B.E.- Mining Engineering Sem IV
MN405 - Strength of Material

P. Pages : 3 **GUG/S/18/3932**

Time : Three Hours Max. Marks : 80

Notes : 1. All questions carry equal marks.
2. Answer **all** questions.
3. Due credit will be given to neatness and adequate dimensions.
4. Assume suitable data wherever necessary.
5. Illustrate your answers wherever necessary with the help of neat sketches.
6. Non programmable calculator is allowed.

1. a) A tie steel bar has enlarged ends of square section $60\,mm \times 60\,mm$ as shown in fig. 1. If the middle portion of the bar is also of square section. Find the size and length of the middle portion if the stress there is $140\,N/mm^2$ and the total extension of the bar is 0.14 mm. Take $E = 2\times10^5\,N/mm^2$. **10**

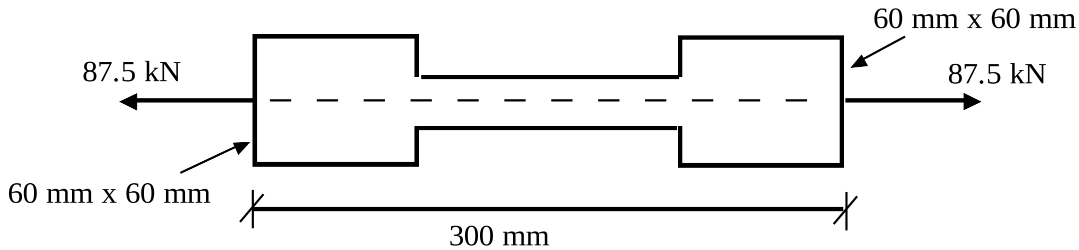

Fig. (1)

b) Derive the relation between the modulus of elasticity and modulus of rigidity. **6**

OR

2. a) Derive the equation of hoop stress and longitudinal stress for thin cylinder. **6**

b) A steel bar is placed between two copper bars, each having the same area and length as steel bar at 20ºC. At this stage they are rigidly connected together at both the ends. When the temperature is raised to 320ºC, the length of the bars increases by 1.5 mm. Determine the original length and final stresses in the bars. **10**
Take :

$E_S = 220\,GN/m^2$

$E_C = 110\,GN/m^2$

$\alpha_S = 0.000012/^\circ C$

$\alpha_C = 0.0000175/^\circ C$

3. a) Explain Mohr's circle. Elaborate the procedure of Mohr's circle for like normal stresses acting on both x and y axis. **6**

b) A resultant tensile stress of 70 MPa is acting as shown in fig. (2) Another direct tensile stress of 40 MPa is acting over a plane, which is at right angle to the previous one find the resultant stress in the second plane, the principal planes and stress and the plane of maximum shear intensity. **10**

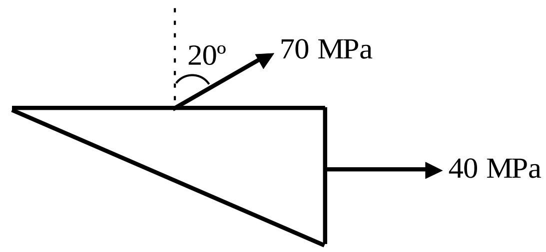

Fig. (2)

OR

4. a) Derive torsion formula with assumption. **8**

b) A hollow shaft of diameter ratio 3/8 is required to transmit 600 kW at 110 r.p.m. the max. torque being 20% greater than the mean. The shear stress is not to exceeds $63 \mathrm{MN/m^2}$ and the twist in the length of 3m not to exceeds 1.4 degree. Calculate the external diameter satisfying these condition. **8**

Take modulus if rigidity $84 \mathrm{GN/m^2}$.

