01984

B.TECH. (AEROSPACE ENGINEERING) PROGRAMME (BTAE)

Term-End Examination

December, 2010

BAS-008 : STRENGTH OF MATERIALS

Time : 3 hours *Maximum Marks : 70*

Note : *(i) Answer any five questions.*

(ii) All questions carry equal marks.

(iii) Use of calculator is permitted. Assume any missing data if required.

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1. (a) Show that $G = \frac{E}{2(1+\upsilon)}$ **7+7**

Where E = Young's modulus

G = Rigidity modulus, and

υ = Poisson's ratio

(b) A mild steel bar of section 20 mm × 40 mm and length of 400 mm is subjected to an axial tensile load of 120 kN as shown in Figure 1.

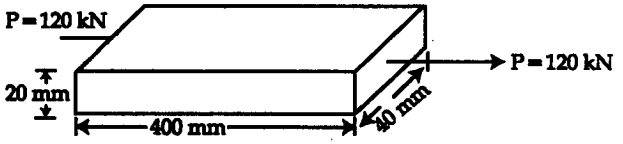

Figure - 1

If $E = 208\ kN/mm^2$, what will be the changes in length, breadth and thickness of bar.

Given Poissons ratio $\upsilon = 0.30$

2. (a) A steel bar of diameter 20 mm is fixed rigidly between two walls. Length of bar is 2 m. Temperature of the bar drops by 40°C 7+7

(i) What is the stress developed in bar, if $\alpha = 11 \times 10^{-6}/°C$, and $E = 208\ kN/mm^2$.

(ii) What is the tensile force exerted by wall when temperature fall is 40°C.

(iii) The ultimate strength of material of bar is $480\ N/mm^2$, By what temperature fall, the bar breaks in tension.

(b) At a point in a strained material, stresses on plane BC are -100 MPa normal stress.

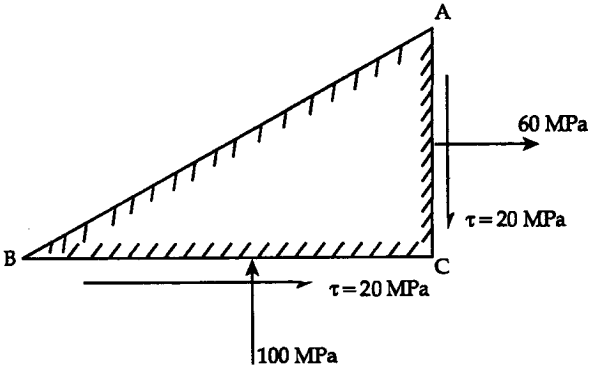

Figure - 2

20 MPa shear stress, on a perpendicular plane AC, stresses are + 60 MPa normal stress, and 20 MPa shear stress. Determine.

(i) Principal stresses

(ii) Principal angles

(iii) Maximum shear stresses

(iv) Angles of planes carrying maximum shear stresses with respect to plane BC.

3. (a) What change in volume would a 200 mm cube of steel suffer at a depth of 4 km in sea water ? For steel E = 208 GPa Poisson's Ratio $\upsilon = 0.29$, and weight density of sea water = 0.01 N/cm^3. 7+7

(b) A rod consists of three bars of unequal diameters as shown in Figure - 3. Find the stress in each bar. Also find the elongation of the rod.

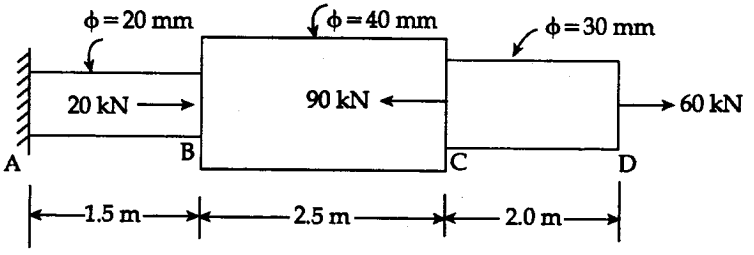

Figure - 3

4. (a) A compound bar is constructed from three bars 50 mm wide by 12 mm thick fastened together to form a bar 50 mm wide by 36 mm thick. The middle bar is of aluminium alloy for which $E = 70\ GN/m^2$, and the outside bars are of brass with $E = 100\ GN/m^2$. If the bars are initially fastened at 18°C and the temperature of whole assembly is then raised to 50°C, determine the stresses set up in the brass and the aluminium. 7+7

Take ; $\alpha_{brass} = 18 \times 10^{-6} k^{-1}$,

and $\alpha_{aluminium} = 22 \times 10^{-6} k^{-1}$.

