THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 03
FINAL EXAMINATION 2008/2009
MEX 3231– STRENGTH OF MATERIAL I
DATE :23RD MARCH 2009
TIME :1400 HRS - 1700 HRS
DURATION :03 HOURS

334

ANSWER ANY FIVE (05) QUESTIONS. ALL QUESTIONS CARRY EQUAL MARKS.

Question 01:

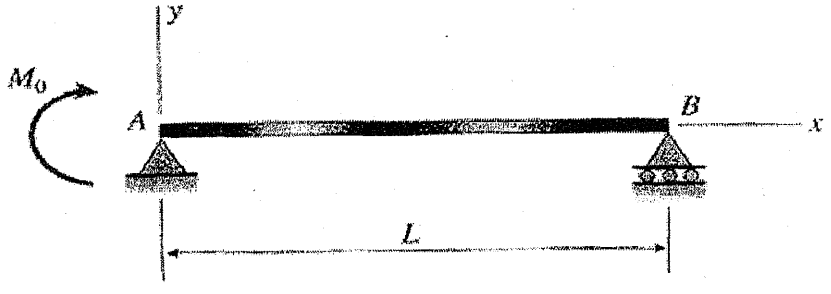


Fig.01

(a) Derive the equation of the deflection curve for a simple beam AB loaded by a couple M_0 at the left handed support as shown in Fig.01.

(b) Hence show that the maximum deflection (δ_{max}) of the beam is

$$\delta_{max} = \frac{M_o L^2}{9\sqrt{3}EI}$$

Question 02:

(a) What are the assumptions made in the analysis of circular shaft under torsion?

(b)

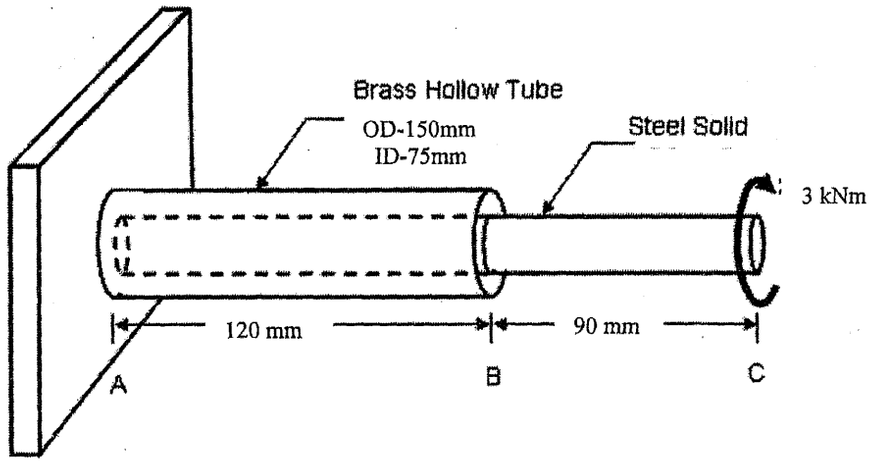


Fig.02

A 75mm diameter solid steel shaft is pressed in to the center of a brass hollow tube, the outer diameter 150mm and inner diameter 75 mm, such that they act as a single composite unit between ***A*** and ***B***. Both are firmly attached to the wall at ***A*** and a 3 kNm torque is applied to the steel shaft at ***C***. Determine the maximum shearing stress in the brass tube and the angular displacement at ***C*** when the torque is applied.

[$G_{st} = 83 \times 10^9$ N/m^2 $G_{brass} = 41 \times 10^9$ N/m^2]

Question 03:

(a) Define briefly the terms principal stress and principal plane in a two dimensional stress system.

(b) Construct a Mohr's circle for the following point stresses:

$\sigma_x = 60$ MPa, $\sigma_y = 10$ MPa and $\tau_{xy} = +20$ MPa .

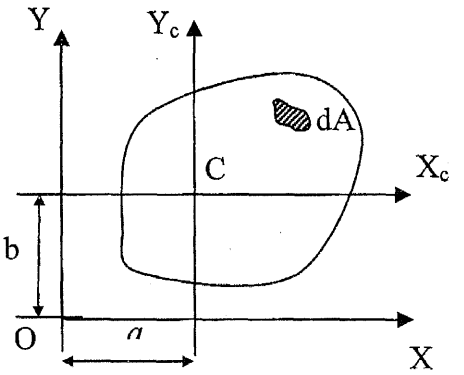
Hence

(i) determine the stress components and planes on which the shear stress is a maximum.

(ii) determine the magnitudes and directions of the principal stresses.

Question 04:

(i)



Show that the second moment of area (I_{OX}) of any area (A) with respect to any axes (OX) is the sum of second moment of area about a parallel centroidal axis (I_{CX_C}) and product of the same area with the square of the distance (b) between the two axes is

$$I_{OX} = I_{CX_C} + b^2 A$$

(ii)

