00604

B.TECH. IN AEROSPACE ENGINEERING PROGRAMME (BTAE)

Term-End Examination

June, 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**.*

1. (a) A copper bar 200 mm long, 20mm diameter is subjected to an axial load of 30 kN. If E for copper $= 105\ kN/mm^2$ and ϑ for copper is 0.35. What are changes in length and diameter ? Load is compressive. **7+7**

(b) A 3 m long solid rectangular bar of cross - section 10 mm $\times$ 15 mm is subjected to a compressive force of 150 kN. What is the change in length of the bar ? Also find the strain and stress produced in the bar.

Take : $E = 2 \times 10^5\ N/mm^2$.

2. (a) A flat steel strip 30 mm × 6 mm makes a composite bar with aluminium strip 30 mm × 8 mm so as to make a section of 30 mm × 14 mm. Length of composite strip is 500 mm. Composite strip is subjected to an axial compressive load P such that contraction in bar is 0.2 mm. What is the magnitude of P ? What are the stresses developed in steel and aluminium strips ? **7+7**

Take :
$E_{steel} = 210\ kN/mm^2$;
$E_{aluminium} = 70\ kN/mm^2$.

(b) Figure 1 shows a triangular element of a stressed body. Normal and shear stresses on two perpendicular planes BC and AC are shown in figure. Determine the normal and shear stresses on inclined plane AB, inclined at an angle of 30° to the plane BC.

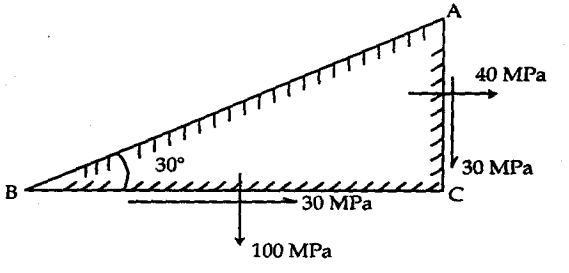

Figure - 1

3. (a) Two parallel walls 6 m apart are stayed together by a steel rod 20 mm diameter, passing through metal plates and nuts at each end. The nuts are tightened, when the rod is at a temperature of 100°C. Determine the stress in the rod, when the temperature falls down to 20°C, if : **7+7**

(i) the ends do not yield, and

(ii) the ends yield by 1 cm.

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

and $\alpha = 12 \times 10^{-6}$ k^{-2}.

(b) A bar of different cross - section is subjected to a tensile force of 50 kN as shown in figure-2. Find the stresses in different sections and the total elongation produced in the bar. Take : $E = 200$ kN/mm^2.

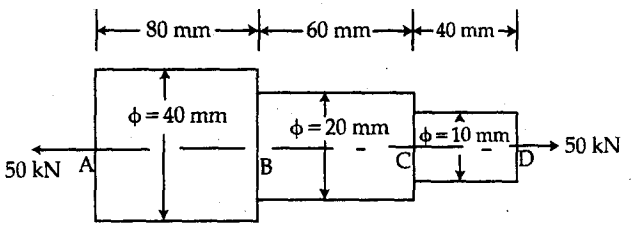

Figure - 2

4. (a) A 3m bar is initially at a temperature of 24°C. It is heated to raise its temperature to 80°C. Estimate the free expansion of the bar. If the expansion is not allowed, find the stress in the bar. **7+7**

Take : $E = 200$ kN/mm^2, $\alpha = 1.2 \times 10^{-5}$/°C

(b) A beam AB, 6 m long, simply supported at end carries 6 kN and 12 kN loads at distances of 2 m and 4 m from A as shown in figure 3. Draw the SF and BM diagrams of the beam.

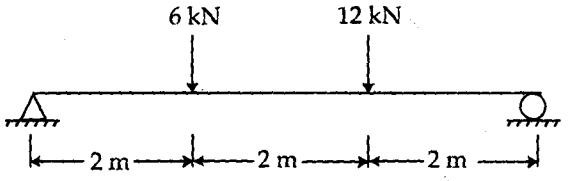

Figure - 3

5. (a) A cantilever beam carries a uniformly distributed load of 2 t/m over the entire length of 6 m and point loads 5t, 3t, 7t and 2t at a distance of 2 m, 4 m, 5 m and 6 m respectively from the fixed end. Draw the SF and BM diagrams of the beam. 7+7

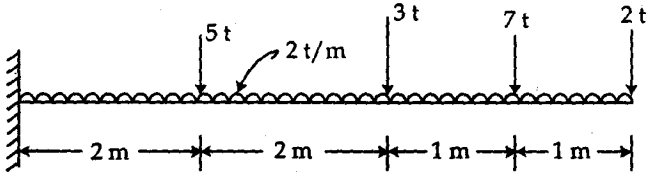

Figure - 4

(b) A 5 m cantilever beam of cross - section 150 mm × 300 mm weighing 0.05 kN/m carries an upward concentrated load of 30 kN at its free end as shown in figure 5. Determine the maximum bending stress at a section 2 m from the free end.

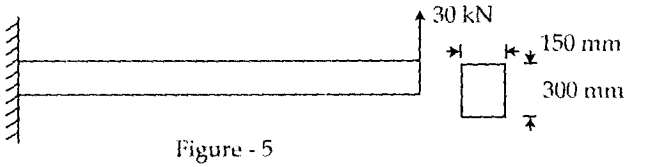

Figure - 5

6. (a) A solid steel rod of 5 m length and 10 mm diameter is subjected to an axial load of 5 kN. Find the stresses induced in the rod if the load is applied : 7+7

(i) gradually,

(ii) suddenly, and

(iii) with impact after falling through a height of 150 mm. Also find the strain energy stored in the rod under the given conditions.

Take : $E = 200\ kN/mm^2$.

(b) A rod of diameter 10 mm and length 1.5 m hangs vertically from the ceiling of a roof. A coller is attached at its lower end on which a load of 250 N falls from a height of 200 mm. Find the strain energy absorbed and the instantaneous deflection of the rod.

Take : $E = 200\ kN/mm^2$.

7. (a) A close coiled helical spring made of round steel wire is required to carry a load of 600 N for a maximum stress not to exceed 240 N/mm^2. Determine the wire diameter if stiffness of the spring is 10 N/mm and maximum diameter of helix is 80 mm. Calculate also the number of turns required in the spring. Neglect the effect due to Wahl's factor. G for steel = 82 kN/mm^2. **7+7**

(b) A simply supported beam has a width of 100 mm and a depth of 150 mm. It is loaded with uniformly distributed load over the entire span of 3 m. If the permissible shear stress is 3 N/mm^2, find the value of the uniformly distributed load on the beam.

8. (a) In separate experiments Young's Modulus and Rigidity Modulus of a material have been determined as 120 GPa, and 50 GPa respectively. Calculate the Poisson's ratio and Bulk Modulus of the material. **7+7**

(b) The state of stress at a critical point of a strained solid is given by $\sigma_x = 70$ kN/mm^2, $\sigma_y = -50$ kN/mm^2 and $\sigma_{xy} = 45$ kN/mm^2. If the strength of solid in tension, compression, and shear are given as 120 kN/mm^2, 90 kN/mm^2 and 75 kN/mm^2 respectively, verify the safety of the component.
