BT – MRE III/ 12.15 –1098 Reg. No. | | | | | | | | |

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B.Tech. Degree III Semester Examination in Marine Engineering December 2015

MRE 1304 MECHANICS OF SOLIDS

Time: 3 Hours Maximum Marks: 100

(5 × 20 = 100)

I. (a) Derive the relationship between the three elastic constants. (5)

(b) Two planes are at right angles and they carry shear stress of intensity 15 N/mm^2. These planes carry tensile stress of 60 N/mm^2 and compressive stress of 30 N/mm^2 respectively. Determine the principal stresses, principal planes, maximum shear stresses and the plane on which it acts. (15)

OR

II. (a) Briefly explain with necessary sketches application of strain rosettes in experimental stress analysis. (5)

(b) Two vertical bars are kept 750 mm apart and are rigidly fixed at top. One rod is steel and the other is copper, where both are 25 mm dia and 3 m long. The cross bar attached at the lower end carries a point load of 6 kN. Find the position of the load so that the rod remains horizontal. Calculate the stresses in each rod $E_s = 206\ GPa, E_c = 100\ GPa.$ (15)

III. (a) Write down the assumptions made in simple bending of beams. (4)

(b) Calculate the depth of a solid beam of width 200 mm, so as to safely carry a UDL of 2 kN/m. The permissible bending stress is 100 N/mm^2 and the span is 4 m. (8)

(c) Calculate the extreme stress in a short column of cross-section 200 mm x 300 mm which carries an axial load of 20 kN at an eccentricity of 20 mm along shorter side and 50 mm along longer side with respect to centroid. (8)

OR

IV. (a) A beam 8 m long is simply supported at the ends and carries UDL of 200 N/m. Concentrated loads 150 N each acts at the quarter spans and a load of 300 N at midspan. Draw the bending moment diagram. (10)

(b) A beam column carries an axial load of 30 kN and a bending moment of 10 kN/m along the longer axis. If the cross-section is 300 mm×400 mm and the Young's modulus is 2 × 10^{4}N/mm^2, calculate the extreme fibre stresses. (10)

V. (a) A simply supported beam of span 4 m is loaded with a UDL of 2 kN/m has an overhang of 2 m with a tip load of 10 kN. Determine the elastic curve by direct integration method. (15)

(b) Sinking of a support induces additional bending moments in a continuous beam. Briefly explain how this is accounted in three moment theorem. (5)

OR

(P.T.O)

VI. (a) A beam fixed at both ends with a span of 5 m, carries a concentrated load at a point 3 m from one of the supports. Calculate the maximum deflection using moment area method. (15)

(b) What are the limitations of the method of successive integration for deflection? (5)

VII. (a) A 200 mm diameter core of 100 mm radius is bored out from a 400 mm diameter solid circular shaft. What percentage of torsional strength is lost by this operation? (10)

(b) Find the mean diameter of the coil and that of the wire for a spring of stiffness of 1.5 N/mm (compression) under a load of 75 N. The permissible shear stress is 120 N/mm^2 and the length of the spring is 60 mm. The modulus of rigidity is 5×10^4 N/mm^2. (10)

OR

VIII. (a) What must be the length of an 8 mm diameter metallic wire so that it could be twisted through one complete revolution without exceeding a shear stress 40 MPa? G = 30 GPa? (15)

(b) Give the expression for strain energy in torsion. Compare it with that due to bending. (5)

IX. (a) What is the effective length of a column and how is this related to boundary conditions of the column? (4)

(b) Briefly describe any one failure theory relevant for ship building steel. (4)

(c) Calculate the change in length, change in diameter and change in volume of a thin cylindrical steel drum, 1 m diameter and subjected to 3 N/mm^2 internal pressures. The steel drum is made of 12 mm plate, $E = 2.1 \times 10^5$ N/mm^2. (12)

OR

X. (a) Calculate the Euler buckling load on a column of annular circular cross-section of inner diameter 120 mm and wall thickness 12 mm. The 4 m long column is fixed at both ends by flanged connections. (10)

(b) Write down the Lame's equation for thick shells subjected to external pressure and draw the distribution of various stresses across the thickness. (10)

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