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# B.Tech. Degree III Semester Supplementary Examination in Marine Engineering December 2015

## MRE 304 MECHANICS OF SOLIDS

Time: 3 Hours

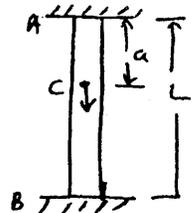
Maximum Marks: 100

(5 × 20 = 100)

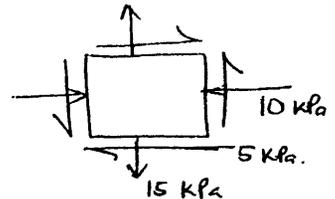
- I. (a) A slightly tapered bar AB of circular cross section and length L is supported at the bigger end B and subjected to a load P at the free end. The bigger diameter is  $d_1$  and smaller diameter is  $d_2$ . Derive the formula for the elongation  $\delta$  of the bar due to an axial force P appeared at A.
- (b) A copper bar AB of length 1 m is placed in position at room temperature with a gap of 0.1 m between end A and a rigid wall. Calculate the axial compressive stress  $\sigma$  in the bar if the temperature rises by  $40^\circ\text{C}$ .  $\alpha_{\text{Copper}} = 17 \times 10^{-6} / ^\circ\text{C}$  and  $E_{\text{Copper}} = 110 \text{ GPa}$ .

OR

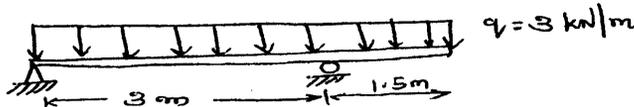
- II. (a) A rigid bar AB is held between two rigid supports. A load  $P=1 \text{ kN}$  is acting at C at a distance  $a=0.4 \text{ m}$  from top. The bar is 1m long. Find the reactions at the supports and also the displacement of point C. The cross sectional area of the bar is  $500 \text{ mm}^2$  and the modulus of elasticity is  $210 \text{ Gpa}$ .



- (b) The state of stress at a point in a strained material is shown in fig. Find the principal stresses and maximum shear stress.

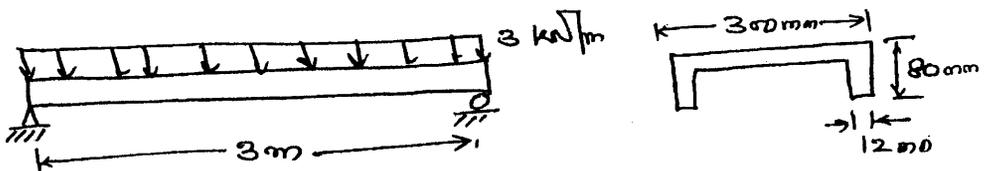


- III. Draw the shear force and bending moment diagram for the beam loaded and supported as shown.

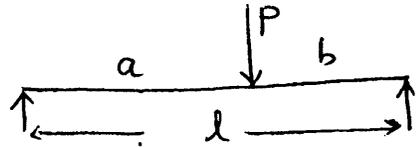


OR

- IV. The beam AB has simple supports at A & B and carries a uniform load of  $3 \text{ kN/m}$  over its entire span. The beam is constructed of 12 mm thick steel plates welded to form a channel section. Calculate the maximum tensile and compressive stresses in the beam.

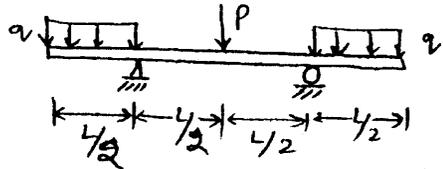


- V. Find the expressions for the slope and deflection of the beam loaded as shown. Also find also the maximum deflection.



OR

- VI. The beam shown in figure has overhangs at both ends and supports a uniform load  $q$  on each overhang. What should be the load  $P$  (in terms of  $q$  &  $L$ ) in order that no deflection will occur at the mid point of the beam?



- VII. A hollow shaft of outside diameter 80 mm and inside diameter 50 mm is made of Aluminium having shear modulus  $G = 27GPa$ . When the shaft is subjected to a torque  $T = 4.8$  kNm, what is the maximum shear strain and maximum normal strain in the bar?

OR

- VIII. A solid circular shaft rotating at 2 Hz is required to transmit 150 kW. What is the minimum required shaft diameter if the allowable shear stress is 40 MPa?

- IX. (a) Derive the expression for circumferential stress developed in a thin shell subjected to an internal pressure.  
 (b) Derive an expression for the critical load when the ends of the column are hinged.

OR

- X. (a) Explain any one theory of failure for ductile materials.  
 (b) A cylindrical vessel of 1.5 m diameter and 1.5 cm thickness is subjected to an external pressure of 1.2 MPa. Find the circumferential, longitudinal and principal stresses in the vessel.