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BIME-021

DIPLOMA – VIEP – MECHANICAL ENGINEERING (DMEVI)

Term-End Examination

00244

June, 2017

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. Standard symbols have usual meanings.*

1. (a) The factor of safety is the ratio of

(i) working stress to ultimate stress

(ii) ultimate stress to yield stress

(iii) ultimate stress to working stress

(iv) yield stress to ultimate stress

(b) E and G are related by the equation

(i) $E = 2G(1 - v)$

(ii) $E = 2G(1 + v)$

(iii) $E = 3G(1 - v)$

(iv) $E = 3G(1 + v)$

where E = Modulus of elasticity,
G = Modulus of rigidity, v = Poisson's ratio.

(c) The plane of maximum shear stress at any point is inclined to the principal planes through that point at an angle of

(i) 0°

(ii) 45°

(iii) 60°

(iv) 90°

(d) The radius of Mohr's circle is equal to

(i) shear stress

(ii) sum of the two principal stresses

(iii) difference of the two principal stresses

(iv) one-half of the difference of the two principal stresses

(e) Torsional members are subjected to

(i) bending moments

(ii) twisting moments

(iii) combined moments

(iv) None of the above

(f) The variation of shear stress with respect to radius in a circular shaft is shown by

(i) line

(ii) parabola

(iii) cubic curve

(iv) None of the above

(g) The energy stored in a unit volume of the elastic body is called

(i) proof resilience

(ii) modulus of resilience

(iii) strain energy density

(iv) None of the above $7 \times 2 = 14$

2. (a) A steel rod, 5 m long and 30 mm in diameter, is subjected to an axial tensile load of 50 kN. Determine the change in length, diameter and volume of the rod. Take $E = 2 \times 10^5$ N/mm^2, and Poisson's ratio = 0·25. 7

(b) Discuss various theories of failure. 7

3. (a) The principal tensile stresses at a point across two mutually perpendicular planes are 120 N/mm^2 and 60 N/mm^2. Determine the normal, tangential and resultant stresses on a plane inclined at 30° to the axis of the minor principal stress. 7

(b) Derive an expression for the stresses on an oblique plane of a rectangular body when the body is subjected to a simple shear stress. 7

4. (a) A steel plate of width 120 mm and thickness 20 mm is bent into a circular arc of radius 10 m. Determine the maximum stress induced and the bending moment which will produce the maximum stress. Take $E = 2 \times 10^5$ N/mm^2. 7

(b) What do you mean by section modulus ? Find an expression for section modulus of a rectangular and hollow circular section. 7

5. (a) How will you find out the principal stresses and strains when a shaft is subjected to combined bending and torsion along with axial thrust ? Derive. 7

(b) A solid steel shaft has to transmit 75 kW at 200 rpm. Taking allowable shear stress as 70 N/mm^2, find suitable diameter for the shaft, if the maximum torque transmitted at each revolution exceeds the mean by 30%. 7

6. (a) Derive an expression for circumferential stress and longitudinal stress for a thin shell subjected to an internal pressure. 7

(b) How will you find out the values of maximum tensile and compressive stresses in a crane hook ? 7

7. (a) Derive a relation for the Euler's crippling load for a column when one end is fixed and the other is free. 7

(b) A solid round bar, 3 m long and 5 cm in diameter, is used as a strut with both ends fixed. Determine the crippling load. Take $E = 2{\cdot}0 \times 10^5$ N/mm^2. 7

8. (a) Prove that the maximum stress induced in a body due to suddenly applied load is twice the stress induced when the load of same magnitude is applied gradually. 7

(b) A tensile load of 60 kN is applied suddenly to a circular bar of 4 cm diameter and 5 m length. If the value of $E = 2 \times 10^5$ N/mm^2, determine the

(i) maximum instantaneous stress induced,

(ii) instantaneous elongation in the rod, and

(iii) strain energy absorbed in the rod. 7
