hole is 0.021 mm and tolerance on a 40 mm diameter shaft is 0.15 mm. For a clearance fit on the 'Hole Basis' system of a basic size of 40mm diameter, with a minimum clearance of 0.05 mm, compute the limit dimensions of the 40 mm diameter Hole and 40 mm dia Shaft by drawing a sketch.
- (b) 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 lengths of all the four bars. **6+6 = 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 are Frequency Response, Amplitude response & Slew Rate of an instrument? **3+3+6 = 12**
7. (a) What is the approximate Ra value of a surface after turning, grinding and superfinishing?
- (b) With the help of a neat sketch describe the construction and working of Taylor-Hobson surface roughness measuring instrument.
- (c) In the measurement of surface roughness, absolute values of height/depth of 10 successive peaks and valleys measured from a datum are as follows:
- Peaks : 45, 42, 40, 35, 35  $\mu\text{m}$
- Valleys : 30, 25, 25, 24, 18  $\mu\text{m}$
- Determine the  $R_z$  value of the surface. **3+5+4 = 12**

**GROUP - E**

8. (a) Derive the relationship between the applied strain and the corresponding change in resistance of a strain gauge.

- (b) If gauge factor  $F = 2$ , Resistance of the strain gauge = 120 ohm and applied strain is 1 microstrain (0.000001), calculate the change in resistance of the strain gauge due to applied strain.
- (c) Explain with a diagram how strain can be measured by using a strain gauge and a Wheatstone Bridge. **5+4+3 = 12**
9. (a) Draw the basic circuit diagram and cross-sectional view of a Linear Variable Differential Transformer and explain how it functions.
- (b) Draw the graph of output voltage vs. core displacement and mark the linear range of a LVDT.
- (c) What characteristic of the output signal from a LVDT can be used to distinguish between displacement of the core on either side of Null position. **6+3+3 = 12**