

**B. TECH.****THIRD SEMESTER EXAMINATION, 2003-2004  
STRENGTH OF MATERIAL**

Time : 2 Hours

Total Marks : 50

**Note :** (1) Attempt All questions.

(2) Missing data, if any, may be suitably assumed.

**1.** Answer any TWO parts of the following :— (6×2)

(a) Write short notes on the following :—

(i) Ductility

(ii) Toughness

(iii) Principal Stresses

(b) If the principal stresses at a point in an elastic material are  $2f$  tensile,  $f$  tensile and  $\frac{1}{2}f$  compressive, calculate the value of  $f$  at failure according to

(i) Maximum principal stress theory,

(ii) Maximum shear stress theory,

(iii) Maximum strain theory.

The elastic limit in simple tension is  $200 \text{ N/mm}^2$  and Poisson's ratio = 0.3.(c) A cantilever 2.5 m long carries a U.D.L. of  $20 \text{ kN/m}$  run. The breadth of the section remains constant and is equal to 100 mm. Determine the depth of the section at the middle of the length of the cantilever and at fixed end if stress remains the same throughout and equal to  $120 \text{ MN/m}^2$ .

2. Answer any TWO parts of the following :— (6×2)  
<http://www.uptuonline.com>
- (a) A flywheel weighing 500 kg is mounted on a shaft 75 mm diameter and midway between bearings 0.6 m apart. If the shaft is transmitting 30 kW at 360 rpm, calculate the principal stresses and the maximum shear stress at the ends of a vertical diameter in a plane close to the flywheel.
  - (b) Derive the equation defining the deflection curve of a uniformly loaded cantilever beam. From this, evaluate the deflection  $\delta$  at the free end.
  - (c) A beam AB of length  $L$ , hinged at the ends, carries a couple (moment)  $M$  at a distance 'a' from the left end. Determine deflection at the point of application of the couple.

3. Answer any TWO of the following :— (6½×2)

- (a) A slender column of length  $l$  is built in at its lower end and free at upper end. Find the first critical value of the compressive load  $P$ .
- (b) A cylindrical shell 3 m long which is closed at the ends has an internal diameter of 1 m and a wall thickness of 15 mm. Calculate the circumferential and longitudinal stresses induced and also change in the dimensions of the shell, if it is subjected to an internal pressure of  $1.5 \text{ MN/m}^2$ . Take  $E = 200 \text{ GN/m}^2$  and  $\mu = 0.3$ .
- (c) A hollow C.I. column whose outside diameter is 200 mm has a thickness of 20 mm. It is 4.5 m long and is fixed at both ends. Calculate the safe load of Rankine -

Gordon formula using a factor of safety of 4.

Take  $\sigma_c = 550 \text{ MN/m}^2$ ,  $a = 1/1600$ . <http://www.uptuonline.com>

4. Answer any *TWO* of the following :— (6½×2)

(a) The maximum stress permitted in a thick cylinder, radii 8 cm and 12 cm, is  $20 \text{ N/mm}^2$ , the external pressure is  $6 \text{ N/mm}^2$ ; what internal pressure can be applied? Plot curves showing the variation of hoop and radial stresses through the material.

(b) A steel shaft 50 mm diameter is to be pressed into a cast iron hub 150 mm external diameter and 100 mm long, so that no relative slip occurs under a torque of 5 kNm. Find the necessary fit allowance in the hub.  $E_s = 2 \times E_{ct}$ , Poisson's ratio = 0.25 for both and coefficient of friction between surfaces = 0.3,  $E_s = 207,000 \text{ N/mm}^2$ .

(c) Write briefly on any *two* of the following :—

(i) Equivalent Torque

(ii) Castigliano's Theorem

(iii) Creep & Creep Strength.