53 (CE 302) STMT

2017

STRENGTH OF MATERIALS

Paper : CE-302

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions out of **seven**.*

1. *(a)* Incase of torsion of circular shaft derive that

$$\frac{\tau}{R} = \frac{T}{J} = \frac{C \cdot \theta}{l}$$

where symbols have their usual meaning. 14

(b) Find the maximum torque, that can be safely applied to a shaft of 80*mm* diameter. The permissible angle of twist is 1·5 degree in a length of 5*m* and shear stress not to exceed 42 *mpa*. Take $C = 84Gpa$. 6

2. (a) A load of 270*kN* is carried by a short concrete column 250*mm* × 250*mm* in size. The column is reinforced with 8 bars of 16*mm* diameter. Find the stresses in concrete and steel, if the modulus of elasticity for the steel material is 18 times that of concrete. If the stress in concrete is not to exceed 5*MPa*, find the area of steel required, so that the column may carry a load of 500*kN*. 8+6=14

(b) What is a composite section ? Explain the procedure for finding the stresses developed, when a composite section is subjected to an axial loads. 2+4=6

3. *Fig.*01 show a rolled steel beam of an unsymmetrical I-section.

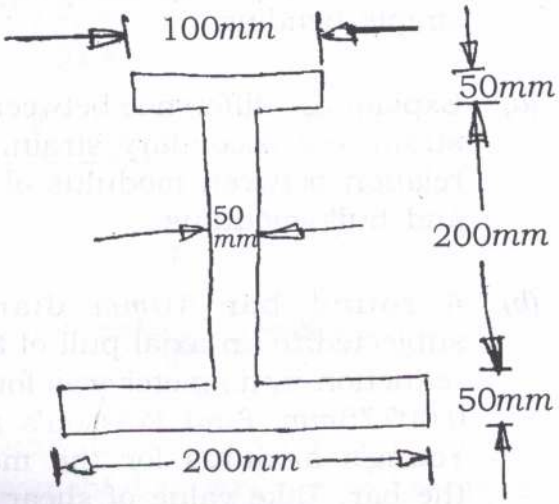

*Fig.*01

If the maximum bending stress in the beam section is not to exceed 40*MPa*. Find the moment, which the beam can resist. 20

4. *(a)* Discuss modulus of section for a given section of the beam. Also discuss it's significance. Derive the equation for the theory of simple bending. 2+2+7

(b) Define and also explain the concept of theory of simple bending. Also list out the assumptions made in the theory of simple bending. 2+4+3

5. (a) Explain the difference between primary strain and secondary strain. Derive a relation between modulus of elasticity and bulk modulus. 4+6

(b) A round bar $40mm$ diameter is subjected to an axial pull of $80kN$ and reduction in diameter was found to be $0{\cdot}00775mm$. Find Poisson's ratio and Young's modulus for the material of the bar. Take value of shear modulus as 40 *GPa*. 10

6. (a) A beam ABCD, $4m$ long is overhanging by $1m$ and carries load as shown in *fig.* 02. Draw the SFD and BMD for the beam. Show all the calculations. 10

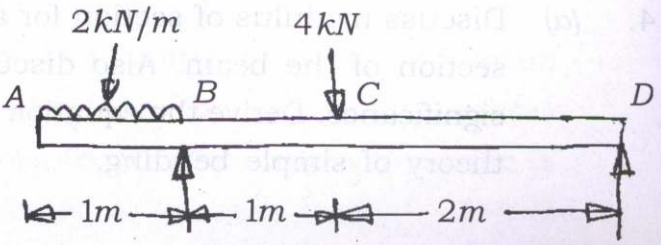

fig. 02

(b) A simply supported beam of span 2·5*m* is subjected to a uniformly distributed load and a clockwise couple as shown in *fig.* 03.

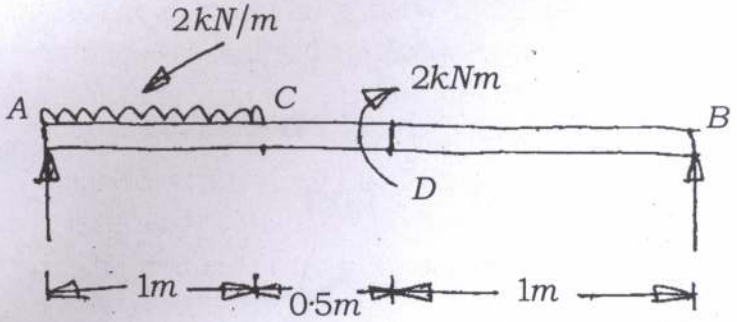

fig. 03

Draw the shear force and bending moment diagrams for the beams. Show all the calculations. 10

7. A plane element in a body is subjected to a tensile stress of 100 *MPa* accompanied by a clockwise shear stress of 25 *MPa*. Find *(i)* The normal and shear stress on a plane inclined at an angle of 20° with the tensile stress and *(ii)* The maximum shear stress on the plane. Write the steps of construction. 20