5. a) Draw the shear force and bending moment diagram for a cantilever carrying load whose intensity varies uniformly from zero at the fixed and to 'w' per unit run at the free end. **12**

b) Derive relation between load, shear force and bending moment. **4**

OR

6. Draw the S.F.D. and B.M.D. for the simply supported beam shown in fig. 3 clearly mark the position of the maximum bending moment and locate the point of contraflexure if any. **16**

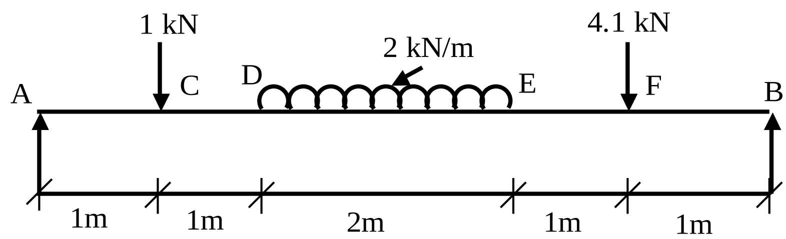

Fig. (3)

7. a) Explain the theory of simple bending with assumptions. **4**

b) What is section modulus. Explain with examples. **4**

c) A hollow circular bar having outside diameter twice the inside diameter is used as a beam. From the bending moment diagram it is found that the bar is subjected to a bending moment of 40 kN-m. If the allowable bending stress in the beam is to be limited to $100 \times 10^3 \mathrm{N/m^2}$. Find inside diameter of bars. **8**

OR

8. a) A beam simply supported at ends and having cross section as shown in fig. 4 is loaded with a U.D.L. over whole of its span. If the beam is 8m long. Find the UDL if maximum permissible bending stresses in tension is limited to $30\,MN/m^2$ and in compression to $45\,MN/m^2$. What are the actual maximum bending stress set up in the section. **12**

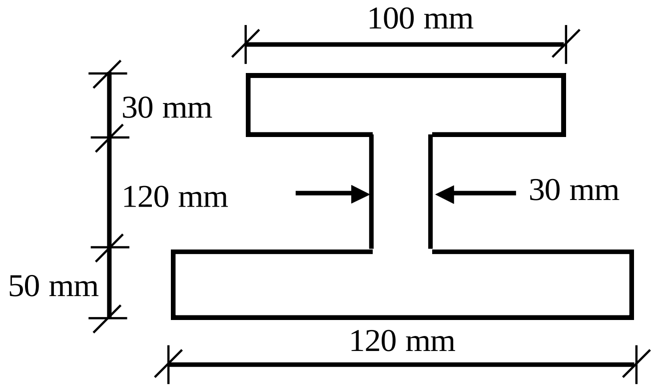

Fig. (4)

b) What are the different type of cement used in construction work. Explain any three with their chemical composition. **4**

9. A beam of length of 6 m is simply supported at its ends and carries two point loads of 48 kN and 41 kN at a distance of 1 m and 3 m respectively from the left support as shown in fig. 5. Using Macaulay's method find : **16**

i) Deflection under each load.

ii) Maximum deflection and

iii) The point at which maximum deflection occurs.

Given :

$E = 2 \times 10^5 \; N/mm^2$

$I = 85 \times 10^6 \; mm^4$

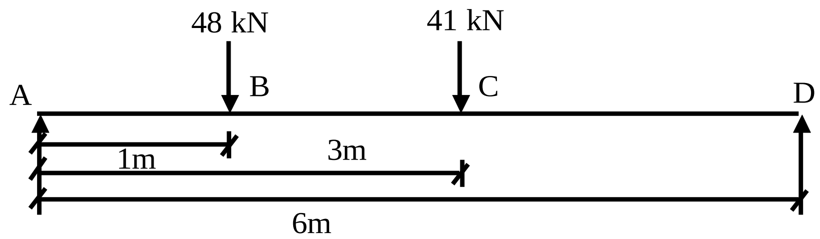

Fig. (5)

OR

10. a) Find the Euler's crippling load for a column with one end fixed and other end free. **8**

b) A solid round bar 60 mm in diameter and 2.5 m long is used as a strut both end of strut is hinged. Find the safe compressive load for this strut using Euler's formula. **8**

Assume $E = 200\,GN/m^2$ and factor of safety = 3.

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