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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (S, FE) / S1 (PT) (S, FE) Examination December 2023 (2015 Scheme)

Course Code: CE201

Course Name: MECHANICS OF SOLIDS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Differentiate between(i) Axial strain and lateral strain (ii) Bulk modulus and Rigidity modulus (iii) Normal stress and shear stress (6)

b) Find the Poisson's ratio and bulk modulus of a material whose modulus of elasticity is 200 GPa and modulus of rigidity is 80 GPa. A rod 2 m long and 40 mm diameter made with this material is stretched by 2.5 mm under an axial load. Find the lateral contraction and change in volume of the rod. (9)

2 a) A compound bar consists of a circular steel rod of 20 mm diameter rigidly fitted into a copper tube of internal diameter 22 mm and thickness 5 mm. If the bar is subjected to a load of 100 kN, find the stresses developed in the two materials. Take Es = 2×10^5 N/mm^2 and Ec = 1.2×10^5 N/mm^2 (5)

b) Show that stress developed due to axial force applied gradually is half of that due to suddenly applied force. (6)

c) Explain pure shear and the state of complementary shear stress with neat diagram. (4)

3 a) A brass bar 32 mm diameter is subjected to forces as shown in Fig.1. Find the value of P necessary for equilibrium and strains in different segments. Also calculate the change in length of the bar. Assume E = 100 GPa. (7.5)

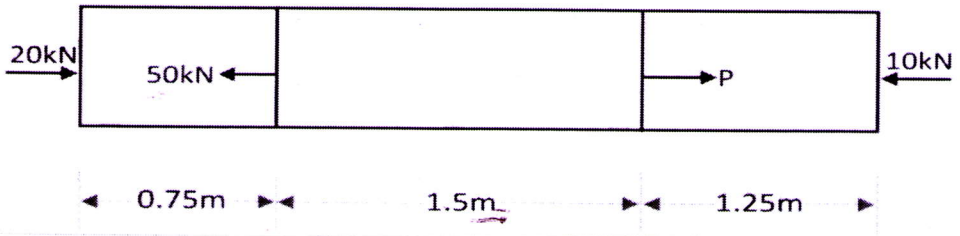

Fig.1

b) A steel bar 20 mm diameter is 7 m long & has collar attached to it. A load of 800N falls on it from a height of 60 mm. Find i) Stress ii) Change in length. iii) Strain energy iv) modulus of resilience. Young's modulus for material is 2×10^5 N/mm^2. (7.5)

PART B

Answer any two full questions, each carries 15 marks.

4 a) A cast iron beam of triangular section of 100 mm width and 100 mm depth is placed with its base horizontal. The beam is simply supported over a span of 6 m. If the allowable stress in tension and compression are 50 MPa and 150 MPa respectively, find the safe concentrated load at the centre of the beam. (9)

b) Prove that the maximum shear stress in a rectangular section of a beam is 1.5 times the average shear stress. (6)

5 a) Calculate the strain energy due to bending in a cantilever beam of span 1m subjected to a u.d.l. of 2kN/m over half span from free end. (8)

b) Define i. point of contraflexure ii. section modulus. (4)

c) Write a short note on 'flitched beam'. (3)

6 a) A beam ABC carries a uniformly distributed load of 2kN/m. It is simply supported at A and B 6 m apart with an overhang BC of 1m. It also carries a concentrated load of 5 kN at 2 m from A. State the position and amount of maximum BM. Sketch the SFD and BMD (11)

b) Write on 'beams of uniform strength'. (4)

PART C

Answer any two full questions, each carries20 marks.

7 a) Compare the strengths of a solid steel column to that of a hollow one of the same area of cross section. Internal diameter of hollow column is 2/3 of external diameter. Columns have same length and end conditions. Use Euler's approach. (10)

b) Determine the maximum power transmitted at 280 rpm by a steel shaft of 35 mm internal diameter and 4.5 mm thick, if the allowable stress is 75 MPa and the angle of twist is not to exceed 1° in a length of 1.5 m. Assume G= 80 GPa for the material. (10)

8 a) Show that in thin cylinders, the circumferential stress is twice the longitudinal stress when subjected to internal pressure. (6)

b) A cantilever of span 4 m is carrying a UDL of 2 kN/m over a length of 2 m from free end. Find the maximum slope and deflection. (14)

9 a) Plane stress conditions exist at a point on the surface of a loaded structure, where the normal stresses and shear stress are as shown in Fig.2. Determine the stresses acting on a plane which is oriented at anti clock-wise angle of 15° with y axis. (9)

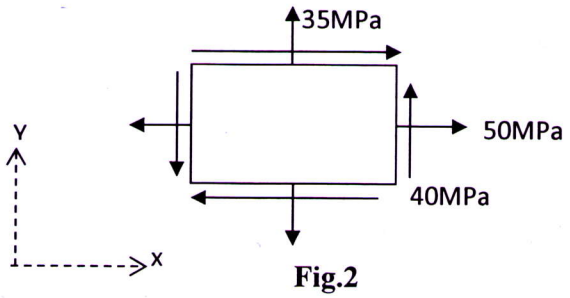

Fig.2

b) Give equations for radial stress and circumferential stress in a thick cylinder. (5)

c) Define i) Slenderness ratio of a column ii) Kern of a circular section (6)

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