BAS-008

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

01584 **Term-End Examination**

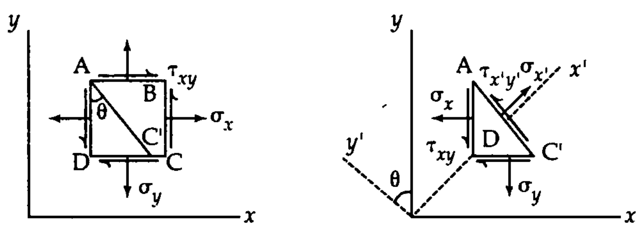
June, 2011

BAS-008 : STRENGTH OF MATERIALS

Time : 3 hours *Maximum Marks : 70*

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

1. Figure 1(a) shows state of stress at a point in the body of material which is loaded by external forces. Figure 1(b) shows a free body ADC′ cut from the element ABCD. **14**



(a) (b)

Fig. 1

The exposed section AC′ is supposed to carry stresses $\sigma_{x'}$ and $\tau_{x'y'}$: x' and y' are shown in Figure 1(b).

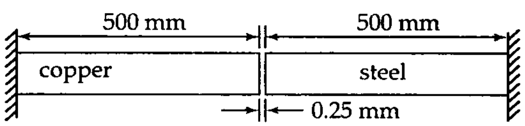
Calculate $\sigma_{x'}$ and $\tau_{x'y'}$ in terms of σ_x, σ_y and τ_{xy} and angle θ. Find conditions when $\sigma_{x'}$ and $\tau_{x'y'}$ will be maximum.

2. (a) A bronze cylinder (25 mm dia.) is inserted in a hollow aluminium cylinder (50 mm outside dia.) and placed on a rigid support. A rigid plate is placed on top of two cylinders which are equal in length. A load of 450 kN is applied at the centre of the top plate coinciding with the common axis of two cylinders. Calculate the stress in bronze and aluminium cylinders. E for bronze $= 25.8 \times 10^5$ MPa. E for aluminium $= 17 \times 10^5$ MPa. **8**

(b) In a changed situation a rigid plate is placed on the top of the hollow aluminium cylinder. The bronze cylinder is placed on the rigid plate such that both cylinders have common axis. Calculate the stresses in both cylinder. Use data from 2(a). **6**

3. (a) Figure 2 shows 2 bars placed with a gap of 0.25 mm between their faces and other ends built in the rigid supports. The bar on left is copper and that on the right is steel and each is 60 mm in dia. (i) Determine total force on each bar if temperature is raised by 40°C. (ii) Determine the deformation in each bar. **10**

Use $\alpha_{steel} = 11.5 \times 10^{-6}$ per deg.C,
$E_{steel} = 2.1 \times 10^5$ MPa
$\alpha_{copper} = 16.5 \times 10^{-6}$ per deg.C,
$E_{copper} = 1.13 \times 10^5$ MPa



(b) Two strips of steel and copper of same length, width and thickness are jointed along larger surface with a strong adhesive which is not affected by rise in temperature. The composite bar is subjected to moderate rise of temperature. Discuss how the composite will deform and the stresses induced in two strips. **4**

4. Following strains are measured at a point in a machine part. $\epsilon_x = 800\mu$, $\epsilon_y = 200\mu$, $\gamma'_{xy} = 600\mu$. Calculate principal strains, principal stresses, maximum shearing stress and direct stress on plane of maximum shearing stress. **14**
$E = 2.1 \times 10^5$ N/mm^2. $\nu = 0.3$.

5. (a) A rubber belt of rectangular cross section (thickness = 10 mm, width = 50 mm) is placed upon a pulley of 1 m dia. No tension is applied on the belt. Find bending stress induced in the belt cross-section. E for rubber belt = 100 N/mm^2. **5**

(b) Three wooden planks - one 600×100 mm^2 and two 300×100 mm^2 each, are to be joined in (i) to make a rectangular section of 600 mm depth $\times$ 200 mm width, (ii) to make an I - section of 800 mm depth. If the maximum bending moment to be supported by the beam so formed is 140 kNm, calculate max bending stress in two cases. **9**

6. (a) From definition of strain energy develop an expression for the strain energy of a round shaft which is subjected to a torque, T. 5

(b) A simply supported beam of span l is loaded by a uniformly distributed load of intensity w/unit length. Another beam of same material span and cross - section is loaded by a single concentrated load W at the middle of the length. The loads (both udl and concentrated) are chosen to satisfy the condition that max. bending moment is same. Find the ratio of strain energies in two cases. 9

7. (a) Describe types of beams and loads that act upon the beam. Show that for any support in beam rate of loading $= -\frac{dF}{dx}$ and shear force at any section is related to bending moment at that section as $F = \frac{dM}{dx}$ 5

(F is shear force, M is bending moment)

(b) A cantilever of length l is loaded by a uniformly increasing load with zero at fixed end to w_o/unit length at free end. Draw S.F. and B.M. diagrams and find max. B.M. and Max. S.F. if $w_o = 10$ kN/m. Compare the magnitudes of M_{max} for this load of cantilever and if whole load is placed as concentrated load at free end. Take $l = 2$ m. 9

8. (a) Explain the application of theories of failure. What are different theories of failure ? 5

(b) The principal stresses in plane stress state at a point are 2σ (tensile) and σ (compressive), then find the value of σ using all theories of failure. Use tensile yield strength as 100 N/mm^2 and Poisson's ratio as 0.3. 9
