B.Tech Degree III Semester Examination in Marine Engineering December 2011

MRE 304 MECHANICS OF SOLIDS

Time : 3 Hours Maximum Marks : 100

I. (a) State Hooke's Law. Derive the relation between Young's modulus, Bulk modulus and Modulus of rigidity. (10)

(b) A steel bolt of 20mm diameter passes concentrically through a copper tube of internal diameter 25mm and external diameter 35mm, the length of the whole assembly is 800mm. The nut is over tightened by quarter of a turn after tight fitting of the assembly. Determine the stresses induced in the bolt and the tube if the pitch of the nut is 3mm. Young's modulus of steel is $2.1 \times 10^5 N/mm^2$ and that of copper is $1.2 \times 10^5 N/mm^2$. (10)

OR

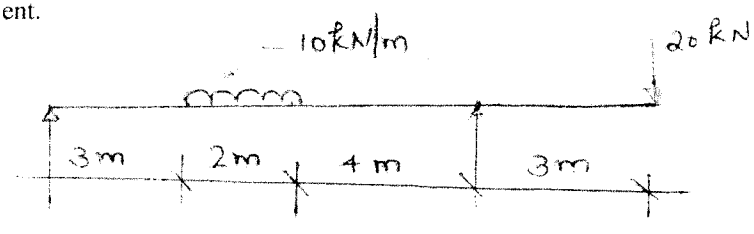
II. (a) Derive the equation for the elongation of a uniformly tapering circular rod of length l and diameter d_1 and d_2 at the ends. (10)

(b) What do you mean by principal stress? Explain the relevance of it in mechanics of solids. (6)

(c) What is Mohr's diagram of stress? (4)

III. (a) Explain the assumptions made in simple bending of beams, clearly bringing out the simplifications implied by them. (6)

(b) Draw the shear force and bending moment diagrams for the beam shown in figure. Clearly calculate the maximum value and its location for both shear force and bending moment. (14)



OR

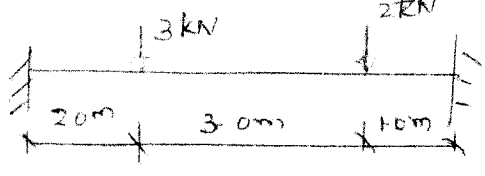
IV. (a) A short column is subjected to bending moment of 20 kNm and an axial load of 10 kN at an eccentricity 5mm. Calculate the maximum tensile and compressive stresses in the column, if its diameter is 300mm. (10)

(b) A rectangular beam cross section is 200mm x 400mm. Calculate the maximum distributed load it can withstand on its span of 4m, if permissible stress in compression is $50N/mm^2$ and that in tension is $70N/mm^2$. Assume any other data if necessary. (10)

V. Find the maximum deflection of a beam simply supported at two ends and with a span of 6.0m. The beam carries a udl of 2 kN/m spread on the entire span and one concentrated load of 20 kN, at 1.8m from left support. (20)

OR

VI. Draw the bending moment diagram and clearly locate the maximum value and location of bending moment for the beam shown in the figure. (20)



(P.T.O)

VII. (a) A shaft ABC of 500mm length and 40mm external diameter has been bored for such a way that the length AB is 20mm diameter and BC is 30mm dia. If the angle of twist in AB remains same as that in BC, find the maximum power the shaft can transmit at a speed of 200 rpm. Also find the lengths AB and BC. Permissible shear stress in the material is $80N/mm^2$. (12)

(b) Explain the assumptions made in the simple shaft torsion equation. Write down the equation and explain the terms. (8)

OR

VIII. (a) Name a few applications of springs and point out the differences between closed coil and open coil springs. (6)

(b) A close coiled helical spring of length 40mm has stiffness 10N/mm. The modulus of rigidity of the material of the spring is $8x10^4N/mm^2$. (i) Find the load at which the spring becomes a solid if the gap between any two adjustment coil is 2mm (ii) the shear stress corresponding to maximum load in the previous case. Also Determine the wire diameter and mean coil diameter, if these are at a ratio 1:10. (14)

IX. (a) Explain any three failure theories with the support of necessary equations. (8)

(b) Explain the assumptions made in the Euler column theory and derive the equation for the crippling load of a two end hinged column. (12)

OR

X. Write short notes on ***any four***. (4x5=20)

(i) Rankine Gordon formula
(ii) Effect of end conditions on buckling load.
(iii) Stresses in thick shell subjected to internal pressure.
(iv) Analysis of compound cylinders
(v) Strength of wire wound cylinders
(vi) Shrinkage allowance
(vii) Slenderness ratio
(viii) Ductility and plasticity

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