Code: 20A01305T

R20

B.Tech II Year I Semester (R20) Supplementary Examinations April/May 2024

MECHANICS OF MATERIALS

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

*****

1 Answer the following: (10 X 02 = 20 Marks)

(a) What is the principle of Strain Rosette? 2M

(b) Why is principal stress problem considered as Eigen value problem? 2M

(c) Write the relationship between Load, Shear force and Bending moment. 2M

(d) If a simple supported beam is supported with uniformly varying load, show the nature of SFD and BMD. 2M

(e) If two shafts are connected in parallel, give the relationship between angle of twist and torque transmitted by them. 2M

(f) What are major stresses induced in closed coiled helical spring with its critical location? 2M

(g) If a thin cylinder is subject to uniform radial load, how to determine the critical stress of the cylinder wall thickness. 2M

(h) Sketch the tangential and radial stress distribution of a thick cylinder subjected to internal pressure. 2M

(i) Give an example for both symmetrical and symmetrical bending. 2M

(j) Define Curved Beam. 2M

PART – B

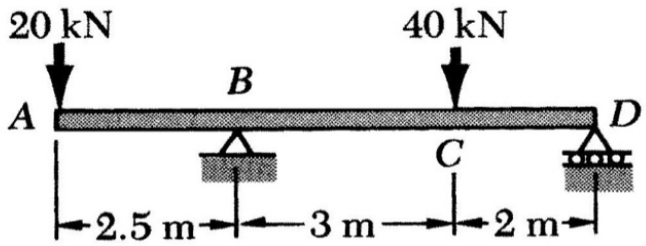
(Answer all the questions: 05 X 10 = 50 Marks)

2 A steel bar AB of uniform thickness 20 mm, tapers uniformly from 100 mm to 50 mm in a length of 500 mm. Determine the elongation of plate; if an axial tensile force of 50 kN is applied on it. [E = 20000MPa]. 10M

OR

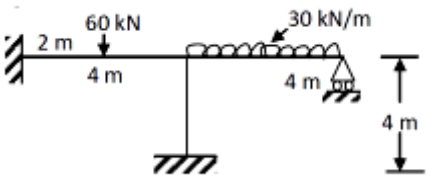
3 The stresses at a point in a bar are 200 MPa (tensile) and100 MPa (compressive). Determine the resultant stress in magnitude and direction on a plane inclined at 60° to the axis of major stress. Also, determine the maximum intensity of normal and shear stress in the material at the point. 10M

4 Draw the shear and bending moment diagrams for the beam and loading shown in figure below. 10M



OR

5 Analyse the frame shown in figure and draw BMD flexural rigidity is same for all members. 10M



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6 A shaft made of mild steel is required to transmit 120 kW at 400 r.p.m. The supported length of the shaft is 3 metres. It carries two pulleys each weighing 1kN supported at a distance of 0.8 metre from the ends respectively. Assuming the safe value of stress, determine the diameter of the shaft. 10M

OR

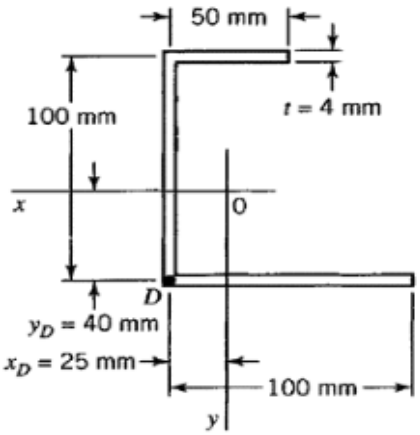
7 A leaf spring carries a load of 3400 N and placed over a span of 800 mm. The spring can deflect by 50 mm. Consider, allowable bending stress for the spring material as 350 MPa and $E = 200\,GPa$. If number of leaves and with of the leaf is 54 mm. Determine the thickness of leaves. 10M

8 A thick cylinder of steel having an internal diameter of 100 mm and external diameter of 200 mm is subjected to an internal pressure of 80 MPa. Find the maximum stress induced in the material and the change in the external diameter. 10M
Take Young's modulus = 20000 MPa and Poisson's ratio = 0.3.

