53 (CE 302) STMT

2014

STRENGTH OF MATERIALS

Paper : CE 302

Full Marks : 100

Pass Marks : 30

Time : Three hours

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

Answer ***any five*** *questions from* ***eight.***

1. *(a)* Describe Elastic limit and elasticity. An elastic rod 25*mm* in diameter, 200*mm* long extends by 0·25*mm* under a tensile load of 40*kN*. Find stress strain and elastic modulus for the material of the rod. 4+6

   (b) For a bar of 3 varying sections, derive that total change in the length of the bar is given by $dl = dl_1 + dl_2 + dl_3$. 10

2. *(a)* Show that the relation between E, K & C is given by $E = 9KC/(3K + C)$, where symbols have their usual meanings. 10

(b) A bar of metal $100mm \times 50mm$ in cross section is $250mm$ long. It carries a tensile load of $400kN$ in the direction of its length, a compressive load of $4000kN$ on its $100mm \times 250mm$ faces and a tensile load of $2000\,kN$ on its $50mm \times 250mm$ faces. If $E = 2 \times 10^5\ Mpa$ and value of $\mu = 0{\cdot}25$, find the change in volume of the bar. 10

3. *(a)* Describe the theory of simple bending. Also derive the equation for the theory of simple bending. 10

(b) A rectangular beam $60mm$ wide and $150mm$ deep is simply supported over a span of 4 *meters*. If the beam is subjected to a uniformly distributed load of $5kN/m$, find the maximum bending stress induced in the beam. 10

4. A plane element in a boiler is subjected to a tensile stresses of 400 *Mpa* on one plane and 150 *Mpa* on the other at right angle to each other. Also the stresses are accompanied by a shear stress of 100*Mpa* such that when associated with the major tensile stress tends to rotate the element in an anticlockwise direction. Find

(a) Principal stresses and their directions.

(b) Maximum shearing stresses and directions of the plane on which they act. 20

5. *(a)* Define volumetric strain. 4

(b) For volumetric strain of a rectangular body subjected to an axial force, show that

$\delta V \Big/ V = e\left(1 - \frac{2}{m}\right)$, where symbols have their usual meanings. 16

6. Draw the SFD & BMD for the beam shown in *Fig.* 01 20

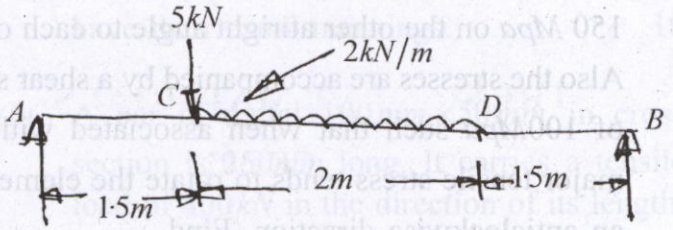

Fig. 01

7. Draw the SFD & BMD for the beam shown in *Fig.* 02 20

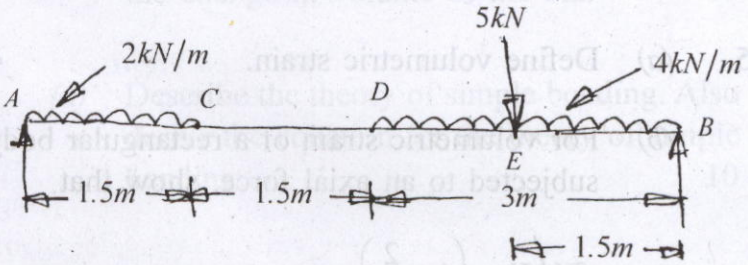

Fig. 02

8. *(a)* Explain the important guidelines for the relation between loading, shear force and bending moment for a loaded beam. 10

(b) Discuss tortion of circular shaft in detail. Also define point of contraflexure. 10
