Printed Pages — 4   TME — 303

| (Following Paper ID and Roll No. to be filled in your Answer Book) |
| PAPER ID : 4071   Roll No. |

B.Tech.

THIRD SEMESTER EXAMINATION, 2006-07

STRENGTH OF MATERIALS

Time : 3 Hours   *Total Marks : 100*

Note : *(i)*   *Attempt ALL questions.*

(ii)   *All questions carry equal marks.*

(iii) *In case of numerical problems assume data wherever not provided.*

(iv)   *Be precise in your answer.*

1.   Attempt *any two* parts of the following :   **(10x2=20)**

(a)   A point in a strained material is subjected to a tensile stress of 65 N/mm^2 and a compressive stress of 45 N/mm^2, acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 are acting on these planes. Find the normal stress, tangential stress and resultant stress on a plane inclined to 30° with the plane of the compressive stress.

(b)   (i)   The stresses in the three principal direction are +65 MN/m^2, +20 MN/m^2 and −85 MN/m^2. Find the principal strain. Take $\mu = 0.3$ and $E = 200$ GN/m^2.

(ii) A mild steel shaft 100 mm diameter is subjected to a maximum torque of 15 kN-m and a maximum bending moment of 10 kN-m at a particular section. Find the factor of safety according to the maximum shear stress theory of failure if the elastic limit in simple tension is 240 MN/m^2.

(c) Write short notes *any two* of the following :

    (i) Equilibrium equations and its applications

    (ii) Airy's stress function.

    (iii) Castigliano's theorem.

2. Attempt *any two* parts of the following :   (10x2=20)

(a) A timber beam of 3 m span carries a uniformly distributed load of 5 kN/m and a point load 1 kN at the centre of the span. If the permissible bending stress be 100 N/mm^2, find the section taking depth as twice the breadth.

(b) A beam of uniform section, 10 metres long, is simply supported at the ends. It carries point loads of 150 kN and 65 kN at distance of 2.5 m and 5.5 m respectively from the left end. Calculate :

    (i) the deflection under each load

    (ii) the maximum deflection

Take : E = 200 GN/m^2 and I = 118×10^{-4} m^4.

(c) In a hollow circular shaft, the external diameter is 100 mm and internal diameter is 60 mm. The allowable shear stress in the shaft material is 55 N/mm^2. Determine the angle of twist in a length of twenty times the external diameter of the shaft.

Take : G = 8.5×10^4 N/mm^2.

3. Attempt *any two* parts of the following :   (10x2=20)

(a) A helical spring having 12 coils of mean coil diameter of 20 cm is made of 10 mm diameter steel rod. The helix angle is 25°. Find the angular twist and the axial deflection of one end of spring relative to the other if it is subjected to an axial couple of 14 N-m. Calculate the maximum bending and torsional stresses in the wire.

Take : $E = 200$ GN/m^2 and $G = 80$ GN/m^2.

(b) A mild steel hollow column, having 100 mm external diameter and 60 mm internal diameter and 4 m length is used as a column. Determine the crippling load by Rankine's formula, when both ends are hinged.

Take $\sigma_c = 320$ N/mm^2, $\alpha = \dfrac{1}{7500}$.

(c) (i) Classify columns and struts with a short description of each classification.

(ii) Write down the limitations of Euler's formula for critical load.

4. Attempt *any two* parts of the following :   (10x2=20)

(a) Prove that in the case of a thin cylindrical shell subjected to an internal fluid pressure, the volumetric strain is equal to twice the circumferential strain plus the longitudinal strain.

(b) Derive an expression for maximum principal stress on thick cylindrical shell subjected to external pressure.

(c) A hollow cylinder of 45 cm internal diameter and 10 cm thickness contains the fluid under pressure of 850 N/cm^2. Find the maximum and minimum hoop stress across the section.

5.   Attempt *any two* parts of the following :   (10x2=20)

   (a)   A curved beam, rectangular in cross-section is subjected to pure bending with couple of $+40$ kN $-$ cm. The beam has width of 2 cm and depth of 4 cm and is curved in plane parallel to width. The mean radius of curvature is 5 cm. Find the position of the neutral axis, and the ratio of the maximum to the minimum stress.

   (b)   A 6 cm $\times$ 4 cm $\times$ 0.6 cm unequal angle is placed with the longer leg vertical, and is used as beam. It is subjected to a bending moment of 150 N-m acting in the vertical plane through the centroid of the section. Determine the maximum bending stress induced in the section.

   (c)   Explain *any two* of the following :

      (i)   Why is the knowledge of shear centre of a beam important ?

      (ii)   In crane hooks, trapzoidal section is very commonly used.

      (iii) Some application of curved beam with large initial curvature.

- o O o -