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B037413(037)

B. Tech. (Fourth Semester) Examination, April-May 2021

(AICTE Scheme)

(Mechanical Engg. Branch)

STRENGTH of MATERIALS

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : *Attempt all questions. Part (a) of each question is compulsory and carries 4 marks. Solve any* ***two*** *parts from part (b), (c) & (d) and carries 8 marks each.*

Unit-I

1. (a) Draw stress-strain diagram for ductile and brittle materials. Name the salient points in the diagram. 4

(b) Derive the relationship between modulus of elasticity, bulk modulus and Poisson's ratio. 8

(c) A concrete column of cross-sectional area 400 mm × 400 mm is reinforced by four longitudinal 50 mm diameter round steal bars placed at each corner. If the column carries a load of 30 kN, determine : 8

(i) Loads carried by concrete and steel bars.

(ii) The stress produced in concrete and steel bars.

(d) A bar of 30 mm diameter is subjected to a pull of 60 kN. The measured extension on gauge length of 200 mm is 0·09 mm and the change in diameter is 0·0039 mm. Calculate the Poisson's ratio and the values of the three modulii. 8

Unit-II

2. (a) Define point of contraflexure. What do you understand by pure bending? 4

(b) Enumerate the assumptions made in deriving the formula for bending stress. Also prove that $\frac{\sigma}{y} = \frac{M}{I} = \frac{E}{\varrho}$ for a beam subjected to lateral loading. 8

(c) A simply supprted beam AB, 8 m long carrying a point load 3 kN at 2 m from A and point load 2 kN at 5 m from A and a uniformly distributed load of 2 kN/m between the point loads. Determine the magnitude of maximum bending moment. Draw shear force and bending moment diagram. 8

(d) A uniform T-section beam is 100 mm wide by 150 mm deep with a 25 mm thick flange and a 12 mm thick web. If the maximum bending stresses for the material of the beam are 80 MN/m^2 in compression and 160 MN/m^2 in tension, find the maximum u.d.l that the beam can carry over a simply supported span of 4 m. 8

Unit-III

3. (a) Write the expression of slope and deflection at the free end for a cantilever beam carrying : 4

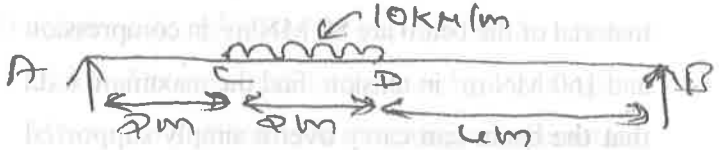
(i) a uniformly distributed load over the whole span.

(ii) a point load at the free end.

(b) A simply supported beam of 3 m span carries point loads of 120 kN and 80 kN at a distance of 0·6 m

and 2 m respectively from the left hand support. If I for the beam is equal to 16×10^8 mm^4 and $E = 210$ GN/m^2, find the deflection under loads. 8

(c) A beam AB of span 8 m is simply supported at the ends A and B and is loaded as shown in figure. If $E = 200 \times 10^6$ kN/m^2 and $I = 120 \times 10^{-6}$ m^4, using Macaulay's method, determine (i) Deflection at the mid span, (ii) Slope at end A. 8



(d) Using moment area method determine the slope and deflection at the free end of a cantilever beam subjected to a point load at the free end. 8

Unit-IV

4. (a) Write the torsion equation and explain the terms used in the equation. 4

(b) A solid shaft is required to transmit 96 kW of power at 180 rpm. Find the diameter of the shaft, if permissible stress for the material is 60 N/mm^2 and permissible twist is 0·33 per metre length. Take modulus of rigidity $G = 80$ GN/m^2. 8

(c) A steel rod of diameter 25 mm is encased in an Aluminium tube of external diameter 40 mm and 5 mm wall thickness. The composite shaft is required to transmit a torque of 100 kN-m. If both the shafts are rigidity welded at its ends and have equal lengths, find the maximum shear stress developed in each of the shaft. Take $G_a = 0{\cdot}3 \times 10^5$ N/mm^2 and $G_{steel} = 1 \times 10^5$ N/mm^2. 8

(d) The solid length of a closed coil spring is 50 mm. The spring has stiffness of 1.5 N/mm. The shearing stress in the wire is 120 N/mm^2, under axial load of 50 N. Determine the diameter of wire, mean diameter of the coil and number of turns.

Take $G = 40 \times 10^3$ M/mm^2. 8

Unit-V

5. (a) Define Principal and Principal stresses. 4

(b) Deduce expressions for stresses on an inclined plane in a body subjected to a bi-axial stress condition. 8

(c) The principal tensile stresses at a point across two perpendicular planes are 80 N/mm^2 and 40 N/mm^2. Find the normal, tangential and resultant stresses on a plane at an angle 20° with the major principal plane. Find also the obliguity of resultant stress. 8

(d) A 800 mm long shaft with a diameter of 80 mm cames a flywheel weighing 4 kN at its midway. The shaft transmits 24 kW at a speed of 240 rpm. Determine the principal stresses and the maximum shear stress at the ends of a vertical and horizontal diameter in a plane near the flywheel. 8