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APR-MAY

B. E. (Third Semester) Examination, 2020

(Old Scheme)

(Mech. Engg. Branch)

MECHANICS of SOLIDS-I

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

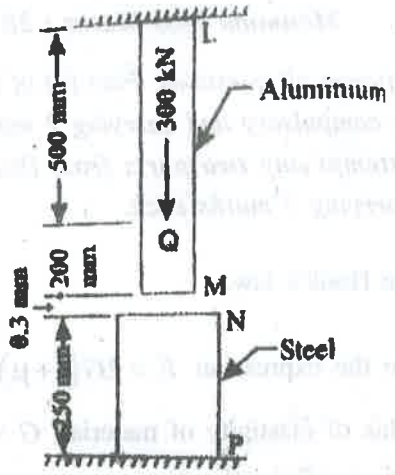
Note : *Attempt all questions. Part (a) of each question is compulsory and carrying 2 marks each and attempt any two parts from (b), (c) and (d) carrying 7 marks each.*

1. (a) Define Hook's law. 2

(b) Derive the expression $E = 2G(1+\mu)$. Where E = modulus of elasticity of material, G = modulus of rigidity, μ = Poison's ratio.

(c) A concrete cylinder of diameter 150 mm and length 300 mm when subjected to an axial compressive load of 240 kN resulted in an increase of diameter by 0.127 mm and a decrease in length of 0.28 mm. Compare the value of Poisson's ratio $\mu = \frac{1}{m}$ and modulus of elasticity E.

(d) A 700 mm length of aluminium alloy bar is suspended from the ceiling so as to provide a clearance of 0.3 mm between it and a 250 mm length of steel bar as shown A_{al} = 1250 mm^2, E_{al} = 70GN/m^2. Determine the stress in the aluminium and in the steel due to a 300 kN load applied 500 mm from the ceiling.



2. (a) What are the merits and demerits of fixed over simply supported beam.

(b) Derive an expression for maximum bending moment for a simply supported beam carrying a uniformly distributed load of w per unit run over the whole span.

(c) Derive bending equation under simple bending.

(d) Three beams have the same length, the same allowable stress and the same bending moment. The cross-sections of the beams are square, a rectangle with twice the width and a circle. Determine the ratios of weights of the circular and the rectangular beams with respect to the square beam.

3. (a) Give the expression for the maximum deflection of a cantilever of length/carrying a udl "w" per unit run over the whole length.

(b) Establish relation between slope, deflection and radius of curvature of a beam.

(c) A beam with a span of 4.5 meters carries a point load of 30 kN at 3 meters from the left support. If for the section, $I_{xx} = 54.97 \times 10^{-6}$ m^4 and E = 200 GN/m^2, find :

(i) The deflection under the load.

(ii) The position and amount of maximum deflection.

(d) A cantilever of length I loaded with uniformly distributed load of w per unit length over the whole span is propped at the free. Calculate the prop reaction if :

(i) The prop is rigid

(ii) The prop yields by an amount δu under unit load.

4. (a) State the torsion equation.

(b) Derive torsion equation for a circular shaft of length "l" and diameter 'D'.

(c) Derive an expression for equivalent torque under combined bending and torsion.

(d) A close coiled helical spring made of wire 5 mm in diameter and having on inside diameter of 40 mm joins two shafts. The effective number of coils between the shafts is 15 and 0.735 kW is transmitted through the spring at 1000 rpm. Calculate the relative axial twist in degrees between the ends of spring and also the intensity of bearing stress in the material. E = 200 GN/m^2.

5. (a) Define principle stresses and principle planes.

(b) Derive an expression for stresses due to pure shearing.

(c) A point is subjected to perpendicular stresses of 50 MN/m^2 and 30 MN/m^2, both tensile. Calculate the normal, tangential stresses and resultant stress and its obliquity on a plane making an angle of 30° with the axis of second stress.

(d) A thin cylindrical tube 80 mm internal diameter and 5 mm thick, is closed at the ends and is subjected to an internal pressure of 6 MN/m^2. A torque of 2009.6 Nm also applied to the tube. Find the hoop stress, longitudinal stress, maximum and minimum principal stresses and maximum shear stress.