BE (Third Semester)

Mechanical Engineering

Mechanics of Solid - I - 337354(37)

2014 - Winter Session , New Scheme

Chapter 1

1 Define stress & strain. **2**

2 A metallic rod is 10 mm diameter, tested under an axial pull of 10 kN. The diameter of the rod is reduced by 0.003 mm. The modulus of rigidity of the rod is 0.5×10^5 N/mm^2. Find the other modulii. **7**

3 A steel tie rod 50 mm in diameter snd 2.5 m long is subjected to a pull of 100 kN. To what length the rod should be bored centrally so that the total entension will increase by 15 percent under the same pull, the bore being 25 mm diameter? Take E = 200 GN/m^2. **7**

4 A steel rail is 12.6 m long and is laid at a temperature of 24ºC. the maximum temperature expected is 44ºC : **7**

1. Estimate the minimum gap between two rails to be left so that temperature stresses do not develop.
2. Calculate the thermal stresses developed in the rails if :
    1. No expansion joint is provided
    2. If a 2 mm gap is provided for expansion.

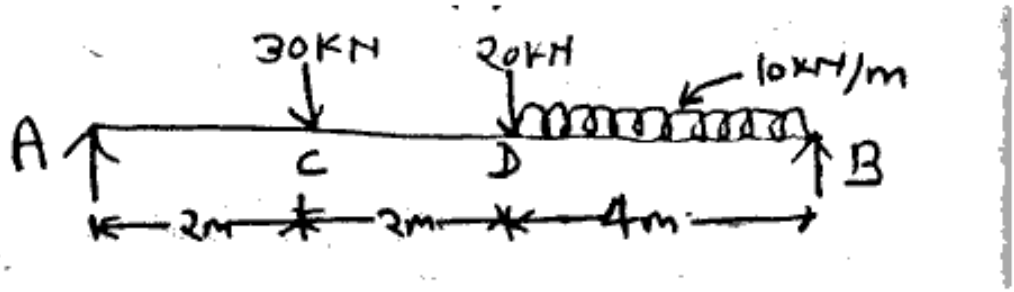
Take E = 2×10^5 MN/m^2 & $\alpha = 12\times10^{-6}$/ºC.

Chapter 2

1 Describe the various types of beams. **2**

2 Derive the bending equation for the simple bending of beam. List the assumptions also. **7**

3 Draw the bending moment and shear force diagram for the simply supported beam as shown in figure. **7**



4 Three beams have the same length, the same allowable stress & the same bending moment. The cross sections of the beams are square, a rectangle with depth twice the width and a circle. Determine the ratios of weights of the cicular & the rectangular beams with respect to the square beam. **7**

Chapter 3

1 State the moment area theorem. **2**

2 Find the slope & deflection of a simply supported beam of length l carrying a uniformly distributed load of w per unit run. Use double integration method. **7**

3 A simply supported beam of uniformly section has a span l and carries two equal loads W/2 each symmetrically placed at distance l/3 on either side of midspan. Find the deflection at the midspan using Macaulay's method. **7**

4 A catilever beam of length L, carries a uniformly distributed load w/unit length over a length 'a' from the fired end. Derive the formula for deflection at the free end using the moment area method. **7**

Chapter 4

1 Define torsional rigidity. **2**

2 Derive the torsion equation for shaft. List the assumptions also. **7**

3 A solid cylindrical shaft is to transmit 300 kW at 100 rpm : **7**

1. What the shear stress is not to exceed 80 MN/m^2, find its diameter
2. What percentage saving in weight would be obtained if this shaft is replaced by a hollow one whose internal diameter equals 0.6 of the external diameter, the length, the material and maximum shear stress being the same.

4 A closed coiled helical spring is to have a stiffness of 900 N/m in compression, with a maximum load of 45 N and a maximum shearing stress of 120 N/mm^2. The solid length of the spring (i.e. coils touching) is 45 mm. Find : **7**

1. The wire diameter
2. The mean coil radius
3. The number of coils

Take modulus of rigidity of material of the spring = 0.4×10^5 N/mm^2.

Chapter 5

1 Define principal planes. **2**

2 Two mutually perpendicular planes of an element of material are subjected to direct stress of 35 MN/m^2 (tensile) & 15 MN/m^2 (tensile). The shear stress across these planes is 9 MN/m^2. Find the magnitude & direction of the resultant stress on a plane making an angle of 40^0 with the plane of first stress. Find also the normal & tangential stresses on the planes by analytical method and graphically both. **14**

3 Direct stresses of 120 MN/m^2 in compression are applied to an elastic material at a certain point on plates at right angles to another. If the maximum principle stress is not to exceed 150 MN/m^2 in tension, to what shearing stress can the material be subjected? Solve graphically or otherwise. What is then the maximum resulting shearing stress in the material? Also find the magnitude of the other principle stress and its inclination to 120 MN/m^2 stress. **14**