

**DIPLOMA MECHANICAL ENGINEERING
(DMEVI)**

Term-End Examination 01361
December, 2012

BIME-021 : MECHANICS OF MATERIALS

Time : 2 hours

Maximum Marks : 70

Note : Attempt five questions in all. Question No. 1 is compulsory. All questions carry equal marks. Scientific calculator is allowed.

1. (a) Hook's law holds good up to 7x2=14
- (i) Yield point
 - (ii) Elastic limit
 - (iii) Plastic limit
 - (iv) Breaking point
- (b) The young's modulus of a material is 125 GPa and poissons ratio is 0.25. The modulus of rigidity of material is
- (i) 30 GPa (ii) 50 GPa
 - (iii) 80 GPa (iv) 100 GPa
- (c) Modulus of resilience is the proof resilience per unit volume of material. (True/False)

- (d) The strain energy stored in a body, when the load is gradually applied, is

(i) $\frac{\sigma E}{V}$ (ii) $\frac{\sigma V}{E}$

(iii) $\frac{\sigma^2 E}{2V}$ (iv) $\frac{\sigma^2 V}{2E}$

$\sigma \rightarrow$ Stress in material, $V \rightarrow$ Volume of body
 $E \rightarrow$ Modulus of elasticity of material.

- (e) The neutral axis of the symmetrical beam does not pass through the centroid of the beam (True/False)
- (f) The polar moment of inertia of a solid circular shaft of diameter (D) is

(i) $\frac{\pi D^3}{16}$ (ii) $\frac{\pi D^3}{32}$

(iii) $\frac{\pi D^2}{32}$ (iv) $\frac{\pi D^4}{32}$

- (g) A thin spherical shell of diameter (d), thickness (t) is subjected to an internal pressure (p). The stress in the shell material is

(i) $\frac{Pd}{t}$ (ii) $\frac{Pd}{2t}$

(iii) $\frac{Pd}{4t}$ (iv) $\frac{Pd}{8t}$

2. (a) For a given material, Young's modulus is 110 GN/m^2 and shear modulus is 42 GN/m^2 . Find the bulk modulus and lateral contraction of a round bar of 37.5 mm diameter and 2.4 m long when stretched 2.5 mm . 8
- (b) Explain the shear strain energy theory. 6
3. (a) The principal stresses at a point across two perpendicular planes are 75 MN/m^2 (tensile) and 35 MN/m^2 (tensile). Find the normal, tangential stresses and the resultant stress and its obliquity on a plane at 20° with the major principal plane. 10
- (b) Explain the Principal planes and Principal stresses. 4
- 4 (a) What do you mean by simple bending ? What are the assumptions made in the theory of simple bending ? 6
- (b) A hollow circular bar having outside diameter twice the inside diameter is used as a beam. From the bending moment diagram of the beam, it is found that the bar is subjected to a bending moment of 40 K N.m . If the allowable bending stress in the beam is to be limited to 100 MN/m^2 . Find the inside diameter of the bar. 8

- 5 (a) A hollow shaft is to transmit 300 kW at 80 r.p.m. If the shear stress is not to exceed 60 MN/m^2 and internal diameter is 0.6 of the external diameter. Find the external and internal diameters assuming that the maximum torque is 1.4 times of the mean torque. 8
- (b) What are the lame's equation for stresses for thick cylinder? What are the assumptions made in lame's theory ? 6
6. (a) Derive the expression for Euler's Formula when both ends of the column are hinged or pinned. 7
- (b) Derive the expression for strain energy when load is applied Gradually and suddenly. 7
7. (a) In a material the Principal stresses are 60 MN/m^2 , 48 MN/m^2 and 36 MN/m^2 . Calculate : 8
- (i) Total strain energy
- (ii) Volumetric strain energy
- (iii) Shear strain energy.
- Take $E = 200 \text{ GN/m}^2$ and $\frac{1}{m} = 0.3$
- (b) Derive the expression for the Bending equation. 6

8. Write the short note on *any four* :

3.5x4=14

- (a) Bulk modulus
 - (b) Maximum shear stress theory
 - (c) Creep
 - (d) Mohr's circle
 - (e) Bending of curved bars.
 - (f) Rankine buckling load.
-