OR

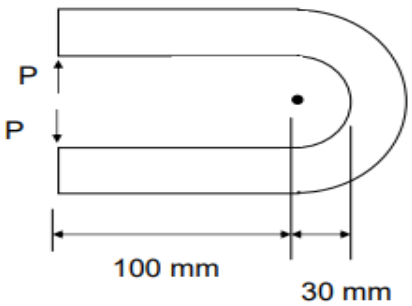
9 A cylindrical shell with 0.8 m in diameter and 3 m long is having 10 mm wall thickness. If the shell is subjected to an internal pressure of 2.5 MPa, determine (i) change in diameter, (ii) change in length and (iii) change in volume. Take E = 200 GPa and Poisson's ratio = 0.25. 10M

10 A beam has a nonsymmetrical section whose shape and dimensions are shown in figure. Locate the shear center. 10M



OR

11 For a square 50x50 mm cross-section, find the maximum tensile and compressive stress if $\mathrm{P} = 10\ \mathrm{kN}$ and plot the total stress across the cross-section. 10M



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PART – A

(Compulsory Question)

*****

1 Answer the following: (10 X 02 = 20 Marks)

(a) Express Young's modulus in terms of Bulk and Rigidity modulus. 2M

(b) Show the relation between Modulus of Elasticity And Modulus of Rigidity. 2M

(c) Compare Overhanging beam with Continuous Beam. 2M

(d) Differentiate Sagging and Hogging Bending Moment. 2M

(e) Define the term Spring Index. 2M

(f) Define Torsion. 2M

(g) Define Circumferential Stress. 2M

(h) A spherical shell of 1 m diameter is subjected to an internal pressure 0.5 N/mm^2. Discover the thickness of the shell, if the allowable stress in the material of the shell is 75 N/mm^2. 2M

(i) What is Link Radius? 2M

(j) Formulate the Mathematical form of Bending Moment Theory. 2M

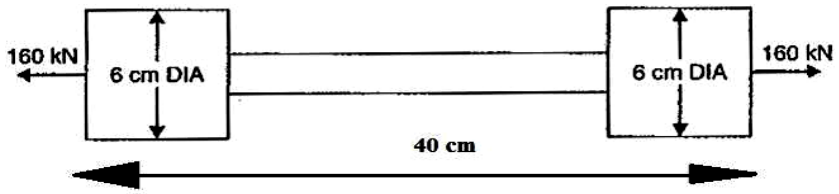
PART – B

(Answer all the questions: 05 X 10 = 50 Marks)

2 At a certain point in a strained material, the stresses on two planes, at right angles to each other are 20 N/mm^2 and 10 N/mm^2 both tensile. They are accompanied by a shear stress of a magnitude of 10 N/mm^2. Find graphically or otherwise, the location of principal planes and evaluate the principal stresses. 10M

OR

3 The bar shown in figure is subjected to a tensile load of 160 KN. If the stress in the middle portion is limited to 150 N/mm^2, determine the diameter of the middle portion. Find also the length of the middle portion if the total elongation of the bar is to be 0.2 mm. Young's modulus is given as equal to 2.1×10^5 N/mm^2. 10M



4 A beam of length 10 m is simply supported at its ends carries two concentrated loads of 5 KN each at a distance of 3 m and 7 m from the left support and also a uniformly distributed load of 1 kN/m between the point loads. Draw the shear force and bending moment diagrams. 10M

OR

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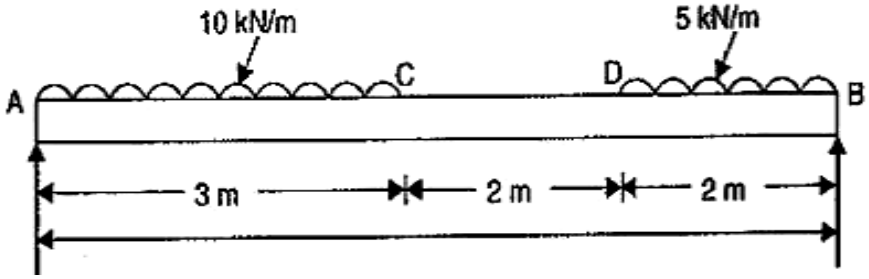
5 A Simply supported beam is carrying loads as shown in figure draw the shear force and bending moment diagrams for the beam. 10M



6 A close coiled helical spring is to have a stiffness of 1.5 N/mm of compression under a maximum load of 60 N. the maximum shearing stress produced in the wire of the spring is 125 N/mm^2 .The solid length of the spring is 50 mm. Find the diameter of coil, diameter of wire and number of coils .C = 4.5 x $l0^4$ N/mm^2. 10M

