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***B.Tech. Degree III Semester Examination in  
Marine Engineering December 2014***

**MRE 1304 MECHANICS OF SOLIDS**

Time: 3 Hours

Maximum Marks: 100

(5 × 20 = 100)

- I. (a) Define volumetric strain. Derive the equation for volumetric strain of a rectangular block subjected to normal stresses on all its faces. (10)
- (b) A material has an Young's modulus of  $1.25 \times 10^5 \text{ N/mm}^2$  and a poisson's ratio of 0.25. Calculate the modulus of rigidity and the bulk modulus. (10)

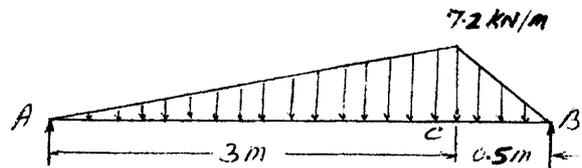
OR

- II. (a) A body is subjected to two mutually perpendicular principal tensile stresses of unequal intensities. Find the normal, tangential and the resultant stresses on an oblique section by Mohr's circle method. (10)
- (b) The principal tensile stresses at a point across two mutually perpendicular planes are  $120 \text{ N/mm}^2$  and  $60 \text{ N/mm}^2$ . Determine the normal, tangential and resultant stresses on a plane inclined at  $30^\circ$  to the axis of major principal stress, by Mohr's circle method. (10)

- III. (a) Derive the bending equation  $\frac{M}{I} = \frac{E}{R} = \frac{f}{y}$  for a beam subjected to simple bending. (8)
- (b) A simply supported beam of span 10 m is 300 mm deep. The section of the beam is symmetrical. The moment of inertia of the section is  $9.5 \times 10^7 \text{ mm}^4$ . If the permissible bending stress is  $120 \text{ N/mm}^2$ . Find (12)
- (i) safe point load that can be applied at the centre of span
- (ii) safe UDL that can be applied on the span.
- Neglect dead load of the beam.

OR

- IV. (a) Derive the equation for bending moment at a section X, in a cantilever of length  $l$  carrying a UDL of  $w$  per unit length over the whole length. (10)
- (b) A simply supported beam AB of span 3.5 m carries a triangular load of maximum intensity  $7.2 \text{ kN/m}$  as shown in figure. Draw shear force and bending moment diagram for the beam. (10)

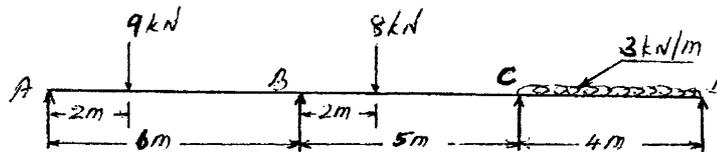


(P.T.O.)

- V. (a) Derive the equation for slope and deflection for a simply supported beam with eccentric point load. (10)
- (b) A simply supported beam AB of span 4 m is carrying a triangular load varying from zero at A to 5 kN/m at B. Determine the maximum deflection of the beam. Take rigidity of the beam at  $1.25 \times 10^{12} \text{N-mm}^2$ . (10)

OR

- VI. A continuous beam ABCD, simply supported at A, B, C and D is loaded as shown in figure. Find the moments over the beam and draw bending moment and shear force diagrams. (20)



- VII. (a) State the assumptions in the theory of pure torsion. Derive the expression for power transmitted by a shaft. (10)
- (b) In a tensile test, a test piece 25mm in diameter, 200 mm gauge length stretched 0.0975 mm under a pull of 50,000 N. In a torsion test, the same rod twisted 0.025 radian over a length of 200 mm, when a torque of 400 Nm was applied. Evaluate the poisson's ratio and the three elastic moduli for the material. (10)

OR

- VIII. (a) Derive the expression for the stiffness of a closely coiled helical spring, subjected to an axial force. (8)
- (b) A closely coiled helical spring is made out of 10 mm diameter steel rod, the coil consisting of 10 complete turns with a mean diameter of 120 mm. The spring carries an axial pull of 200 N. Find the maximum shear stress induced in the section of the rod. If  $C = 8 \times 10^4 \text{N/mm}^2$ , find the deflection of the spring, the stiffness and the strain energy stored by the spring. (12)

- IX. (a) Derive the expression for the circumferential strain for a thin cylindrical shell subjected to an internal pressure. (10)
- (b) A thin cylindrical tube with closed ends has an internal diameter of 50 mm and a wall thickness of 2.50 mm. The tube is axially loaded in tension with a load of 10 kN and is subjected to an axial torque of 500 Nm under an internal pressure of 6 N/mm<sup>2</sup>. Determine the principal stresses on the outer surface of the tube and the maximum shear stress. (10)

OR

- X. (a) Explain maximum strain energy theory of failures. (8)
- (b) A bar of length 4 m when used as a simply supported beam and subjected to a uniformly distributed load of 30 kN/m over the whole span deflects 15 mm at the centre. Determine the crippling loads when it is used as a column with the following conditions: (12)
- both ends pin jointed
  - one end fixed and the other hinged
  - both ends fixed

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