

***B.Tech. Degree III Semester Supplementary Examination in
Marine Engineering December 2017***

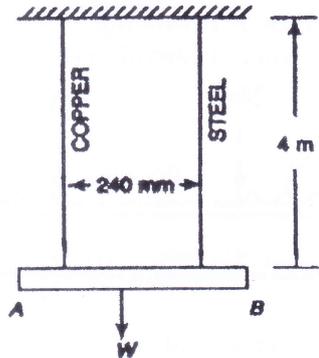
MRE 304 MECHANICS OF SOLIDS
(Prior to 2013 Scheme)

Time : 3 Hours

Maximum Marks : 100

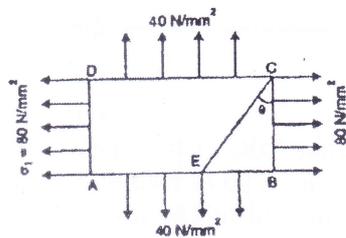
(5 × 20 = 100)

- I. (a) What is meant by a statically indeterminate problem? How can such a problem be solved? (5)
- (b) A horizontal bar supported by two suspended vertical wires 240 mm apart fixed to a rigid support. A load W is attached to the bar. The left-hand side wire is of copper with a diameter of 5 mm and the right-hand side wire is of steel of 3-mm diameter. The length of both the wires is 4 m initially. Find the position of the weight on the bar relative to the copper wire so that both the wires extend by the same amount. (15)
- Also, calculate the load, stresses and the elongation of each wire if $W = 1\text{ kN}$. Neglect the weight of the bar and take $E_s = 210\text{ GPa}$ and $E_c = 120\text{ GPa}$.



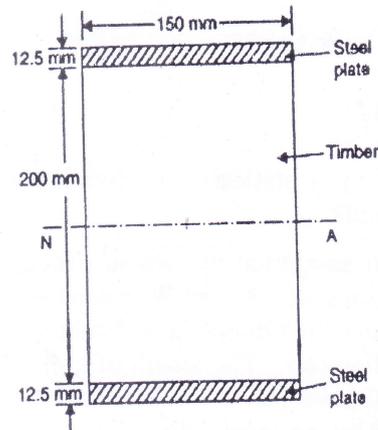
OR

- II. (a) Briefly explain with necessary sketches application of strain rosettes in experimental stress analysis. (5)
- (b) At a point in a strained material the principal tensile stresses across two perpendicular planes are 80 N/mm^2 and 40 N/mm^2 . Determine normal stress, shear stress and the resultant stress on a plane inclined at 20° with the major principal plane. Determine also the obliquity. What will be the intensity of stress, which acting alone will produce the same maximum strain if Poisson's ratio is 0.25. (15)



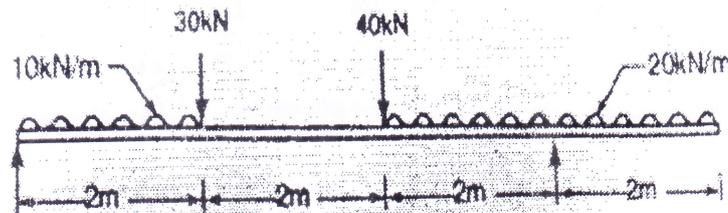
(P.T.O.)

- III. (a) What are the assumptions made in the derivation of the bending equation? (8)
- (b) A timber beam 100 mm wide and 200 mm deep is to be reinforced by bolting on two steel flitches each 150 mm by 12.5 mm in section. Calculate the moment of resistance in the following cases : (i) flitches attached symmetrically at the top and bottom, (ii) flitches attached symmetrically at the sides. Allowable stress in timber is 6 N/mm^2 . What is the maximum stress in the steel in each case? (12)
- Take $E_s = 2 \times 10^5 \text{ N/mm}^2$ and $E_t = 1 \times 10^4 \text{ N/mm}^2$.

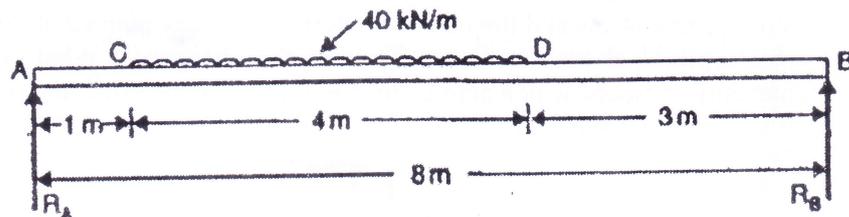


OR

- IV. (a) Explain the terms shear force, axial force and bending moment. (5)
- (b) Draw the shear force and bending moment diagram for the beam given below. Locate the point of contraflexure if any. (15)



- V. (a) What are the limitations of the method of successive integration for deflection? (5)
- (b) A beam of length 8 m is simply supported at its ends. It carries a uniformly distributed load of 40 kN/m as shown in figure. Determine the deflection of the beam at its mid-point and also the maximum deflection and position of maximum deflection. Take $E = 2 \times 10^5 \text{ N/mm}^2$ and $I = 4.3 \times 10^8 \text{ mm}^4$. (15)



OR

- VI. A continuous beam ABC of 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)

(Contd....3)

VII. (a) A hollow circular shaft 12 m long is to transmit 100 kW at 300 rpm. If maximum shear stress is not to exceed 80 N/mm^2 , and the ratio of inner diameter to the outer diameter is 0.75, find the dimensions of shaft and the angle of twist of one end of shaft relative to other end. Modulus of rigidity of the material is 85 kN/mm^2 . (10)

(b) A rod AB tapers from 100 mm to 50 mm diameter in a length of 1.2 m. Find the angular rotation of the free end when a torque of 3 kNm is applied. Take $G = 80 \text{ kN/mm}^2$. What is the maximum stress induced and what is the percentage error in calculating the angular rotation if the bar is treated as of uniform diameter with average value? (10)

OR

VIII. (a) Explain strain energy in torsion. (5)

(b) An axially loaded close 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). (15)

IX. A copper cylinder of 100 mm and metal thickness of 4mm is closely wound with steel wire of 2 mm diameter with tensile stress of 60 N/mm^2 . Find stresses in copper cylinder and steel wire when a fluid is filled at a pressure of 4 N/mm^2 . Take $E_s = 2 \times 10^5 \text{ N/mm}^2$, $E_c = 1.2 \times 10^5 \text{ N/mm}^2$ and $\mu = 0.28$. (20)

OR

X. (a) Explain maximum distortion energy theory of failure. (10)

(b) Find the thickness of metal necessary for a steel cylindrical shell of internal diameter 200 mm to withstand fluid at a pressure of 50 N/mm^2 . The maximum hoop stress across the section is not to exceed 150 N/mm^2 . (10)
