BTMRE – III – 12.13 – 1019

B.Tech. Degree III Semester Examination in Marine Engineering December 2013

MRE 304 MECHANICS OF SOLIDS

Time : 3 Hours Maximum Marks : 100

I. (a) Derive the relationship between modulus of elasticity and modulus of rigidity. (10)

(b) A reinforced concrete column of size 230mm X 400mm has 8 steel bars of 12mm diameter. If the column is subjected to an axial compression of 600kN, find the stresses developed in steel and concrete. (10)

OR

II. (a) Explain Mohr's circle. (5)

(b) At a point in a bracket, the stresses on two mutually perpendicular planes are $35MN/m^2$ and $15MN/m^2$ (both tensile). The shear stress across these planes is $9MN/m^2$. Find the magnitude and direction of the resultant stress on a plane making an angle of 40° with the plane of first stress. Find also the normal and tangential stresses on the planes. (15)

III. (a) What are the assumptions made in the derivation of bending equation? (5)

(b) A cast iron beam has an I-section with top flange 80mm X 40mm, web 120mm X 20mm and bottom flange 160mm X 40mm. If tensile stress is not to exceed $30N/mm^2$ and compressive stress $90MN/mm^2$, what is the maximum uniformly distributed load the beam can carry over a simply supported span of 6m if the larger flange is in tension? (15)

OR

IV. (a) Define shear force, bending moment and point of contraflexure. (5)

(b) Draw the shear force and bending moment diagrams for a continuous beam of four equal spans each of length 'l' and bearing a uniformly distributed load of 'w' per unit length on each span. (15)

V. A simply supported beam of length 14m carries two point loads at 3m and 9.5m respectively from the left support. Calculate the deflections of the beam under the loads. Take E=200GPa and $I= 160x10^6mm^4$. (20)

OR

VI. A cantilever of length 2a is carrying a load of W at the free end and another load of W at its centre. Determine, by moment area method, the slope and deflection of the cantilever at the free end. (20)

VII. (a) Define polar modulus and torsional rigidity. (5)

(b) A hollow shaft of diameter ratio 3/8 is to transmit 375kW at rpm, the maximum torque being 20% greater than the mean; the shear stress is not to exceed $60N/mm^2$ and the twist in a length of 4m is not to exceed 2 degrees. Calculate its external and internal diameters which would satisfy the above conditions. Take modulus of rigidity as $8.5x10^4 N/mm^2$. (15)

OR

(P.T.O.)

VIII. (a) Write short note on strain energy in torsion. (5)

(b) The stiffness of a close coiled helical spring is 1.5N/mm of compression under a maximum load of 60N. The maximum shearing stress produced in the wire of the spring is 125N/mm^2. The solid length of the spring (when the coils are touching) is given as 5cm. Find: (15)

(i) diameter of wire
(ii) mean diameter of coils
(iii) number of coils required.

Take modulus of rigidity=4.5X10^{4}N/mm^2.

IX. (a) Derive the expression for longitudinal stress for a thin shell subjected to an internal pressure. (5)

(b) Determine the maximum and minimum hoop stress across the section of a pipe of 400mm internal diameter and 100mm thick, when the pipe contains a fluid at a pressure of 8N/mm^2. Also sketch the radial pressure distribution and hoop stress distribution across the section. (15)

OR

X. (a) Explain maximum shear stress theory of failure. (5)

(b) Derive an expression for crippling load when one end of the column is fixed and the other end is free. (15)

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