

**BACHELOR OF TECHNOLOGY IN
MECHANICAL ENGINEERING
(COMPUTER INTEGRATED
MANUFACTURING)**

Term-End Examination

00739

June, 2012

**BME-014 : METROLOGY AND
INSTRUMENTATION**

Time : 3 hours

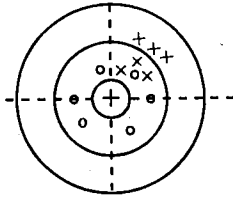
Maximum Marks : 70

Note : Answer five questions. All questions carry equal marks. Use of calculator is permitted.

1. (a) Why do you need standards for measurement ? What different standards are in use ? Which of these appears to be more logical ? 4
- (b) Define stress and mention its units in two unit systems. Why are the units of stress and modulus of elasticity same ? A steel bar of 10 mm diameter is pulled by an axial force of 200 N. The modulus of elasticity of steel $E = 2 \times 10^5$ MPa. Find Strain energy stored in steel bar in FPS system. 6
- (c) The voltage across windings of a d.c. electric motor is 220 volt and it consumes 12 A of current. What is the power of motor in h.p. ? 4

2. (a) A car travelling at constant speed from point 1 to point 2 consumes 9.6 litre of petrol. The distance between 1 and 2 is 120 miles. Find the economy of car in units of miles/gal and km/litre. Take one gal = 231 in³. 4
- (b) Sketch a Vernier caliper showing main scale and vernier scale. Define least count of vernier caliper and explain how diameter of bar is measured. 10
3. (a) Write expression for resistance of an electric wire of length l and area of cross-section of A . Taking total differential of the equation, explain change of resistance will be proportional to strain if wire is pulled. Define gauge factor. 5
- (b) A single wire of 20 mm length is cemented on steel specimen which will be subjected to a strain of $E = 0.05 \times 10^{-2}$ mm/mm. The gauge factor of wire of resistance of 210Ω is found to be 2.02. During the measurement of resistance the temperature of wire and steel base increased by 20°C . The coefficients of thermal expansion of steel is 4.9×10^{-5} and for wire it is $5.6 \times 10^{-5}/^\circ\text{C}$. Find the change in resistance of wire. 9

4. (a) What is error in measurement ? Classify errors and describe each class. 5
- (b) Distinguish between accuracy and precision, by giving example. Two shooters A and B shoot at target and marks are shown by (0) and (x) for A and B. Which is accurate and which is precise ? 4



- (c) On a tension bar of diameter $d = 10 \pm 0.1$ mm a force along length $P = 1000 \pm 20$ kN is applied. Calculate maximum and minimum errors by common sense. 5
5. (a) In an experiment two variables y_i and x_i were recorded as below : 10

y_i :	1	2	2.5	3.0	3.5
x_i :	0.225	2.075	3.005	3.950	4.850

With x as independent variable find relationship $y = mx + C$. Show on a plot.

- (b) Two metered taps are adding water to a tank. The quantities added are $Q_1 = 20 \pm 2\%$ and $Q_2 = 78 \pm 3\%$ litres. By what amount the addition will be in error. 4

6. (a) Define tolerance and describe types of tolerances. If the diameter of a shaft may vary from 25.05 mm to 25.10 mm, show tolerance on a sketch with basic size of 25.0 mm. 4
- (b) Define interference, transition and clearance fits. Give examples where they are used. If the shaft in a hole has to be lubricated, which fit will be selected? 5
- (c) The diameters of shaft and holes are prescribed as $25^{+0.025}_{-0.015}$ and $25^{+0.03}_{-0.00}$ respectively. Find extreme values of diameters and see if there is any chance and that the clearance between shaft and hole may not exist 5
7. (a) Name the instruments for measurement of dimensions that are based on optical principles. What are the principles of optical projector? 5
- (b) Describe the advantages of projector 4
- (c) Describe the following 5
- (i) collimating lens
 - (ii) incandescent light
 - (iii) achromatic condenser
 - (iv) projection lens
 - (v) field diameter

8. (a) What is CMM ? What are types of structure in which CMM is built ? 6
- (b) Explain the phenomenon of interference of light waves. Two monochromatic light waves emerge from two slits in the same vertical plane and reach at a point on screen parallel to the plane of slit. Develop an expression for the path difference. 4
- (c) Describe the light sources used in interferometry. 4
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