Exam Date & Time: 28-Nov-2019 (08:30 AM - 11:30 AM)

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

III SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOV 2019

STRENGTH OF MATERIALS [MME 2154]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

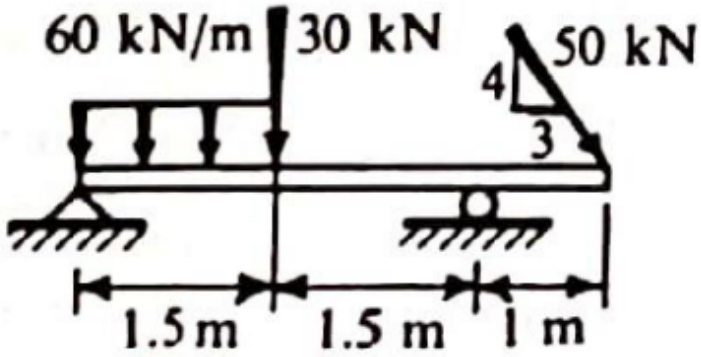
Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) With the help of engineering stress-strain diagram explain the behavior of mild steel in tension. (3)

A)

B) Establish a relationship between bending moment, shear force and rate of loading for a beam. (2)

C) For the beam configuration shown in figure, plot the shear force and bending moment distribution diagram. Also determine maximum bending moment and the location of point of contra flexure if any. (5)

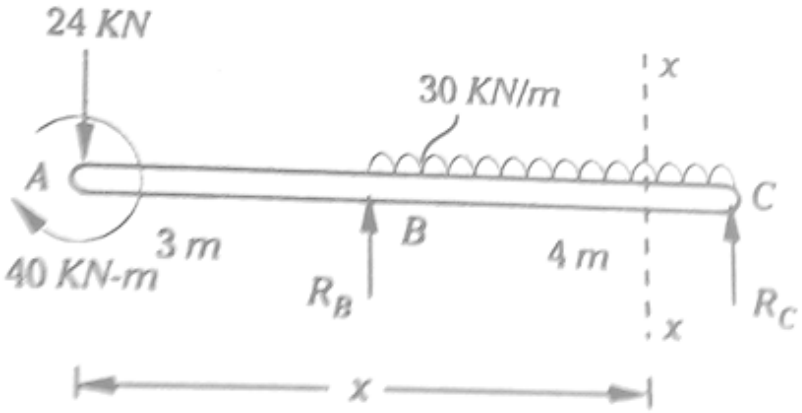


2) A plane element is subjected to 200 N/mm^2 tensile stresses along horizontal X- direction, 300 N/mm^2 compressive stresses along vertical Y-direction and positive shear stresses of 100 N/mm^2 on each side of the plane. Determine the principal stresses, maximum shear stress and corresponding inclinations of the planes. Plot the planes and stress. Use analytical method. (3)

A)

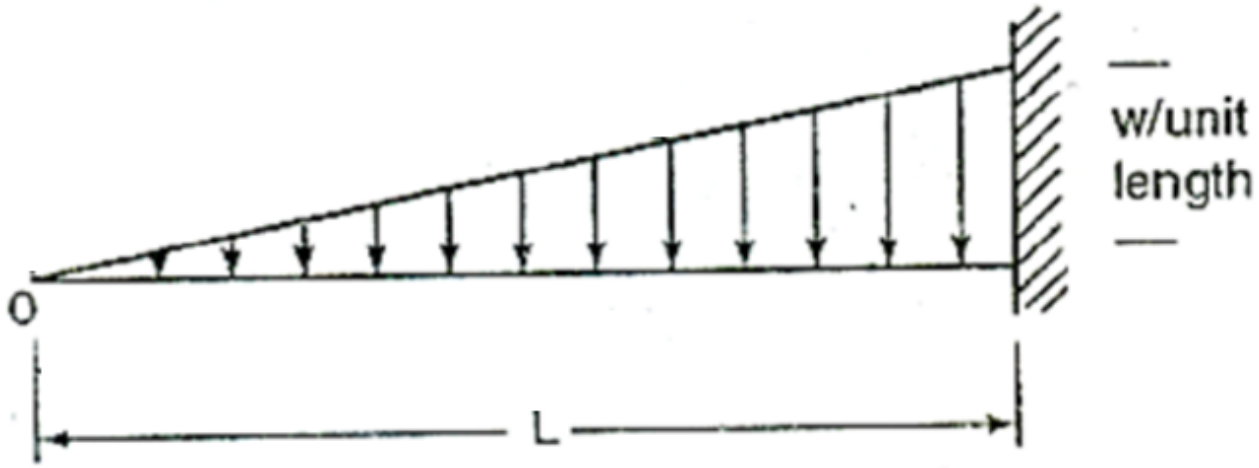
B) What is factor of safety (FOS)? Mention the parameters which affect the decision of magnitude of FOS. (2)

C) For the beam configuration shown in figure, determine the maximum deflection and slope at the supports through Macaulay's method. Take EI = 15 x 10^9 kN-mm^2. (5)



3) For the beam configuration shown in figure determine the deflection and slope at the free end using direct integration method.

