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320354(20)

B. E. (Third Semester) Examination, April-May 2021

(New Scheme)

(Civil Engg. Branch)

MECHANICS of SOLIDS

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

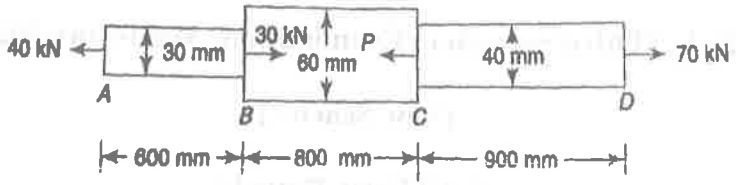
Note : *Every section first question is compulsory and attempt any* ***two*** *of 3 questions.*

Unit-I

1. (a) Establish relation among elastic constant. 2

   (b) Describe the behaviour of a ductile material such as steel under increased tensile load? 7

(c) A circular steel bar having three segments is subjected to various forces at different cross section as shown in fig. Determine the necessry forces to be applied at section C for the equilibrium of the bar. Also, find the total elongation of the bar. 7



(d) A rigid block AB weighing 180 kN is supported by three rods symmetrically placed as shown in fig. Before attachig the weight,the lower ends of the rods are set at the same level. The areas of cross section of the steel and copper rods are 800 mm^2 and 1350 mm^2 respectively.

Determine :

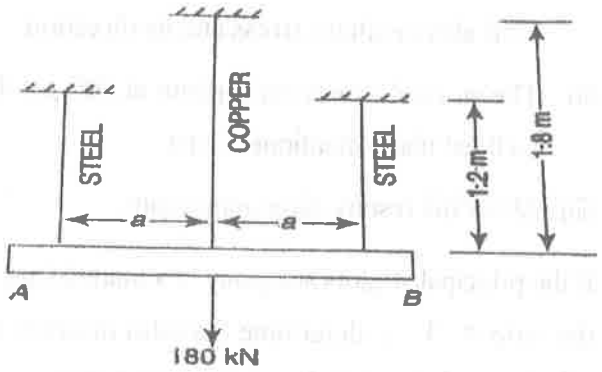
(i) The stresses in the rods, if the temperature is raised by 25°C

(ii) The stresses in the rods,if the temperature is raised by 50°C

(iii) The temperature rise for no stress in the copper rod.

$E_c = 95$ GPa ; $\alpha_c = 18 \times 10^{-6}/\text{C}$; $E_s = 205$ GPa

$a_s = 11 \times 10^{-6}/\text{C}$ 7



Unit-II

2. (a) Show that the sum of direct stresses on any two mutually perpendicular planes at a point is constant 2

(b) Construct Mohr's stress circle and discuss it use to measure principal stresses and stresses on inclined planes. 7

(c) The stresses on two perpendicular planes through a point in a body are 160 MPa and 100 MPa, both compressive along with a shear stress of 80 MPa.

Determine :

(i) The normal and the shear stresses on a plane inclined at 30° to the plane of 160 MPa stress. Find also resultant stress and its direction.

(ii) The normal stress on a plane at 90° to the inclined plane mentioned in (i).

(iii) Show the results diagrammatically. 7

(d) If the principal straints at a point in a material are in the ratio 4 : 3 : 2, determine the ratio of principal stresses at that point. Poisson's ratio is 0·3. 7

Unit-III

3. (a) Enumerate the assumptions made in the theory of simple bending. 2

(b) Compare the flexural strength of three beams of equal weight with the following specification :

(i) I section with the length of web, thickness of each flange and thickness of web in terms of width b of flanges being of the 1·7 b, 0·15 b, 0·1 b respectively.

(ii) Rectangular section of depth equal to twice the width.

(iii) Solid circular section. 7

(c) A timber beam 100 mm wide by 200 mm deep is reinforced by bolting on two steel plates each of 10 mm thick one on either side of beam. Find the maximum stress attained in the steel and the moment of resistance of the section if :

(i) The plates are 200 mm deep

(ii) The plates are 160 mm deep and are symmetrically placed

The maximum stress in the timber is to be 8 MPa and the Young's modulus of steel is 20 times that of timber. 7

(d) A simply supported beam of 7 m span with overhangs rests on supports which are 4 m aparts. The left end overhanging is 2 m. The beam carries loads of 30 kN and 20 kN on the left and right ends respectively apart from a uniformly distributed load of 25 kN/m between the supporting points. Draw the shear force and bending moment diagrams. 7

Unit-IV

4. (a) Define kern of a section, deduce the expression for middle quarter rule for circular section with diameter d and eccentricity e. 2

(b) Deduce the expression for Euler crippling load for column with both ends fixed. 7

(c) A 3·2 m long fixed end hollow cast-iron column has its internal and external diameters as 60 mm and 80 mm respectively. Determine Rankine's cripling load using the value of crushing stress to be 500 MPa and the value of Rankine's constant 1/1600. 7

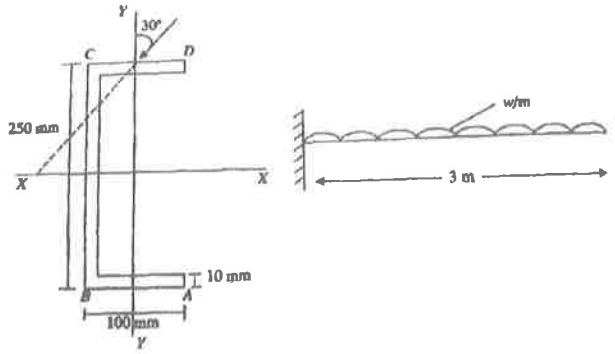
(d) Describe the laws of stability for retaining walls. 7

Unit-V

5. (a) What do you mean by shear center? Show approximately the location of shear centers in channel section, angle section, hollow rectangular section and Z section. 2

(b) Enumerate the assumptions made in torsion theory for axisymmetric sections and dericve the torsion equation? 7

(c) The channel section shown in fig. is used as a cantilever beam of span 3 m the plane of the uniformly distributed load on te span is inclined at 30° to the vertical Find the maximum allowable value of w if the permissible stress in the material is 150 MPa in tension and 80 MPa in compression. 7



(d) A close coiled helical spring has 20 turns wire of diameter 25 mm. The mean radius of the coils is 100 mm. Find the maximum stress and elongation of the spring under an axial load of 2 kN. Take $G = 85$ GPa. 7