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

Term-End Examination

December, 2011 00562

BAS-008 : STRENGTH OF MATERIALS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer **any five** questions. **All** questions carry **equal** marks. Use of scientific calculator is **permitted.***

1. The principal axes at a point in the body of material make angle of 15° with arbitrary x-y axes. The maximum principal stress and minimum principal stress at that point are 250 N/mm^2 (tensile) and 20 N/mm^2 (tensile). Find **14**

(a) maximum shearing stress and direct stress on plane of maximum shearing stress along with the angle which plane of maximum shearing stress makes with x-axis,

(b) the stresses perpendicular to x and y-axes and associated shearing stress (σ_x, σ_y and τ_{xy}). Show the state of stress on sketch.

2. (a) A mild steel specimen is tested on universal testing machine. With gradually increasing load, show on a diagram, how stress and strain will vary. Mark yield stress and ultimate strength. Define modulus of elasticity and modulii of resilience and toughness. 8

(b) For an isotropic elastic material how many independent elastic constants exist ? The state of stress at a point in a machine element is σ_x=100 N/mm^2,σ_y=75 N/mm^2 and τ_{xy} = 80 N/mm^2. If E = 2.1×10^5 N/mm^2 and ν=0.3 find strains along x and y axes and shearing strain. 6

3. (a) A composite bar is made of matrix of area A_m and fibre of area A_f. The modulus of elasticity of matrix is E_m and that of fibre is E_f. All fibres are in one direction making total area of cross-section of composite as $A_m + A_f$. Find modulus of elasticity of composite as function of E_f, E_m, V_f and V_m where V_f and V_m are respectively volume fractions of fibre and matrix. 7

(b) A power transmission cable contains 4 steel wire of 2.6 mm dia. each, surrounded by 9 copper wires of 1.69 mm dia. each. If a length of 2.5 m of this cable is tightened under a tension of 2.4 kN what will be the extension of the cable ? 7

E_{steel}= 200×10^3 MPa,

E_{copper}= 100×10^3 MPa.

4. (a) The ends of 3 m long, 60 mm dia, steel rod are rigidly supported. At 20°C there is no stress in the rod. If the temperature is reduced to -10 °C, what will be the stress in the rod ? By what amount the dia, of rod will change ? $\alpha_{steel} = 12 \times 10^{-6}$ per°C, $\nu = 0.25$, $E = 206 \times 10^3$ N/mm^2. 7

(b) AB (Al alloy) and CD (steel) are two bars arranged as shown in Fig.1. Determine the horizontal displacement of point E if the temperature reduces by 45 °C. The member BE has insignificant coefficient of expansion due to temperature. 7

$\alpha_{Al} = 22.5 \times 10^{-6}$ mm / mm °C and $\alpha_{steel} = 11.67 \times 10^{-6}$ mm/mm°C.

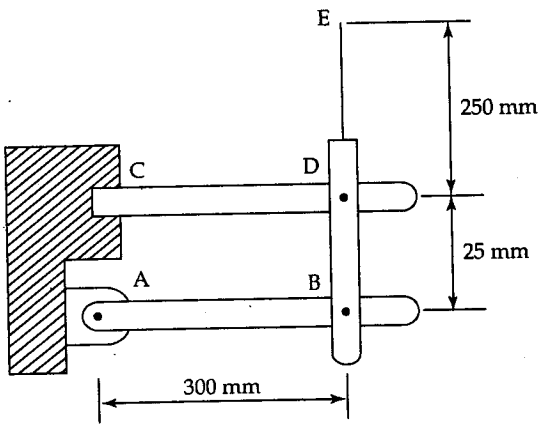

Fig. 1

5. (a) The load on a simply supported beam varies from zero at left hand to 10 kN/m at right hand support. Write equations to S.F and B.M and draw S.F and B.M diagrams. Mark all values of S.F and B.M specifying where shear force changes sign and B.M becomes maximum. 7

(b) A beam is supported at simple supports at a distance of 2 m and has equal overhangs of $\frac{1}{2}$ m on both sides. It is loaded by two concentrated loads of 2 kN on each free end of hangover. Find the radius of curve to which beam between the supports would bend. The beam cross - section is a rectangle 12 mm deep $\times$ 100 mm wide and $E=2.1\times10^5$ N/mm^2. 7

6. (a) The principal stress in two dimensional space at a point are 98 N/mm^2 (tensile) and 50 N/mm^2 (compressive). The modulus of elasticity, $E=2.1\times10^5$ N/mm^2 and Poisson's ratio, $\nu=0.28$. Find volumetric strain and strain energy per cubic meter. 6

(b) A V-threaded bolt has shank dia. of 18 mm and thread core dia. of 16.16 mm. If it is subjected to tensile force along its axis of 1 kN find energy stored. The shank is 70 mm long and threaded length is 24 mm. Compare this energy with bolt if shank and core dia. of thread are equal. $E = 2\times10^5$ N/mm^2. 8

7. (a) If a beam is loaded by transverse load, show how the bending and shearing stresses are distributed over cross-sections which may be rectangular, circular, I-section and T-section. 6

(b) A simply supported beam, span 4 m, is loaded by a *udl* over half the span from L.H support. The intensity of *udl* is 2 kN/m. The section of beam is a T - section with flange of 120×30 mm^2 and web of 120×30 mm, making height of 150 mm. Calculate maximum bending and shearing stresses in the beam section. 8

8. (a) Three bars of steel, aluminium and bronze are joined end to end and compressed at two free ends by a force P. Develop an expression for change of length, in terms of diameter of each length, modulus of elasticity and load. 6

(b) A steel shaft is stepped as shown in Fig.2 8

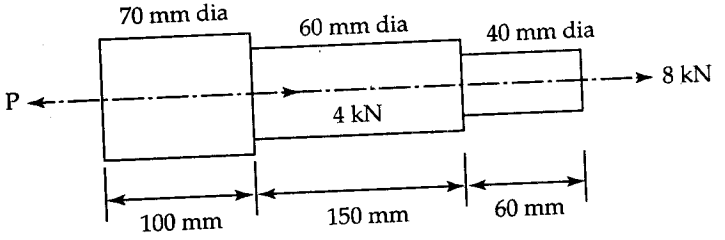

Fig. 2

If $E = 2.1 \times 10^5$ N/mm^2, $\nu = 0.3$. Find change of length of bar and change in diameters of three segments of length, under the load shown in figure.