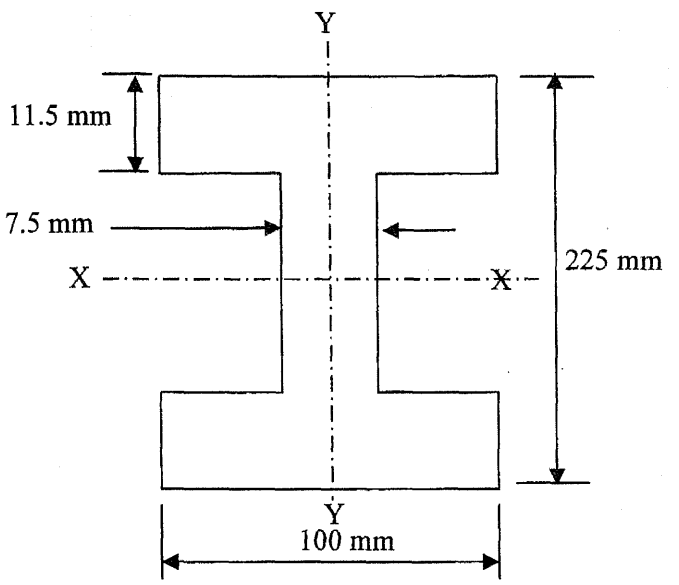


Fig.04

The beam of symmetrical I section shown in Fig.04 is simply supported over a span of 9m. If the maximum permissible stress is 75 N/mm^2 what concentrated load can be carried at a distance of 3m from one support?

Question 05:

A composite bar, made up of aluminium and steel, is firmly held between two unyielding supports as shown in Fig.Q5.

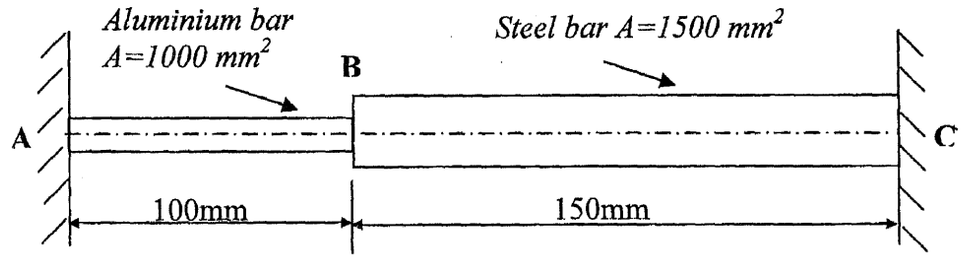


Fig.Q5

An axial load of 200 kN is applied at B at 320 K. Find the stresses in each material, when the temperature is 370 K. Take E for aluminium and steel as 70GPa and 210 GPa and coefficient of expansion for aluminium and steel as 24×10^{-6}/K and 12×10^{-6}/K respectively.

Question 06:

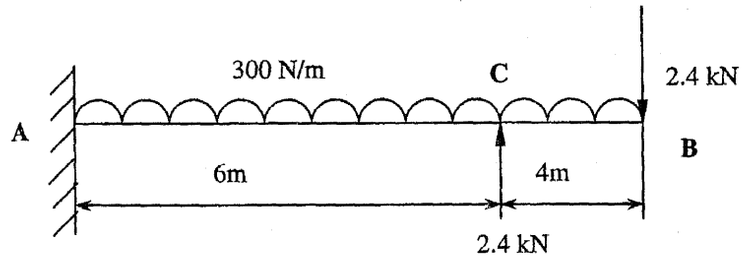


Fig 06

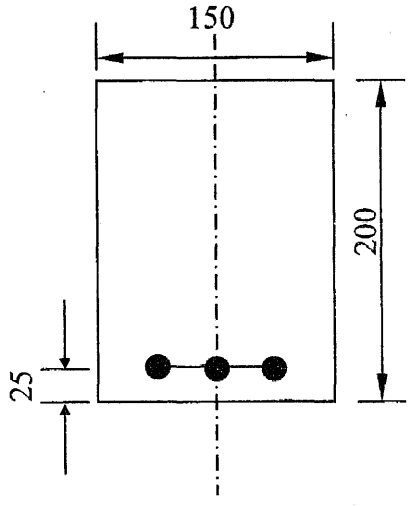
A beam of uniform section and length 10 m is rigidly fixed at one end as shown in Fig.06. It carries a uniformly distributed load of 300 N/m over its entire span. Vertical concentrated loads of 2.4 kN are applied at point C and B in the directions shown.

(i) Draw the free body diagram, clearly indicating the forces at the fixed end.

(ii) Draw the shear force and bending moment diagrams for the beam.

(iii) Hence determine the position and the magnitude of the maximum bending moment in the beam.

Question 07:



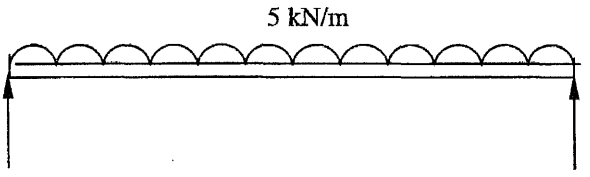


Fig.07

A reinforced concrete beam of 4m span, simply supported at the ends is designed to carry a uniformly distributed load of 5 kN/m as shown in Fig.07. A rectangular beam of section 150mm x 200mm is proposed to be used. If 250 mm^2 area of steel is placed at 25 mm above the bottom surface of the beam and the applicable modular ratio is 16, determine the maximum stresses in steel and concrete.

Question 08:

(a) For a strut of length L and uniform section modulus EI, fixed at one end and pinned at the other, show that the critical load is approximately $\frac{2\pi^2 EI}{L^2}$

(b) Briefly describe the concept of 'equivalent length' or 'effective length' as applied to buckling of struts under different end conditions.

(c) Find the Euler's buckling load and maximum deflection for a steel tube of 10mm Hence internal diameter, 30mm external diameter and 2.5m length having both ends pinned. Take E as $2x10^5$ N/mm^2 and yield stress for steel as 330 N/mm^2.

(d) Find the safe load if the factor of safety is 3.

ALL RIGHT RESERVED