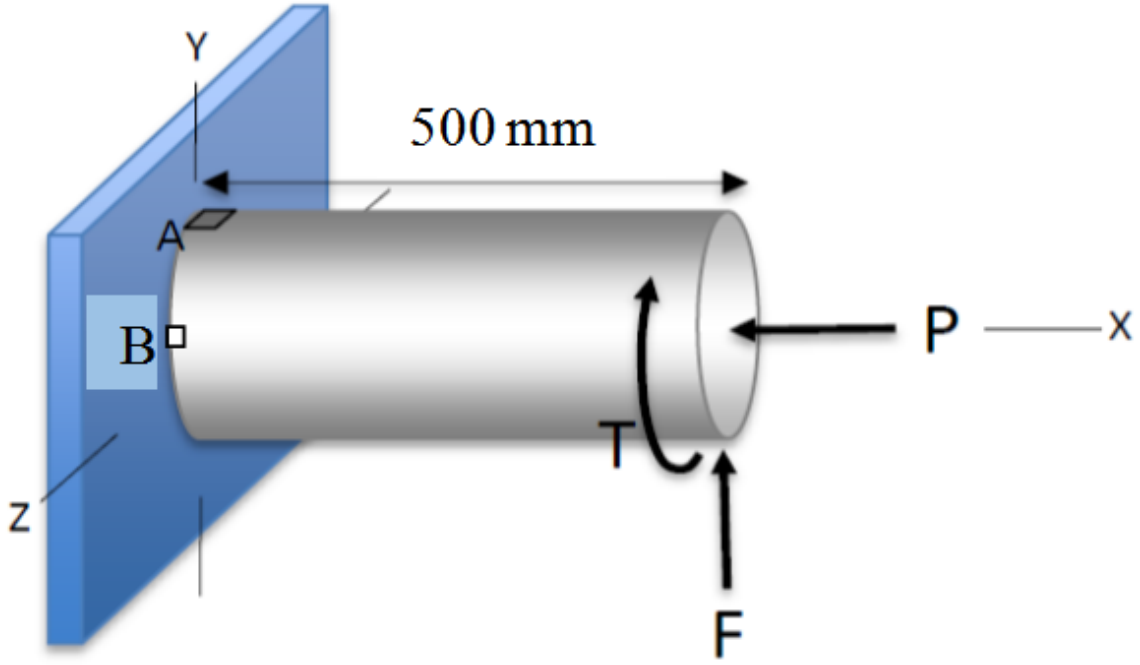
A)



(3)

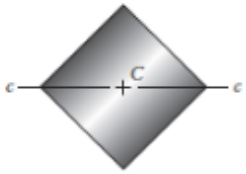
B) A square cross section timber column of 6 m can withstand a stress of 9 MPa. Determine the permissible width of column by using Euler's equation if both ends of the column are fixed. Assume modulus of elasticity as 12 x 10^6 kPa. (2)

C) The rod below is subjected to a torque T = 11.5 kN-mm, a load P = 1100 N in the negative x-direction, and a load F = 110 N in the positive y-direction. The rod is machined out of an AISI 4130 steel bar (Tensile strength 655 MPa, compressive strength 520 MPa, shear strength 330 MPa), and has a diameter of d = 12.5 mm. Predict the nature and magnitude of the stresses developed at point 'A'(Topmost Point on the circumference as shown) . Also compute the principal and maximum shear stresses using analytical method. Is the rod safe under given loadings? Justify. (5)



4) A square cross section beam is oriented as shown in figure. The section has sides 424.5 mm and it experiences a shearing force of 50 kN. Compute the maximum shearing stress and its location. Plot the variation of stress in the section.

A)



(4)

B) State the assumptions made in theory of pure torsion and derive the torsion equation. (4)

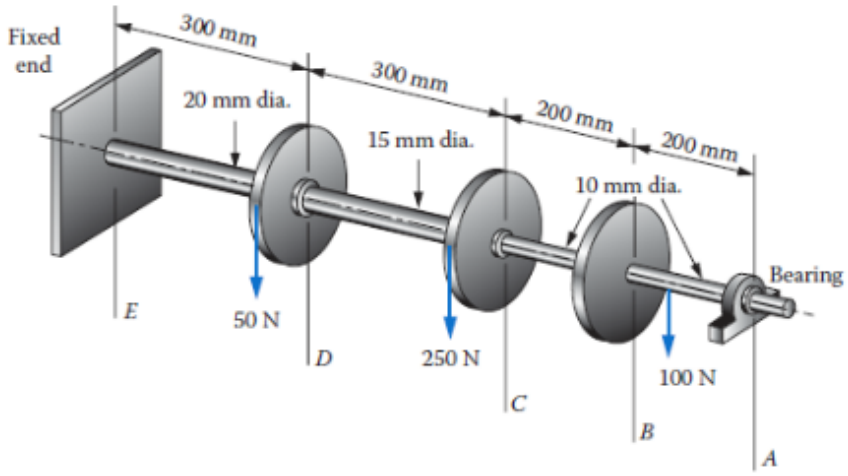
C) Differentiate between:

i. Long and Short columns

ii. Bending and Buckling (2)

5) Figure shows a steel (G = 80 GPa) shaft to which three disks are attached. The shaft is fixed against rotation at its left end, but free to rotate in a bearing at its right end. Each disk is 300 mm in diameter. Downward forces act at the outer surfaces of the disks so that different levels of torque are applied to the rod. Determine the angle of twist of section A relative to the fixed section E. Also find the stress developed in each segment of the shaft. (4)

A)



B) A thick cylinder of external and internal diameters of 300 mm and 180 mm is subjected to an internal pressure of 42 MPa and external pressure of 6 MPa. Determine the stresses in the material. If the external pressure is doubled, what internal pressure can be maintained without exceeding the previously determined maximum stress? (4)

C) Define: i) Bulk Modulus ii) Resilience (2)

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