BET-022

Diploma in Civil Engineering / Diploma in Electrical and Mechanical Engineering

03282

Term-End Examination

December, 2010

BET-022 : STRENGTH OF MATERIALS

Time : 2 hours *Maximum Marks : 70*

Note : Question number 1 is compulsory. Attempt any four questions from the remaining. Assume suitable data wherever necessary and mention it clearly. Use of calculator is allowed.

1. Choose of correct answers from the given alternatives : **7x2=14**

   (a) The relation between Young's modulus E, Bulk modulus K and the Poission's ratio μ is given by :

   (i) $E = 2K(1 - 2\mu)$

   (ii) $E = 3K(1 + \mu)$

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

   (iv) $E = 2K(1 + \mu)$

(b) Under two dimensional system of forces, the maximum shear stress (τ_{max}) on an inclined plane is :

(i) $\left(\frac{\sigma_1 + \sigma_2}{2}\right)$

(ii) $\left(\frac{\sigma_1 - \sigma_2}{2}\right)$

(iii) $(\sigma_1 + \sigma_2)$

(iv) $2(\sigma_1 - \sigma_2)$

where, σ_1 and σ_2 are the principal stresses at a point in a strained body.

(c) The bending moment at the centre of a simply supported beam of length l carrying a uniformlly distributed load of w/unit length is :

(i) wl

(ii) $\frac{wl}{2}$

(iii) $\frac{wl^2}{4}$

(iv) $\frac{wl^2}{8}$

(d) Which is the correct bending formula ?

(i) $\frac{M}{\sigma} = \frac{Y}{I} = \frac{R}{E}$

(ii) $\frac{M}{I} = \frac{Y}{\sigma} = \frac{E}{R}$

(iii) $\frac{M}{E} = \frac{I}{R} = \frac{\sigma}{Y}$

(iv) $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$

(e) The slope of a simply supported beam of span 'l' carrying a concentrated load 'W' at the centre is :

(i) $\frac{Wl^2}{8EI}$

(ii) $\frac{Wl^2}{12EI}$

(iii) $\frac{Wl^2}{16EI}$

(iv) $\frac{Wl^2}{24EI}$

(f) When both ends of a column are fixed, the crippling load is W. If one end of the column is made free, the value of crippling will change to :

(i) $\frac{W}{16}$

(ii) $\frac{W}{4}$

(iii) $\frac{W}{2}$

(iv) 4W

(g) A shaft of diameter 'd' is subjected to a torque 'T', the maximum shear stress is :

(i) $\frac{32T}{\pi d^3}$

(ii) $\frac{16T}{\pi d^2}$

(iii) $\frac{16T}{\pi d^3}$

(iv) $\frac{64T}{\pi d^4}$

2. (a) Define the following : 4

(i) Modulus of elasticity.

(ii) Limit of proportionality.

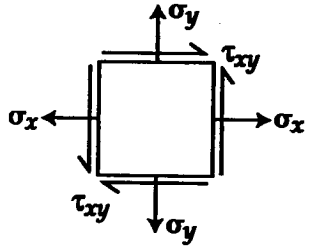
(iii) Ultimate stress (Design stress)

(iv) Poission's ratio.

(b) A steel rod, circular in cross-section, taper from 25 mm diameter to 12.5 mm diameter in a length of 500 mm. Find how much of its length will increase under a pull of 25 kN, if $E = 2.1 \times 10^5$ N/mm^2 ? 10

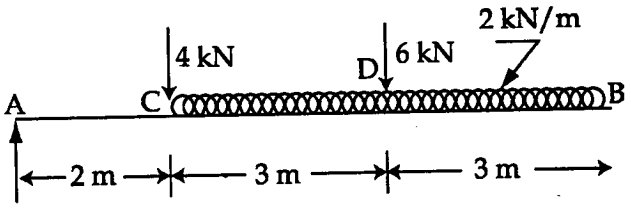
3. (a) Define and explain principal stresses and principal planes. 4

(b) The state of stress at a point in a stressed material is given by $\sigma_x = 220$ N/mm^2, $\sigma_y = 110$ N/mm^2 and $\tau_{xy} = 200$ N/mm^2 as shown in figure below : 10



Determine the direction and magnitude of principal stresses in the material.

4. Draw the shear force and Bending moment diagrams for a simply supported loaded beam and locate the sections where SF and BM will be maximum. **14**



5. Calculate the maximum intensity of shear stress induced and the angle of twist in degrees for a length of 10 meters for a solid shaft of 100 mm diameter transmitting 112.5 kW at 150 rpm. Take $G = 8.2 \times 10^4$ N/mm^2 for the material of the shaft. **14**

6. (a) A timber beam of rectangular section carries a load of 2 kN at mid span. The beam is simply supported over a span of 3.6 m. If the depth of the section is to be twice the breadth, and the bending stress not to exceed 9 N/mm^2, determine the cross-sectional dimensions. **10**

(b) Write various assumptions made in the theory of bending. **4**

7. (a) What do you understand by terms 'column' and 'strut' ? Explain long, medium and short columns. 4

(b) A column 6 m long, fixed at both ends, consists of an I-section with flanges 200 mm wide × 12 mm thick and web 10 mm thick, overall depth of I-Section is 300 mm. Plates 240 mm wide × 10 mm thick are attached to the flanges, one to each flange. Using Euler's theory, find buckling load for this column. $E = 2 \times 10^5$ N/mm^2. 10

8. (a) A simply supported beam AB of span 5 meters is carrying a point load of 30 kN at a distance of 3.75 m from the left end A. Calculate the slopes at A and B and deflection under the load. Take $EI = 26 \times 10^{12}$ N-mm^2. 7

(b) A simply supported beam of span 4 m is carrying a uniformly distributed load of 2 kN/m over the entire span. Find the maximum slope and deflection of the beam. Take EI for the beam as 80×10^9 N-mm^2. 7