C 3106

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Fourth Semester

(Regulation 2004)

Civil Engineering

CE 1252 — STRENGTH OF MATERIALS

(Common to B.E. Part–Time Third Semester Regulation 2005)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Derive a relation for strain energy due to shear.

2. State Maxwell's reciprocal theorem.

3. Derive a relation for prop reaction for a simply supported beam with uniformly distributed load and propped at the centre.

4. A steel fixed beam AB of span 6 m is 60 mm wide and 100 mm deep. The support B sinks down by 6 mm. Find the fixing moments at A and B. Take E = 200 GPa.

5. Discuss the effect of crippling load (P_C) obtained by Euler's formula on Rankine's formula for short columns.

6. Differentiate a thin cylinder and a thick cylinder with respect to hoop stress.

7. What do you mean by triaxial state of stress.

8. State Von mises theory.

9. State any four assumptions made in the analysis of stresses in curved bars.

10. What do you mean by unsymmetrical bending.

PART B — (5 × 16 = 80 marks)

11. (a) The external diameter of a hollow shaft is twice the internal diameter. It is subjected to pure torque and it attains a maximum shear stress τ. Show that the strain energy stored per unit volume of shaft is $\frac{5\tau^2}{16C}$.

Such a shaft is required to transmit 5400 kW at 110 r.p.m. with uniform torque, the maximum stress not exceeding 70 MN/m^2. Calculate the shaft diameters and the energy stored per m^3 when transmitting this power. G = 83 GN/m^2.

Or

(b) Using Castigliano's first theorem, calculate the central deflection, and the slope at ends of a simply supported beam carrying a UDL of intensity w per unit length over the whole span.

12. (a) A simply supported beam of span 10 m carries a uniformly distributed load of 1152 N per unit length. The beam is propped at the middle span. Find the amount by which the prop should yield, in order to make all the three reactions equal. Take $E = 2 \times 10^5$ N/mm^2 and I for beam = 10^8 mm^4.

Or

(b) A fixed beam AB of span 6 m is carrying uniformly distributed load of 4 kN/m over the left half of the span. Find the fixing moments and support reaction.

13. (a) Find the ratio of thickness to internal diameter for a tube subjected to internal pressure when the pressure is 5/8 of the value of the maximum permissible circumferential stress. Find the increase in internal diameter of such a tube 100 mm internal diameter when the internal pressure is 100 MN/m^2. Take E = 200 GN/m^2. Poisson's ratio = 0.286.

Or

(b) A T–section 150 mm × 120 mm × 20 mm is used as a strut of 4 m long with hinged at its both ends. Calculate the crippling load, if young's modulus for the material be 200 GPa.

14. (a) In a triaxial stress system, the six components of the stress at a point are given below :

$\sigma_x = 6$ MN/m^2; $\sigma_y = 5$ MN/m^2; $\sigma_z = 4$ MN/m^2

$\tau_{xy} = \tau_{yx} = 1$ MN/m^2; $\tau_{yz} = \tau_{zy} = 3$ MN/m^2; $\tau_{zx} = \tau_{xz} = 2$ MN/m^2.

Find the magnitude of the three principal stress.

Or

(b) In a two dimensional stress system, the direct stresses on two mutually perpendicular planes are σ and 120 MN/m^2. In addition, these plane carry a shear stress of 40 MN/m^2. Find the value of σ at which the shear strain energy is least. If failure occurs at this value of the shear strain energy, estimate the elastic limit of the material in simple tension. Take the factor of safety on elastic limit as 3.

15. (a) Determine the principal moments of inertia for an unequal angle section 60 mm × 40 mm × 6 mm.

Or

(b) A beam of rectangular section, 80 mm wide and 120 mm deep is subjected to a bending moment of 12 kNm. The trace of the plane of loading is inclined at 45° to the Y–Y axis of the section locate the neutral axis of the section and calculate the maximum bending stress induced in the section.