Printed Pages : 7

Roll No.

320354(20)

BE (3rd Semester)
Examination, April-May, 2018

(New Scheme)

Mechanics of Solids

Time Allowed : 3 hours

Maximum Marks : 80
Minimum Pass Marks : 28

Note : (*i*) Part (*a*) of each question is compulsory. Attempt questions worth 16 marks from each Unit. Assume suitable data if required and mention it clearly. Draw the neat sketches wherever required.

(*ii*) The figures in the right-hand margin indicate marks.

Unit-I

1. (*a*) Explain hoop stress and longitudinal stress. [2]

(*b*) A steel rod and two copper rods together support a load of 400 kN as shown in Fig.1. The cross-sectional area of steel rod is 2400 mm^2 and of each copper rod is 1500 mm^2. Find the stresses in the rods.

(Turn Over)

[2]

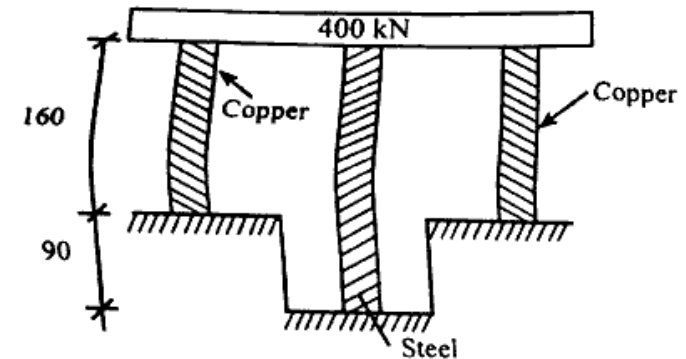Take E for steel as 2×10^5 N/m^2 and for copper is 100 kN/mm^2. [7]

Fig. 1.

(*c*) A composite bar made up of steel and aluminium is held between two supports as shown in Fig. 2. The bars are stress-free at a temperature of 40 °C. What will be the stresses in the two bars when the temperature is 20 °C if [7]

(*i*) the supports are non-yielding ;

(*ii*) the supports come nearer to each other by 0.10 mm?

Take E_s = 200 kN/mm^2 E_a = 70 kN/mm^2

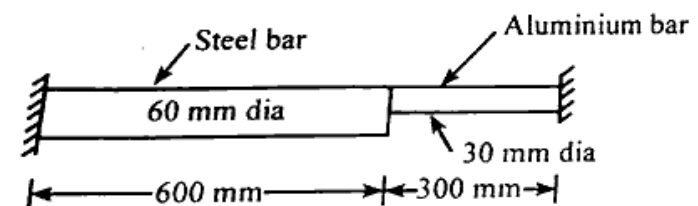α_s = 12×10^{-6} per °C α_a = 24×10^{-6} per °C

Fig. 2

(Continued)

(d) A bar 35 mm in diameter was subjected to a tensile load of 54 kN and measured extension on 300 mm gauge length was 0.112 mm and change in diameter was 0.00366 mm. Calculate Poisson's ratio and value of three moduli. [7]

Unit-II

2. (a) Draw the shear stress distribution across the I-section beam. [2]

(b) Direct stresses of 100 N/mm^2 tensile and 80 N/mm^2 compressive exist on two perpendicular planes as a certain point in a body. They are also accompanied by shear stress on the planes. The greatest principal stress at the point due to these is 130 N/mm^2.

(i) What should be the magnitude of the shearing stresses on the two planes?

(ii) What will be the shearing stress at that point? [7]

(Turn Over)

(c) A cylindrical shell 3 m long and 100 cm internal diameter and 15 mm metal thickness is subjected to an internal pressure of 1.8 N/mm^2. Determine : [7]

(i) Minimum intensity of shear stress

(ii) Change in the dimensions of the shell and change in volume

Take $E = 2 \times 10^5$ N/mm^2 and $l/m = 0.25$

(d) A cylindrical shell 2 m long and 80 cm internal diameter and 12 mm metal thickness is subjected to an internal pressure of 1.50 N/mm^2. Determine : [7]

(i) Minimum intensity of shear stress

(ii) Change in the dimensions of the shell and change in volume

Take $E = 2 \times 10^5$ N/mm^2 and $l/m = 0.30$

Unit-III

3. (a) What is bending stress? How is it different from direct stress? [4]

(Continued)

[5]

(b) A beam *ABCD* has an internal hinge at *B* and is loaded as shown in Fig. 3. Determine the reactions at *A*, *C* and *D* and plot the shear force and bending moment diagrams indicating principal values.   [12]
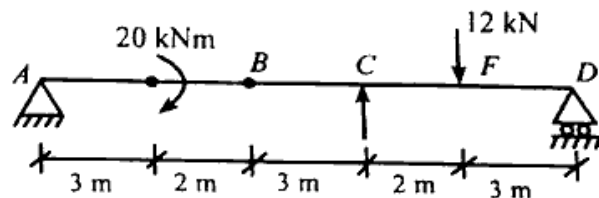

Fig. 3

(c) A timber beam of rectangular section is to support a UDL load of 25 kN over a span of 5 m. If the depth of the section is to be twice the breadth and the stress in the member is not to exceed 60 N/mm² find the dimensions of the cross-section.

How would you modify the cross-section of the beam if it were a concentrated load placed at the centre with the same ratio of breadth to depth?   [12]

Unit-IV

4. (a) What are the modes of failure for different types of columns?   [4]

(b) Derive the expression for Euler's load for a column with one end fixed and other end free.   [12]

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[6]

(c) A retaining wall 4 m high with a smooth vertical back retains a dry sandy backfill of unit weight 16 kN/m³ and angle of shearing resistance is 30°. The backfill carries a uniformly distributed surcharge of 12 kN/m². Find by Rankine's theory the *total active earth pressure per metre length* of wall and its point of application above the base.   [12]

Unit-V

5. (a) What are the functions of a spring?   [2]

(b) Obtain the formula for shear centre of a channel section.   [7]

(c) A shaft transmits 200 kW power at 100 r.p.m.

     (i) Determine the necessary diameter of solid circular shaft.

     (ii) The necessary diameter of hollow circular section, the inside diameter being 2/3 of the external diameter. The allowable shear stress is 60 N/mm². Taking the density of material as 70 kN/m³, calculate the percentage saving in the material if the hollow section is used.   [7]

(d) A close-coiled helical spring made out of a 10 mm diameter steel rod has 10 complete coils each of mean diameter of 80 mm. Calculate :   [7]

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(*i*) The stress induced in the section of the rod

(*ii*) The deflection under the pull

(*iii*) The amount of energy stored in the spring during the extension if it is subjected to an axial pull of 200 N. Take $N = 0.85 \times 10^5$ N/mm^2

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