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

(New Scheme)

(Mech., Production & Automobile Engg. Branch)

MECHANICS of SOLIDS-I

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : *Part (a) of each question is compulsory which carry 2 marks. Attempt any* ***two*** *part from (b), (c) and (d) in each question carry 7 marks.*

1. (a) Define stress and strain and classify stresses. 2

(b) Draw stress and strain curve for ductile and brittle material and explain it. 7

(c) A member LMNP is subjected to point loads as shown in fig.

Calculate :

(i) Force P necessary for equilibrium

(ii) Total elongation of the bar

Take $E = 210$ GN/m^2

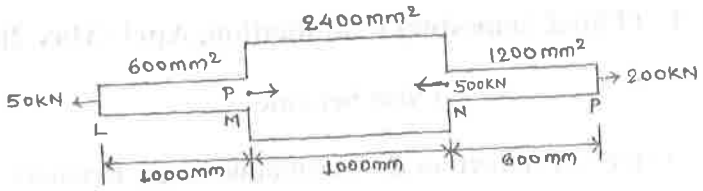

Fig. 1

(d) A steel rod 15 m long is at a temperature of 15°C. Find the free expansion of the length when the temperature is raised to 65°C. Find the temperature stress produced when :

(i) The expansion of the rod is prevented

(ii) The rod is permitted to expand by 6 mm

Take : $\alpha = 12 \times 10^{-6}$ per °C

and $E = 200$ GN/m^2. 7

2. (a) Write relation between shear force and bending moment, rate of loading. 2

(b) Derive bending equation of beam with proper assumptions. 7

(c) Draw the shear force and bending moment diagrams for a cantilever loaded as shown in figure below. 7

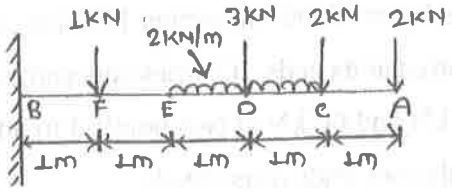

Fig. 2

(d) A simply supported beam and is cross section as shown in figure below. The beam carries load $W = 20$ kN as shown Its self weight is 7 kN/m. Calculate the normal stress at 1-1. 7

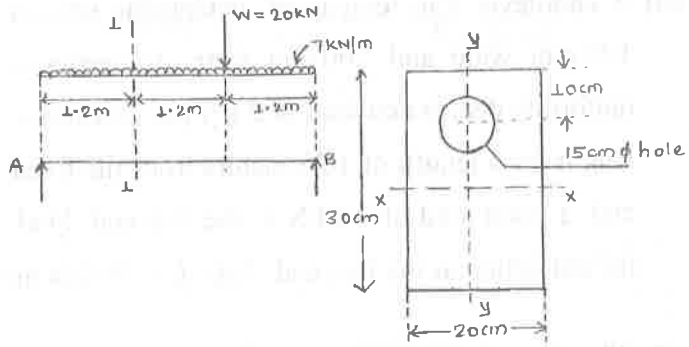

Fig. 3

3. (a) Write moment area theorems. 2

(b) Derive expressions for maximum deflecton of a simply supported beam under UDL of magnitude 'w'. 7

(c) A steel beam of uniform section 14 m long is simply supported at its ends. It carries concentrated loads of 90 kN and 60 kN at two points 3 m and 4·5 m from the two ends respectively. 7

Calculate :

(i) The deflection of the beam at the points under the two loads.

(ii) The maximum deflection

(iii) Take $I = 6{\cdot}4 \times 10^{-4}$ m^4 and $E = 210 \times 10^{-6}$ kN/m^2

(d) A cantilever 2 m long is of rectangular section 100 mm wide and 200 mm deep. It carries a uniformly distributed load of 2 kN per unit meter length for a length of 1·25 meters from the fixed end, a point load of 0·8 kN at the free end. Find the deflection at the free end. Take $E = 10$ GN/m^2. 7

4. (a) What is torsional rigidity. 2

(b) Derive torsional equation for a circular shaft and state its assumption. 7

(c) A solid steel shaft 6 m long is securely fixed at each end. A torque of 1250 Nm is applied to the shaft at a section 2·4 m from one end. What are the fixing torques setup at the ends of the shaft? If the diameter of the shaft is 40 mm. What are the maximum shear stresses in the two portions? Calculate also the angle of twist for the section where the torque is applied, modulus of rigidity = 84 GN/m^2. 7

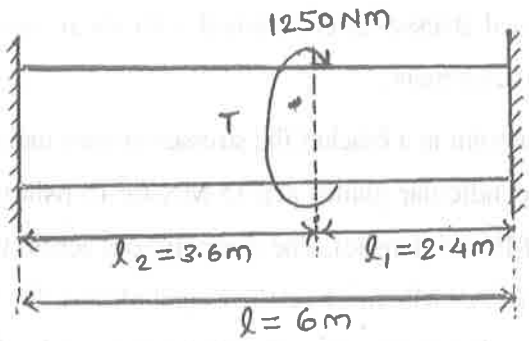

Fig. 4

(d) For a closed coil helical spring subjected to an axial load of 300 N having 12 coils of wire diameter of 16 mm and made with coil diameter of 250 mm. find 7

(i) Axial deflection

(ii) Strain energy stored

(iii) Maximum torsional shear stress in the wire

(iv) Maximum shear stress using Wahl's correction factor

Take $G = 80$ GN/m^2

5. (a) Define principal plane and principal stress. 2

(b) Derive an equation for normal and tangential stress on an inclined plane due to two perpendicular normal stresses accompained with shear stresses on the element. 7

(c) At a point in a bracket the stresses on two mutually perpendicular planes are 35 MN/m^2 (tensile) and 15 MN/m^2 (tensile). The shear stresses across these planes is 9 MN/m^2. Find the magnitude and direction of resultant stress on a plane making an angle of 40° with the plane of first stress. Also find the normal and tangential stresses on the plane. Solve graphically. 7

(d) At a point in a material under stress, the intensity of the resultant stress on a certain plane is 50 MN/m^2 (tensile) inclined at 30° to the normal of that plane.

The stress on a plane at right angle to this has a normal tensile component of intensity of 30 MN/m^2.

Find :

(i) The resultant stress on the second plane.

(ii) The principal stress and planes.

(iii) The plane of maximum shear and intensity. 7

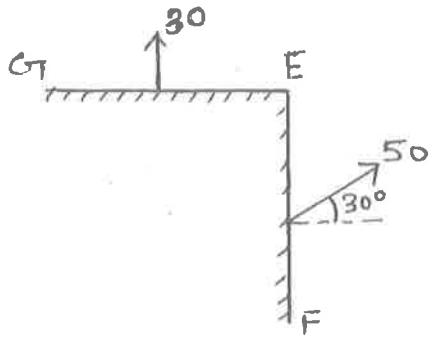

Fig. 5