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BIME-021

DIPLOMA – VIEP – MECHANICAL ENGINEERING (DMEVI)

Term-End Examination

00172

December, 2016

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. Assume missing data, if any, suitably.*

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1. Answer the following questions by choosing the best one out of the given four options : *7×2=14*

(a) Which of the following is a dimensionless quantity ?

(i) Shear Stress

(ii) Bulk Modulus

(iii) Young's Modulus

(iv) Poisson's Ratio

(b) The elastic constants E, G and K are related by the expression

(i) $E = \frac{-GK}{2K + G}$

(ii) $E = \frac{GK}{2K + G}$

(iii) $E = \frac{3GK}{K + 2G}$

(iv) $E = \frac{9GK}{3K + G}$

(c) Two shafts of same length and material are joined in series. If the ratio of their diameters is 2, then the ratio of their angles of twist will be

(i) 2

(ii) 4

(iii) 8

(iv) 16

(d) A thin cylindrical pressure vessel has been subjected to internal pressure. The ratio of longitudinal to hoop stress is

(i) 0·25

(ii) 0·5

(iii) 1·0

(iv) 2·0

(e) Modulus of Resilience of a material is

(i) a measure of its elasticity

(ii) an index of its compressibility

(iii) a shock resisting property

(iv) the property to store energy without permanent deformation

(f) Shear stresses on mutually perpendicular planes are

(i) zero

(ii) equal

(iii) maximum

(iv) minimum

(g) A steel wire ($E = 2 \times 10^{11}$ N/m^2) of sectional area 5×10^{-5} m^2 is to be extended to twice its initial length. To accomplish this task, the two ends of the wire should be pulled by a force of

(i) 10^7 N

(ii) 10^9 N

(iii) 10^{12} N

(iv) 10^{15} N

2. (a) The safe stress for a hollow steel column which carries an axial load of $2 \cdot 1 \times 10^3$ kN is 125 MN/m^2. If the external diameter of the column is 30 cm, determine the internal diameter. *6*

(b) Establish the relationship between the elastic constants of modulus of elasticity and modulus of rigidity. 8

3. (a) A steel rod is 2 m long and 50 mm in diameter. An axial pull of 100 kN is suddenly applied to the rod. Calculate the instantaneous stress induced and also the instantaneous elongation produced in the rod. Take E = 200 GN/m^2. 8

(b) Under what conditions is 'toughness' important from the mechanical property considerations ? Also differentiate between resilience and proof resilience. 6

4. (a) What are the assumptions made with the theory of simple bending ? Also express the Flexural formula mentioning different terms of it. 6

(b) A steel plate of width 120 mm and of 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. 8

5. (a) Find out the expressions for circumferential and longitudinal stresses induced in a thin cylinder pressure vessel, under internal pressure, considering efficiency of circumferential and longitudinal joints. 8

(b) A thin cylinder of internal diameter 1·25 m contains a fluid at an internal pressure of 2 N/mm^2. Determine the maximum thickness of the cylinder, if

(i) the longitudinal stress is not to exceed 30 N/mm^2,

(ii) the circumferential stress is not to exceed 45 N/mm^2. *6*

6. (a) Find out the crippling load of a column in the following cases : *6*

(i) Both ends hinged

(ii) Both ends fixed

(b) A solid round bar of 3 m length and 5 cm in diameter is used as a column with one end fixed and the other end free. Determine the crippling load of the column.

$E = 2{\cdot}0 \times 10^5$ N/mm^2. *8*

7. (a) Derive the expression for finding out the shear stress produced in a circular shaft subjected to torsion. *8*

(b) A solid shaft of 150 mm diameter is used to transmit torque. Find the maximum torque transmitted by the shaft, if the maximum shear stress induced to the shaft is 45 N/mm^2. *6*
