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

MRE 304 MECHANICS OF SOLIDS

Time: 3 Hours

Maximum Marks: 100

- I. (a) Define modulus of elasticity, modulus of rigidity and poisson's ratio. (5)
 (b) A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly joined at each end. If at a temperature of 10° C there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised to 200°C. Take E for steel and copper as $2.1 \times 10^5 \text{ N/mm}^2$ and $1 \times 10^5 \text{ N/mm}^2$ respectively. The value of coefficient of linear expansion for steel and copper is given as 11×10^{-6} per °C and 18×10^{-6} per °C respectively. (15)
- OR**
- II. (a) Explain Mohr's circle. (5)
 (b) At a certain point in a strained material, the stresses on two mutually perpendicular planes are 20 N/mm² and 10 N/mm² (both tensile). The shear stress across these planes is 10 N/mm². Find the location of the principal planes and evaluate the principal stresses. (15)
- III. (a) Derive simple bending equation. (10)
 (b) A cast iron water pipe of 500mm inside diameter and 20 mm thick is supported over a span of 10 meters. Find the maximum stress in the pipe metal, when the pipe is running full. Take the density of cast iron as 70.6 kN/m³ and that of water as 9.8 kN/m³. (10)
- OR**
- IV. (a) Define shear force, bending moment and point of contraflexure. (5)
 (b) A simply supported beam consists of a uniformly varying load from 800 N to 1600 N over a length of 5 m. The length of beam is 5 m. Draw shear force diagram and bending moment diagram. Also determine maximum bending moment and its position. (15)
- V. A horizontal beam AB is simply supported at A and B, 6m apart. The beam is subjected to a clockwise couple of 300 kNm at a distance of 4m from the left end. If the modulus of elasticity, $E = 2 \times 10^5 \text{ N/mm}^2$ and moment of inertia, $I = 2 \times 10^8 \text{ mm}^4$, determine. (20)
 (i) Deflection at the point where couple is acting
 (ii) The maximum deflection
- OR**
- VI. A cantilever of length 2m carries a point load of 20 kN at the free end and another load of 20 kN at its centre. If modulus of elasticity, $E = 10^5 \text{ N/mm}^2$ and moment of inertia, $I = 10^8 \text{ mm}^4$ for the cantilever then determine by moment area method, slope and deflection of the cantilever at the free end. (20)

(P.T.O.)

- VII. (a) Derive torsion equation. (15)
(b) What are the assumptions in deriving torsion equation? (5)

OR

- VIII. (a) Distinguish between closed coil and open coil springs. (5)
(b) The stiffness of a close coiled helical spring is 1.5 N/mm of compression under a maximum load of 60 N. The maximum shearing stress produced in the wire of the spring is 125 N/mm^2 . The solid length of the spring (when the coils are touching) is given as 5cm. Find: (i) diameter of wire (ii) mean diameter of coils (iii) number of coils required. Take modulus of rigidity = $4.5 \times 10^4 \text{ N/mm}^2$. (15)

- IX. (a) Derive the expression for longitudinal stress for a thin shell subjected to an internal pressure. (5)
(b) A compound cylinder is made by shrinking a tube of 160 mm internal diameter and 20 mm thick over another tube of 160 mm external diameter and 20 mm thick. The radial pressure at the common surface, after shrinking is 8 N/mm^2 . Find the final stresses set up across the section, when the compound cylinder is subjected to an internal fluid pressure of 60 N/mm^2 . (15)

OR

- X. (a) Explain maximum normal stress theory of failure.; (5)
(b) Derive an expression for crippling load when both ends of a column are hinged. (15)
