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BET-022

DIPLOMA IN CIVIL ENGINEERING (DCLE(G)) / DIPLOMA IN MECHANICAL ENGINEERING (DME) / DCLEVI / DMEVI / DELVI / DECVI / DCSVI / ACCLEVI / ACMEVI / ACELVI / ACECVI / ACCSVI

Term-End Examination

00235

June, 2017

BET-022 : STRENGTH OF MATERIALS

Time : 2 hours *Maximum Marks : 70*

Note : *Attempt any **five** questions. All questions carry equal marks. Use of scientific calculator is permitted. Assume any missing data suitably.*

1. (a) A steel tube 2·4 cm external diameter and 1·8 cm internal diameter encloses a copper rod 1·5 cm diameter to which it is rigidly joined at each end. If, at a temperature of 10°C there is no longitudinal stress, calculate the stresses in the rod and the tube when the temperature is raised to 200°C. E_s = 210,000 N/mm^2, E_c = 100,000 N/mm^2 Coefficient of linear expansion : $\alpha_s = 11 \times 10^{-6}$ /°C; $\alpha_c = 18 \times 10^{-6}$/°C *8*

(b) Define the following terms : *3×2=6*

(i) Ductility

(ii) Resilience

(iii) Creep

2. (a) What are principal planes and principal stresses ? Also explain pure shear. *6*

(b) For a general two-dimensional stress system, derive the expressions for the location of principal planes and the values of principal stresses. 8

3. A girder, 30 m long, carrying a uniformly distributed load of w kN/m is to be supported on two piers 18 m apart so that the greatest B.M. shall be as small as possible. Find the distances of the piers from the ends of the girder and the maximum B.M. *14*

4. (a) The beam of a symmetrical I-section as shown in Figure 1 is simply supported over a span of 9 m. If the maximum permissible stress is 75 N/mm^2, what concentrated load can be carried at a distance of 3 m from one support ? *7*

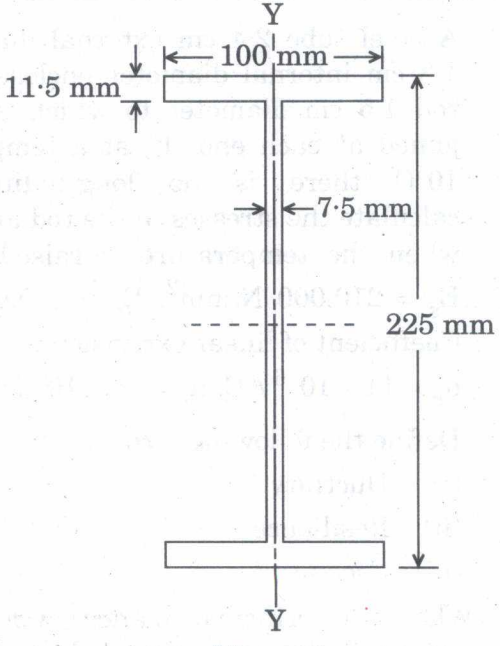

Figure 1

(b) A timber beam with a rectangular section is 10 cm wide by 15 cm deep and carries a uniformly distributed load over a span of 2 m. If the permissible stresses are 28 N/mm^2 longitudinally and 2 N/mm^2 transverse shear, calculate the maximum load which can be carried. 7

5. A simply supported beam of span 20 m, shown in Figure 2, carries two concentrated loads 4 kN at 8 m and 10 kN at 12 m from one end. Calculate

(a) the deflection under each load, and

(b) maximum deflection. *14*

$E = 200{,}000\ N/mm^2$; $I = 10^9\ mm^4$

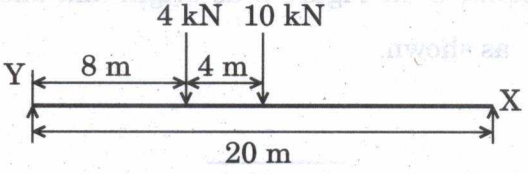

Figure 2

6. A hollow steel shaft has to transmit 6000 kW at 110 r.p.m. If the allowable shear stress is 60 N/mm^2 and the inside diameter = $\frac{3}{5}$ of the outside diameter, find the dimensions of the shaft, and the angle of twist on a 3 m length. $G = 80{,}000\ N/mm^2$. *14*

7. A strut of length l, shown in Figure 3, is fixed at its lower end; its upper end is elastically supported against lateral deflection so that the resisting force is K times the end deflection. Show that the crippling load P is given by

$$\frac{\tan \alpha l}{\alpha l} = 1 - \frac{P}{Kl} \quad \text{where} \quad \alpha^2 = \frac{P}{EI}.$$

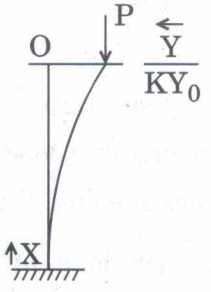

Figure 3

Take point 'O' in Figure 3 as origin and axes $\vec{X}$ and $\vec{Y}$ as shown. *14*