B. Tech Degree III Semester Examination in Marine Engineering, November 2009

MRE 304 MECHANICS OF SOLIDS

Time : 3 Hours Maximum Marks : 100

(All questions carry ***EQUAL*** marks)

I. (a) Sketch and explain Stress – Strain curve for a ductile material.

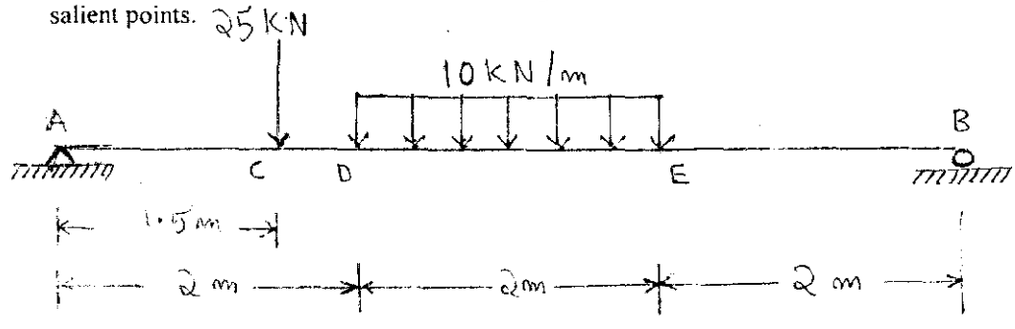
(b) A steel rod of cross sectional area 200 mm^2 is enclosed in a copper tube of cross sectional area 300 mm^2. The length of tube being 300 mm. The assembly is compressed by means of two rigid plates by a force of 60 kN, applied axially. Find the stress developed in the two materials. (i) when the rod is of the same length as the tube (ii) when the rod is 1 mm shorter than the tube.

OR

II. (a) Sketch and explain Mohr's diagram.

(b) A steel ball of diameter 1.2 m is immersed in sea at a depth of 1.5 Km. If E = 200 GN/m^2 and $\mu = 0.3$, find the change in diameter and change in volume of the ball. Density of sea water = 1100 Kg/m^3 and g = 9.81 m/s^2.

III. Draw SFD and BMD for the beam shown in figure and indicate the ordinates at the salient points.



OR

IV. A wire of diameter 'd' is wound round a cylinder of diameter 'D'. Determine the bending stress produced on the cross section of the wire. Hence or otherwise find the minimum radius to which a one centimeter diameter circular rod of high tensile steel can be bent without undergoing permanent deformation. Yield stress is 17000 Kg/cm^2 and E = 2 x 10^6 Kg/cm^2. What is the magnitude of B.M. necessary for this? Repeat the calculation for a 1 mm wire.

V. A simply supported beam of span 'L' is loaded at the quarter points by a load (concentrated) 'W' and a moment 'M', so that the moment tries to reduce the central deflection. Find the value of M, so that the central deflection becomes zero. Also obtain the expression for deflection at the centre in terms of L, M and W.

OR

VI. A cantilever of length 2 m carries a uniformly distributed load of 2.5 kN/m run for a length of 1 m from the fixed end and a point load of 1 kN at the free end. Find the deflection at the free end if the section is rectangular 12 cm wide and 24 cm deep and $E = 1 \times 10^4$ N/mm^2.

VII. The mean diameter of coil of a closed - coiled helical spring is 75 mm and is made up of 10 mm dia steel wire. Determine the maximum axial tensile load that can be carried by the spring if the shear stress in the material is to be limited to 48 MN/m^2. Find also the axial elongation of the spring if it has 12 complete turns. If the modulus of rigidity of the spring material is 80 GN/m^2, find the maximum twist of the wire.

OR

VIII. A propeller shaft is to develop a power of 50 KW at a speed of 100 rpm. If the angle of twist is to be limited to 0.5° in 1 m length of the shaft and G = 80 GN/m^2. Find the minimum diameter (i) when the shaft is to be solid circular one and (ii) when the shaft is hollow one with $di = \frac{3}{4} do$. Compare the weight of the two shafts.

IX. (a) Explain theories of failure.

(b) If circumferential and longitudinal stresses in the wall of a gas container be 100 N/mm^2 and 50 N/mm^2 and elastic limit 300 N/mm^2, find the factor of safety based on (i) Principal Stress Theory (ii) Maximum Shear Stress Theory and (iii) Shear Strain Energy Theory.

OR

X. (a) Compare stress in thick cylinders and thin walled shells subjected to internal pressure.

(b) Using Euler's method, derive expression for critical load of column with both ends fixed.

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