

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

PAPER ID : 4071

Roll No.

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B.Tech.

(SEM. III) ODD SEMESTER THEORY EXAMINATION

2010-11

STRENGTH OF MATERIALS

Time : 3 Hours

Total Marks : 100

Note : (1) Attempt all questions.

(2) Marks are indicated against each part.

(3) Assume missing data suitably, if any.

1. Attempt any two parts :

- (a) A vertical rod 2 m long, fixed at the upper end, is 13 cm^2 in area for 1 m and 20 cm^2 in area for 1 m. A collar is attached to the free end. Through what height can a load of 100 kg fall on to the collar to cause a maximum stress of 50 N/mm^2 ?

$$E = 2,00,000 \text{ N/mm}^2. \quad 10$$

- (b) (i) What are the five principal theories of failure, name them ? 4

- (ii) Construct Mohr's circle for the case of plane stress $\sigma_x = 360 \text{ kg/cm}^2$, $\sigma_y = 200 \text{ kg/cm}^2$ and $\tau_{xy} = 60 \text{ kg/cm}^2$ and determine the magnitudes of the two principal stresses σ_1 and σ_2 and the angle ϕ between the direction σ_x and σ_1 . 6

(c) (i) State and prove Castigliano's Theorem for concentrated loads. 5

(ii) The principal stresses at a point in an elastic material are 60 N/mm^2 tensile, 20 N/mm^2 tensile, and 50 N/mm^2 compressive. Calculate the volumetric strain.

$$E = 100,000 \text{ N/mm}^2. \quad 5$$

2. Attempt any **one** of the following :

(a) (i) 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 and horizontal diameter in a plane close to the flywheel.

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(ii) Find the maximum deflection in a cantilever of length L due to a load W at its free end. 8

(b) A beam of uniform section 9 m long is carried on three supports at the same level, one at each end and one at 6 m from the left end. A uniformly distributed load of 16 kN/m is carried across the whole span, and a point load of 20 kN at 4.5 m from the end. Draw the S.F and B.M diagrams. 20

3. Attempt any **two** of the following :

(a) Determine the maximum angle of helix for which the error in calculating the extension of a helical spring under axial load by the "close - coiled" formula is less than 1% . 10

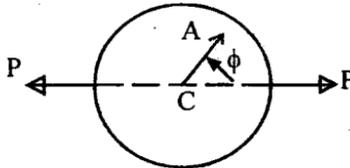
- (b) A cantilever leaf spring of length 0.43 m has four leaves of thickness 9 mm. If an end load of 2.5 kN causes a deflection of 36 mm find the width of the leaves.

$$E = 200,000 \text{ N/mm}^2. \quad 10$$

- (c) A slender column of length l is built-in at its lower end and laterally supported (pin jointed) at its upper end. Find the first critical value of the compression load p . 10

4. Attempt any two of the following :

- (a) A thin spherical shell of mean radius r and wall thickness t is subjected to tensile forces p acting along a diameter of the sphere as shown in figure. There is no internal pressure. Find the principal membrane stresses σ_1 and σ_2 at the point A on the shell defined by the angle ϕ as shown: 10



- (b) The cylinder of hydraulic ram is 6 cm internal diameter. Find the thickness required to withstand an internal pressure of 40 N/mm², if the maximum tensile stress is limited to 60 N/mm² and maximum shear stress to 50 N/mm². 10
- (c) A compound cylinder is to be made by shrinking one tube on to another so that the radial compression stress at the friction is 28.5 N/mm². If the outside diameter is 26.5 cm, and the bore 12.5 cm, calculate the allowance for shrinkage at the common diameter, which is 20 cm.

$$E = 210,000 \text{ N/mm}^2. \quad 10$$

5. Attempt any **two** of the following :

(a) A curved bar of square section 3 cm sides and mean radius of curvature 4.5 cm is initially unstressed. If a bending moment of 300 N-m is applied to the bar tending to straighten it, find the stresses at the inner and outer faces.

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(b) A steel tube having outside diameter 5 cm, bore 3 cm is bent into a quadrant of 2 m radius. One end is rigidly attached to a horizontal box plate to which a tangent to that end is a perpendicular, and the free end supports a load of 100 kg. Determine the Horizontal deflection of the free end under this load using Castigliano's Theorem. $E = 208,000 \text{ N/mm}^2$.

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(c) (i) Develop a general theory of bending of prismatic beam of arbitrary cross-section. (not having an axial plane of symmetry).

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(ii) Write brief note of Shear Centre.

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