C

B.Tech. Degree III Semester Examination in Marine Engineering December 2018

MRE 1304 MECHANICS OF SOLIDS
#### (2013 Scheme)

Time: 3 Hours   Maximum Marks: 100

$(5 \times 20 = 100)$

I. (a) Derive the three relationships between three elastic constants.   (5)
    (b) A steel flat of thickness 10 mm tapers uniformly from 60 mm at one end to   (15)
        40 mm at other end in a length of 600 mm. If the bar is subjected to load of
        60 kN, find its extension. Take $E = 2 \times 10^5$ N/mm^2. What is the percentage
        error if average area is used for calculating the extension?

OR

II. (a) Explain with necessary sketches application of strain gauges.   (5)
     (b) In an elastic material at a certain point, on planes at right angles to one   (15)
         another, direct stresses of 120 N/mm^2 tensile and 100 N/mm^2 compressive
         are acting. The major principal stress in the material is to be limited to
         160 N/mm^2. To what shearing stress may the material be subjected on given
         planes? Also find minimum principal stress and maximum shearing stress at
         that point.

III. (a) What do you mean by composite beams? How will you find out bending   (8)
         stresses in such a beam?
     (b) A symmetric I section has flanges of size 180 mm × 10 mm and its overall   (12)
         depth is 500 mm. Thickness of web is 8 mm. It is strengthened with a plate
         of size 240 mm × 12 mm on compression side. Find the moment of
         resistance of the section, if the permissible stress is 150 N/mm^2. How much
         uniformly distributed load can it carry if it is used as a cantilever of span
   3 m?

OR
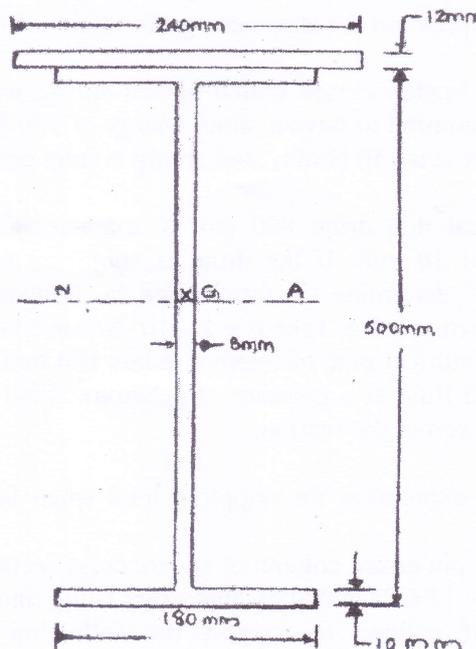
IV.   (a)   Explain the terms shear force, bending moment and point of contraflexure.   (5)

  (b)   Draw the shear force and bending moment diagram for the beam given below.   (15)
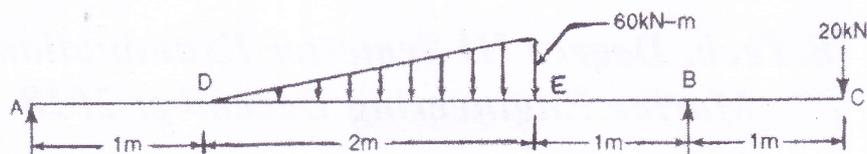

V.   (a)   Explain the Macaulay's method for finding slope and deflection.   (5)

  (b)   Find the fixing moments and support reactions of a fixed beam AB of length 6 m, carrying a uniformly distributed load of 4 kN/m over the left half of the span.   (15)
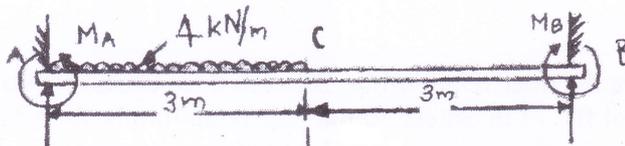
OR

VI.   A continuous beam ABC has two spans AB and BC of length 6 m and 8 m. The span AB carries a point load of 120 kN at 4 m from A, while the span BC carries a point load of 160 kN at 5 m from C. Find the moments and support reactions.   (20)

VII.   (a)   A composite shaft consists of a steel rod 60 mm diameter surrounded by a closely fitting tube of brass. Find the outside diameter of the tube so that when a torque of 1000 Nm is applied to the composite shaft, it will be shared equally by the two materials. Take G for steel = 8.4×10^4 N/mm^2 and G for brass = 4.2×10^4 N/mm^2.   (10)
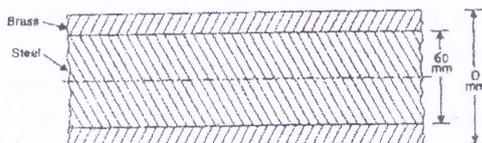
  (b)   A solid circular shaft transmits 75 kW at 200 rpm. Calculate the shaft diameter, if the twist in shaft is not to exceed 1° in 2 m of shaft and the shearing stress is limited to 50 N/mm^2. Take G = 1×10^5 N/mm^2.   (10)

OR

VIII.   (a)   Give the expression for strain energy in torsion. Compare it with that due to bending.   (8)

  (b)   An axially loaded closed coiled helical spring whose free length is to be 50 mm is required to have a strain energy of 450 Nmm when the maximum shearing stress is 140 N/mm^2 and spring is fully compressed (coils touching).   (12)

IX.   (a)   A cylindrical thin drum 800 mm in diameter and 3 m long has a shell thickness of 10 mm. If the drum is subjected to an internal pressure of 2.5 N/mm^2, determine (i) the change in diameter (ii) change in length (iii) change in volume. Take E = 2×10^5 N/mm^2; Poisson's ratio = 0.25.   (10)

  (b)   A thick cylindrical pipe of internal radius 100 mm and thickness 100 mm is subjected to fluid at a pressure of 6 N/mm^2. Find maximum and minimum hoop stress across the section.   (10)

OR

X.   (a)   Derive the expression for crippling load when both ends are hinged in a column.   (6)

  (b)   A 2 m long pin ended column of square cross section is to be made of wood. Assume E = 12 GPa and allowable stress being limited to 12 MPa, determine the size of column to support the following load safely (i) 95 kN (ii) 200 kN. Use factor of safety of 3 and Eulers crippling load for buckling.   (14)

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