(b) A beam AB = 10 m long is hinged at end B and roller supported at point C, at a distance of 3 m from A. The beam carries a udl of 3.5 kN/m run over AD = 8 m as shown in Figure - 4.

Determine (i) support reactions,

(ii) position of point of contraflexure

Draw SF and BM diagrams of the beam.

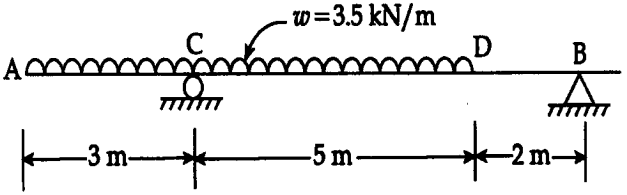

Figure - 4

5. (a) Draw the SF and BM diagrams for 10 m span simply supported beam subjected to a system of loads as shown in Figure - 5. 7+7

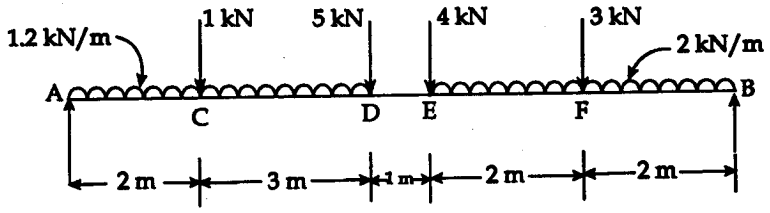

Figure - 5

(b) A simple steel beam of 4m span carries a uniformly distributed load of 6 kN/m over its entire span and a point load 2 kN at its centre. If the permissible stress does not exceed 100 MPa, find the cross-section of the beam assuming depth to be twice of breadth.

6. (a) A rectangular block is subjected to three mutually perpendicular tensile stresses of magnitude 60 N/mm^2, 70 N/mm^2, 80 N /mm^2. Calculate strain energy and energy. The Poisson's ratio is 0.3. Take E = 200 kN/mm^2. 7+7

(b) Find the weight which falls through a height of 5 m on a collar attached to the lower end of a vertical rod of diameter 40 mm and length 3 m. The deflection produced in the rod is 5 mm. Take E = 200 GPa.

7. (a) A steel carriage spring of length 1.5 m having plate width 150 mm and thickness 10 mm is subjected to a bending stress of 200 N/mm^2. The spring during its straightening absorbs 150 Joules of energy. Find the number of plates and their radius of curvature. 7+7

Given $E = 200\ kN/mm^2$.

(b) A rectangular beam of width 200 mm and 300 mm is simply supported over a span of 5 m. Find the load that the beam can carry per metre length, if the allowable bending stress in the beam is 100 N/mm^2.

8. (a) Evaluate the principal stresses and principal planes for the state of stress as shown in Figure - 6. 7+7

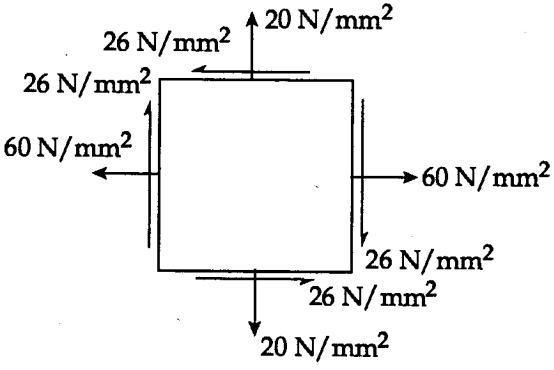

Figure - 6

(b) Two parallel walls are stayed together by a steel rod of 5 cm diameter passing through metal plates and nuts at both ends. The nuts are tightened, when the rod is at 150°C, to keep the walls 10 m apart. Determine the stresses in the rod when the temperature falls down to 50°C, if.

(i) the ends do not yield, and

(ii) the ends yield by 1 cm.

Take $E = 2 \times 10^5$ N/mm^2, and

$\alpha = 12 \times 10^{-6}$ K^{-1}.