



# MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : ME-504

## METROLOGY AND 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 of the following: <http://www.makaut.com>

1×10=10

(i) A feeler gauge is used to check

- |                       |                            |
|-----------------------|----------------------------|
| (a) radius            | (b) screw pitch            |
| (c) surface roughness | (d) thickness of clearance |

(ii) Steel tyres on railway car wheels is an example of

- |                    |                      |
|--------------------|----------------------|
| (a) Transition fit | (b) Interference fit |
| (c) Clearance fit  | (d) Running fit      |

(iii) Time and frequency are the example of <http://www.makaut.com>

- |                           |                           |
|---------------------------|---------------------------|
| (a) Legal metrology field | (b) Fundamental metrology |
| (c) Industrial metrology  | (d) Scientific metrology  |

(iv) Flow is a phenomenon of <http://www.makaut.com>

- |                            |                         |
|----------------------------|-------------------------|
| (a) surface irregularities | (b) surface layout      |
| (c) surface waviness       | (d) surface actual size |

(v) 20H7f8 where 'f' denotes

- |           |                              |
|-----------|------------------------------|
| (a) Gauge | (b) Hole                     |
| (c) Shaft | (d) Hole and Shaft tolerance |

- (vi) In case of hole, GO gauge corresponds to the  
(a) low limit of size. (b) high limit of size.  
(c) base size from the datum. (d) ~~maximum tolerance of hole.~~
- (vii) Two slip gauges in precision measurement are joined by  
(a) Assembling (b) Sliding  
(c) Adhesion (d) ~~Wringing~~
- (viii) Turret is the part of <http://www.makaut.com>  
(a) Micrometer (b) ~~Vernier bevel protector~~  
(c) Taly surf (d) Optical comparator
- (ix) ~~Roughness~~ is a  
(a) ~~Primary texture~~ (b) Secondary texture  
(c) Form factor (d) Micro-magnetic error
- (x) Sine bar should not be  
(a) ~~used for measurement of an angle greater than 45°.~~  
(b) ~~used for measurement of an angle less than 45°.~~  
(c) used for measurement of an angle greater than 45° and if at all they have to be used, the sine bar should measure the complement of the angle. <http://www.makaut.com>  
(d) None of these

**Group - B**

**(Short Answer Type Questions)**

Answer any three of the following questions.

5×3=15

2. What is the 'best size' wire? Derive an expression for the same in terms of pitch and angle of thread.
3. What is the difference between hole basis system and shaft basis system for limits and fits?
4. In measuring the diameter  $D$  of a bore by four balls (3 balls of diameter  $D_1$  and the fourth one of diameter  $D_2$ ) placed over them, the height from the flat surface to the top of the ball of diameter  $D_2$  is measured to be  $H$ . Show that

$$D = D_1 + 2\{H(D_1 + D_2) - H^2\}^{\frac{1}{2}}.$$

Also show that for the success of the method,  $(2D_1 + D_2)$  should be greater than  $D$  and for accuracy of results, <http://www.makaut.com>

$$D_1 + 0.41D_2 \text{ should be less than } 0.58D.$$

5. A 50 mm diameter shaft is made to rotate in the bush. The tolerances for both shaft and bush are 0.050 mm. Determine the dimension of the shaft and the bush to give a maximum clearance of 0.075 mm with the hole basis system. <http://www.makaut.com>
6. Compute the slip gauge block combinations to build the dimensions: (i) 18.09 (ii) 113.385. The slip gauge set M38 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	10.0	10

## Group – C

## (Long Answer Type Questions)

Answer any three of the following questions.

15×3=45

7. (a) Describe the diaphragm pressure gauge with the help of neat sketch.
- (b) Discuss common thermocouple specifications. <http://www.makaut.com>
- (c) Why sign bar is not used to measure angle more than 45°? 
8. (a) Design the general type of GO and NO GO gauge for components having 30H7/f8 fit. Given that
- $i = 0.453D^{(1/3)} + 0.001D$ ,
  - Upper deviation of shaft =  $-5.5D^{(0.41)}$
  - 30mm falls in the diameter step of 18–30 mm
  - IT7 = 16i
  - IT8 = 25i
  - Wear allowance = 10% of gauge tolerance <http://www.makaut.com>
- (b) Explain the construction and working of an optical pyrometer with the help of a schematic diagram.

8+7=15

9. (a) Explain with neat sketches the construction and principle of working of a LVDT.

(b) In the measurement of surface roughness heights of 25 successive peaks and troughs were measured from the datum and were 30, 35, 25, 25, 40, 22, 35, 18, 42, 30, 35, 25, 36, 42, 25, 32, 32, 25, 37, 22, 35, 20, 32, 22 and 40. If the sampling length is 25 mm, determine C.L.A and R.M.S value.  $8+7=15$

10. (a) Discuss what you understand by the following terms in connection with surface roughness measurement: <http://www.makaut.com>

(i) Roughness

(ii) Waviness

(iii) Lay

(iv) Sampling length

(v) Cut-off length

(vi) Average leveling depth and Smoothness value (G)

(b) In the measurement of surface roughness, heights of 18 successive peaks and troughs were measured from a datum and were 35, 25, 40, 22, 35, 16, 42, 25, 35, 28, 36, 18, 45, 22, 35, 21, 27, 18 microns. If these measurements were obtained over a length of 18 mm, determine the C.L.A and R.M.S value of the rough surface. <http://www.makaut.com>  $10+5=15$

11. (a) Balls of diameter 30 mm and 15 mm were used to measure the taper of a ring gauge. During inspection, the ball of 30 mm diameter was protruding by 2.5 mm above the top surface of the ring. This surface was located at a height of 50 mm from the top of the 15 mm diameter ball. Calculate the taper angle. <http://www.makaut.com>

(b) A strain gauge is bonded to a beam 0.1m long and has a cross-sectional area  $4\text{cm}^2$ . Young's modulus for steel is  $207\text{GN/m}^2$ . The strain gauge has an unstrained resistance of  $240\Omega$  and a gauge factor of 2.2. When a load is applied; the resistance of a gauge changes by  $0.013\Omega$ . Calculate the change in length of steel beam and the amount of force applied to the beam.  $7+8=15$