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ET-502(A)

B.Tech. Civil (Construction Management)/ B.Tech. Civil (Water Resources Engineering)

Term-End Examination

00545

June, 2017

ET-502(A) : STRENGTH OF MATERIALS

Time : 3 hours *Maximum Marks : 70*

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

1. (a) Define the following terms :

(i) Poisson's ratio

(ii) Factor of safety

(iii) Young's modulus

(iv) Modulus of rigidity

(b) A rod 200 cm long and of diameter 3·0 cm is subjected to an axial pull of 30 kN. If the Young's modulus of the material of the rod is 2×10^5 N/mm^2, determine

(i) stress

(ii) strain, and

(iii) the elongation of the rod. *4+10*

2. (a) Define the following terms :

(i) Principal plane

(ii) Principal stress

(iii) Crippling load

(iv) Slenderness ratio

(b) Direct stresses of 120 N/mm^2 and 90 N/mm^2 compression exist on two perpendicular planes at a certain point in a body. They are also accompanied by shear stress on the planes. The greatest principal stress at the point due to these is 150 N/mm^2.

(i) What must be the magnitude of the shearing stresses on the two planes ?

(ii) What will be the maximum shearing stress at the point ? *4+10*

3. (a) Prove that the maximum strain energy stored in a body is given by

$$U = \frac{\sigma^2}{2E} \times \text{Volume},$$

where σ = stress at the elastic limit.

(b) 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. *4+10*

4. (a) What are the different types of loads acting on a beam ? Differentiate between a point load and a uniformly distributed load.

(b) A cantilever beam of length 2 m carries the point loads as shown in the Figure 1. Draw the shear force and bending moment diagrams for the cantilever beam.

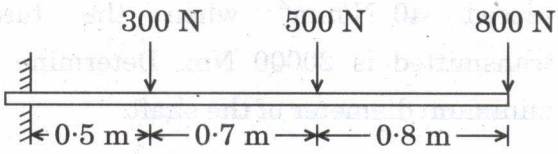

Figure 1 *4+10*

5. (a) A cantilever beam of length 2 m fails when a load of 2 kN is applied at the free end. If the section of the beam is 40 mm × 60 mm, find the stress at the failure.

(b) Prove that the relation

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R},$$

where M = Bending moment,

I = Moment of inertia,

σ = Bending stress,

y = Distance from N.A.,

E = Young's modulus, and

R = Radius of curvature. *4+10*

6. (a) Differentiate between direct stress and bending stress.

(b) A rectangular column of width 120 mm and of thickness 100 mm carries a point load of 120 kN at an eccentricity of 10 mm. Determine the maximum and minimum stresses at the base of the column. *4+10*

7. (a) The shearing stress of a solid shaft is not to exceed 40 N/mm^2 when the torque transmitted is 20000 Nm. Determine the minimum diameter of the shaft.

(b) Find the maximum shear stress induced in a solid circular shaft of diameter 15 cm when the shaft transmits 150 kW power at 180 rpm. *4+10*

8. (a) Differentiate between a thin cylinder and a thick cylinder. Write down an expression for the radial pressure and hoop stress at any point in case of a thick cylinder.

(b) A cylindrical pipe of diameter 1·5 m and thickness 1·5 cm is subjected to an internal fluid pressure of 1·2 N/mm^2. Determine

(i) the longitudinal stress developed in the pipe, and

(ii) the circumferential stress developed in the pipe. *4+10*