OR

7 Find the diameter of the solid shaft to transmit 90 KW at 160 rpm such that the shear stress is limited to 60 N/mm^2. The maximum torque is likely to exceed the mean torque by 20%. Also find the permissible length of the shaft, if the twist is not to exceed 1° over the entire length. Take rigidity modulus as 0.8×10^5 N/mm^2. 10M

8 A cylinder has an internal diameter of 230 mm, wall thickness 5 mm and is 1 m long. It is found to change in internal volume by 12×10^{-6} m^3 when filled with a liquid at a pressure 'p'. Taking E = 200 GPa and 1/m = 0.25, determine the stresses in the cylinder, the changes in its length and internal diameter. 10M

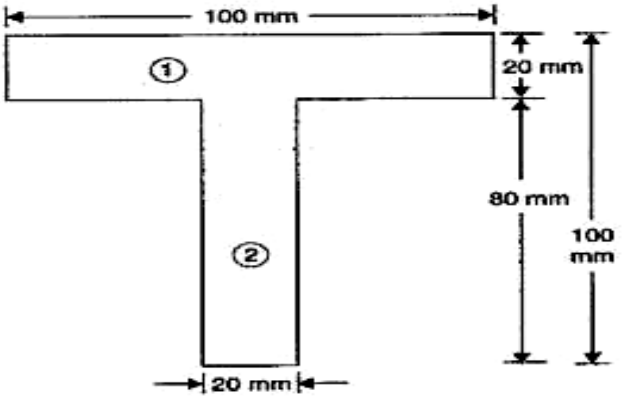
OR

9 A spherical shell of internal diameter 1.2 m and of thickness 12 mm is subjected to an internal pressure of 4 N/mm^2. Determine the increase in diameter and increase in volume. Take E = 2 x 105 N/mm^2 and μ = 0.33. 10M

10 A chain link is made of 2 cm diameter round steel with mean radius of circular ends 2.5 cm, the length of straight portion being 2 cm. determine the values of maximum tensile and compressive stresses, when the link is subjected to a pull of 2 tonnes at its ends. 10M

OR

11 A T-section of a simply supported beam has the width of flange 100 mm, over all depth = 100 mm, thickness of flange and stem = 20 mm. Determine the maximum stress in beam when the bending moment of 12 kN-m is acting on the section. For the above T-section calculate the shear stress at neutral axis and at the junction of web and flange when shear force of 50 kN acting on beam. 10M



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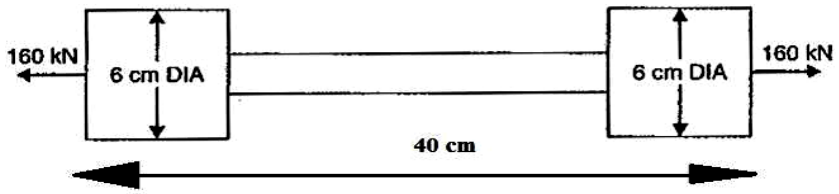

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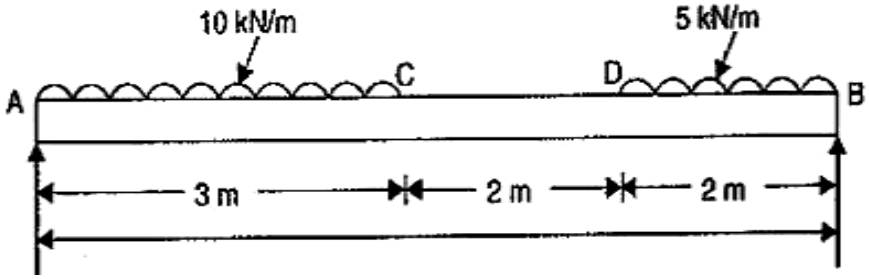

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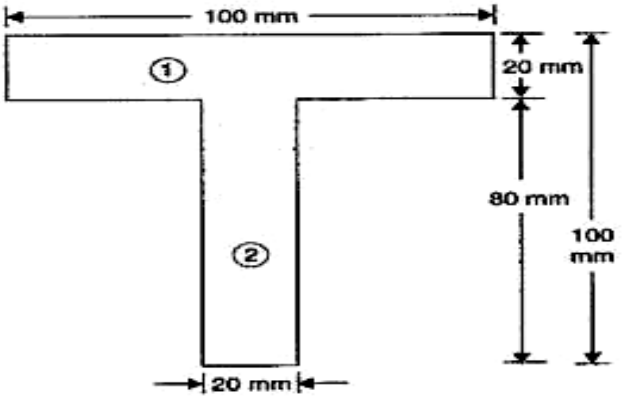

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