No. of Printed Pages : 5

BIME-021

DIPLOMA – VIEP – MECHANICAL ENGINEERING (DMEVI)

Term-End Examination

00552

December, 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 failure criteria for ductile materials is based on the following factor :

(i) Ultimate strength

(ii) Shear strength

(iii) Yield strength

(iv) Limit of proportionality

(b) Modulus of elasticity (E) and Bulk modulus (K) are related by the equation

(i) $E = 3K(1 + 2\mu)$

(ii) $E = 3K(2 - \mu)$

(iii) $E = 3K(1 - 2\mu)$

(iv) $E = 3K(2 + \mu)$

where μ is the Poisson's ratio.

(c) In Mohr's circle of strain, y-axis represents

(i) normal strain

(ii) shear strain

(iii) half of normal strain

(iv) half of shear strain

(d) A principal plane is a plane of

(i) maximum tensile stress

(ii) maximum compressive stress

(iii) maximum shear stress

(iv) zero shear stress

(e) The shear stress in a circular shaft is zero at its following location :

(i) At its outer surface

(ii) At its axis

(iii) At two-third distance from its axis

(iv) None of the above

(f) If a circular shaft is subjected to a torque T and a bending moment M, then the ratio of the maximum shear stress to the maximum bending stress is

(i) $\frac{2M}{T}$

(ii) $\frac{T}{2M}$

(iii) $\frac{2T}{M}$

(iv) $\frac{M}{2T}$

(g) The area between the load-extension curve and extension axis is called

(i) strain energy

(ii) complementary energy

(iii) proof resilience

(iv) None of the above *7×2=14*

2. (a) What is Bulk Modulus ? Derive an expression for Young's modulus in terms of Bulk modulus and Poisson's ratio. 7

(b) A mild steel shaft 100 mm diameter is subjected to a maximum torque of 15 kN-m and a maximum bending moment of 10 kN-m at a particular section. Find the factor of safety according to the maximum shear stress theory of failure if the elastic limit in simple tension is 240 MN/m^2. 7

3. (a) The principal stresses at a point in a bar are 200 N/mm^2 (tensile) and 100 N/mm^2 (compressive). Determine the resultant stress in magnitude and direction on a plane inclined at 60° to the axis of the major principal stress. Also determine the maximum intensity of shear stress in the material at that point. 10

(b) Define the term Obliquity and describe how it is determined. 4

4. (a) Define the terms bending stress in beam, neutral axis and section modulus. What are the assumptions made in the theory of simple bending ? 7

(b) Calculate the maximum stress induced in a cast iron pipe of external diameter 40 mm, of internal diameter 20 mm and of length 4 m when the pipe is simply supported at its ends and carries a point load of 80 N at its centre. 7

5. (a) Derive an expression for the shear stress produced in a circular shaft which is subjected to torsion. What are the assumptions made in the derivation ? 7

(b) A hollow shaft is to transmit 300 kW power at 80 rpm. If the shear stress is not to exceed 60 N/mm^2 and the internal diameter is 0·6 of the external diameter, find the external and internal diameters assuming that the maximum torque is 1·4 times the mean. 7

6. (a) Obtain from the first principle, the relation for the maximum compressive and tensile stresses in a ring. 7

(b) What are Lame's equations for stresses in a thick cylinder ? What are the assumptions made in Lame's theory ? 7

7. (a) Derive a relation for Euler's crippling load for a column when both ends are fixed. 7

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

8. (a) Prove that the stress induced in a body when the load is applied with impact is given by

$$p = \frac{P}{A}\left[1 + \sqrt{\left(1 + \frac{2AEh}{PL}\right)}\right],$$

where P = Load applied with impact,

A = Cross-sectional area of the body,

h = Height through which the load falls,

L = Length of the body, and

E = Modulus of elasticity. 7

(b) A tensile load of 60 kN is gradually applied 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) stretch in the rod,

(ii) stress in the rod, and

(iii) strain energy absorbed by the rod. 7