Question Paper Code : 77052

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Third Semester

Civil Engineering

CE 6302 – MECHANICS OF SOLIDS

(Common to Environmental Engineering)

(Regulation 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by factor of safety?

2. Define: Resilience.

3. How do you relate intensity of loading, shearing force and bending moment?

4. State the basic principles involved in the analysis of a composite beam.

5. A beam 3 m long, simply supported at its ends, is carrying a point load at its centre. If the slope at the ends is 1°, find the deflection at the mid span of the beam.

6. Define: conjugate beam.

7. Determine the strain energy stored in a solid circular shaft of diameter 100 mm and length 1 m when it is subjected to a torque of 20 kNm. Take the shear modulus as 80 GPa.

8. How do you determine the stiffness of an equivalent spring when two springs of different stiffness are connected in series?

9. What is the value of normal stress on the plane of maximum shear stress in an element of a strained body in two dimensional state of stress?

10. What are the assumptions made in the analysis of a pin-jointed plane truss?

PART B — (5 × 16 = 80 marks)

11. (a) When a square bar of certain material (40 mm × 40 mm in section) is subjected to an axial pull of 160 kN, the measured extension on a gauge length of 200 mm is 0.1 mm and the decrease in each side of the square bar is 0.005 mm. Calculate modulus of Elasticity, shear modulus and Bulk modulus for this material.

Or

(b) A solid cylindrical brass bar of 25 mm diameter is enclosed in a steel tube of 50 mm external diameter and 25 mm internal diameter. The bar and the tube are both initially 1.5 m long and are rigidly fastened at both ends. Find the stresses induced in the two materials when the assembly is subjected to an increase in temperature of 50°C. Take coefficient of thermal expansion of steel as 12×10^{-6}/°C and that of brass as 18×10^{-6}/ °C, Modulus of elasticity of steel as 200 GPa and Modulus of elasticity of brass as 100 GPa.

12. (a) A 10 m long beam ABC is simply supported at B and C over a span of 8 m with end A being free. It carries point loads of 8 kN and 4 kN at distances 3 m and 5 m from C. The beam also has two uniformly distributed loads of intensity 4 kN/m for a distance of 4 m starting from C and of 6 kN/m on AB. Draw shearing force and bending moment diagrams indicating all principal values.

Or

(b) A flitched beam is made up of two timber joists, each 60 mm wide and 100 mm deep, with a 10 mm thick and 80 mm deep steel plate placed symmetrically between them on vertical faces. Determine the total moment of resistance of the section if the permissible stress in the timber joist is 7 N/mm^2. Take the modular ratio between steel and timber as 20.

13. (a) A beam AB of span 7 m is simply supported at its ends A and B. It carries a point load of 10 kN at a distance of 3 m from the end A and a uniformly distributed load of 6 kN/m over the right half span length. Determine (i) the maximum deflection in the beam and (ii) slope at the ends. Take EI = 10000 kN·m^2.

Or

(b) A cantilever of length 'L' is carrying a load of W at the free end and another load of 2W at its mid span. Determine the slope and deflection of the cantilever at the free end using conjugate beam method. Take the flexural rigidity for the half length from fixed end as twice that of the remaining length.

14. (a) A circular shaft is required to transmit a power of 220 kW at 200 rpm. The maximum torque may be 1.5 times the mean torque and the shear stress in the shaft not to exceed 50 N/mm². Determine the diameter required if (i) the shaft is solid (ii) the shaft is hollow with external diameter twice the internal diameter. Take modulus of rigidity = 80 kN/mm².

Or

(b) A bumper is to be designed to arrest a wagon weighing 500 kN moving at 80 km/hour. Details of buffer springs available are: diameter = 30 mm, mean radius = 100 mm, number of turns = 18, modulus of rigidity = 80 kN/mm², and maximum compression permitted = 200 mm. Determine the number of springs required for the buffer.

15. (a) At a point in the web of a girder the bending stress is 60 N/mm² tensile and the shearing stress at the same point is 30 N/mm². Determine, (i) principal stresses and principal planes (ii) maximum shear stress and its orientations.

Or

(b) Analyze the simply supported truss shown in Fig. Q.15(b) by method of joints.

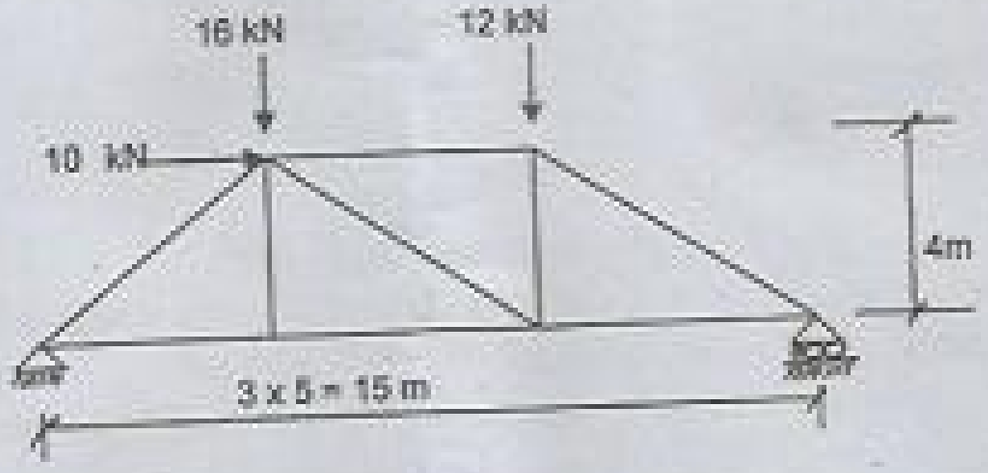

Fig. Q.15(b)