B. Tech Degree III Semester Examination in Marine Engineering December 2010

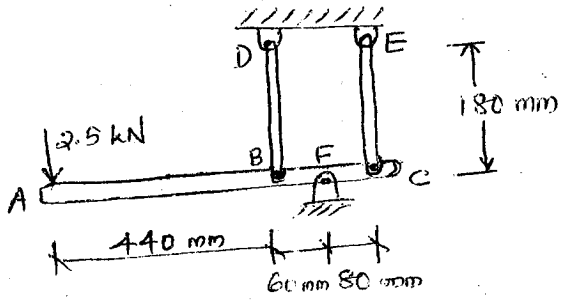
MRE 304 MECHANICS OF SOLIDS

Time : 3 Hours

Maximum Marks : 100

I. (a) What is meant by a statically indeterminate problem? How can such a problem be solved? (5)

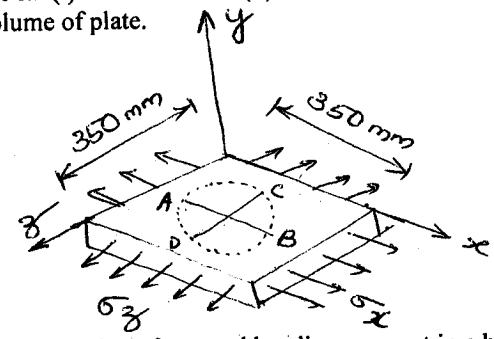
(b) Each of the rods BD and CE is made of brass (E = 105 GPa) and has a cross-sectional area of 200 mm^2. Determine the deflection of end A of the rigid member ABC caused by the 2.5 kN load. (15)



OR

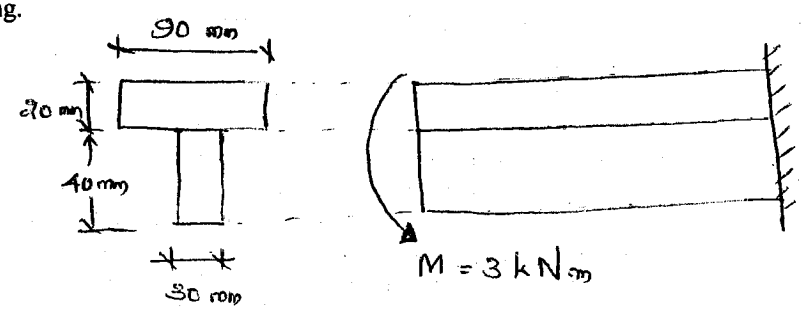
II. (a) Draw the stress – strain curve for a mild steel rod under tension and explain the salient points. (5)

(b) A circle of diameter d = 200 mm is scribed on an unstressed aluminium plate of thickness t = 18 mm. Forces acting in the plane of the plate later cause normal stresses $\sigma_x = 85\,MPa$, $\sigma_z = 150\,MPa$. For $E = 70\,GPa$ and $r = 1/3$, determine the change in (i) diameter AB (ii) diameter CD (iii) the thickness of the plate (iv) volume of plate. (15)



III. (a) Derive the relation between shear force and bending moment in a beam subjected to transverse load of intensity q N/m. (5)

(b) A cast iron machine part is acted up on by 3 kN.m couple shown. Knowing that $E = 175\,GPa$ and neglecting the effects of fillets, determine (i) the maximum tensile and compressive stresses in the casting (ii) the radius of curvature of the casting. (15)



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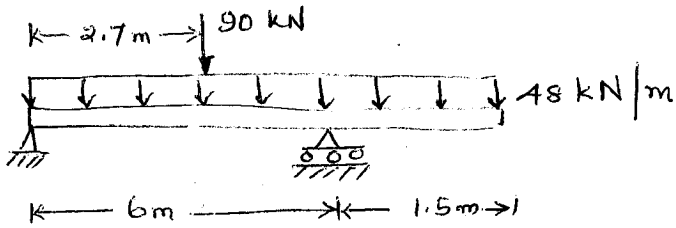
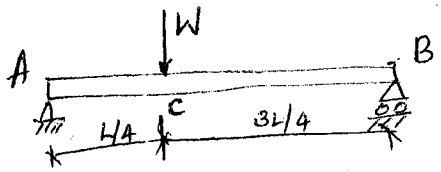
OR

IV. (a) Explain the concept of pure bending. (5)

(b) Draw the shear force and bending moment diagram for the following beam : (15)

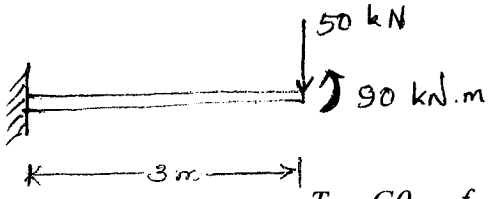


V. For the prismatic beam and the loading shown determine the slope and deflection at point C by integration. (20)



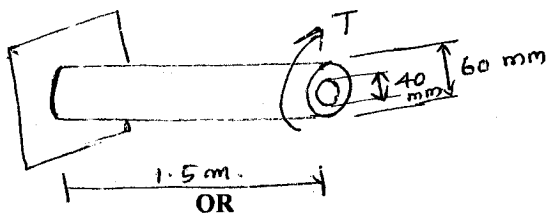
OR

VI. Determine the slope and deflection at end B of the cantilever beam shown. Assume that the flexural rigidity of the beam is $EI = 10\,MN.m^2$. (20)



VII. (a) Derive the torsion formula for circular shaft $\frac{T}{J} = \frac{G\theta}{\ell} = \frac{f_s}{R}$. (10)

(b) What torque should be applied to the end of the shaft shown to produce a twist of 2^o ? Take $G = 80\,GPa$. (10)



OR

VIII. The design of a large shaft connecting a motor to a generator calls for the use of a hollow shaft with inner and outer diameters of 100 mm and 150 mm respectively. Knowing that the allowable shearing stress is $85\,GPa$, determine the maximum torque which may be transmitted (i) by the shaft as designed (ii) by a solid shaft of the same weight (iii) by a hollow shaft of the same weight and of 200 mm outside diameter. (20)

IX. A 2 m long pin ended column of square cross section is to be made of wood. Assuming $E = 12.5\,GPa$, $\sigma_{allow} = 12\,GPa$ for compression parallel to the fiber, and using a factor of safety of 2.5 in computing Euler's critical load for buckling, determine the size of the cross section if the column is to safely support 200 kN load. (20)

OR

X. A steel gun barrel is subjected to an internal pressure of $70\,MPa$. The internal diameter of the barrel is 75 mm and external diameter of 225 mm. A steel band 25 mm thick and internal diameter 0.075 mm smaller than the external diameter of the gun barrel is shrunk on to the gun barrel. Calculate :

(i) the shrinkage pressure on the gun barrel

(ii) Maximum stress in the steel band

Take $E = 200\,GPa$, $\nu = 0.3$. (20)

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