Printed Pages : 7 EME-302

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

PAPER ID : 0429 Roll No. | | | | | | | | | | |

B. Tech.

(Semester-III) Theory Examination, 2011-12

STRENGTH OF MATERIALS

Time : 3 Hours] *[Total Marks : 100*

Note : Attempt questions from *all* Sections as per directions.

Section-A

Attempt *all* questions. 2×10=20

1. State Castigliano's first theorem.
2. Define principal plane and principal stress.
3. What do you mean by 'strength of a shaft' ?
4. State Mohr's theorems for beams.
5. What are the limitations of Euler's formula ?
6. Write short notes on wire winding of cylinders.
7. What are the various stresses induced in closed coil helical springs ?

8. What are the assumptions made in Lame's equation ?

9. Write down the expression for Winkler-Bach formula.

10. Why the shear centre is called the centre of twist ?

Section-B

Attempt any *three* questions. 10×3=30

1. Derive an expression for major and minor principal stresses on an oblique plane when the body is subjected to direct stresses in two mutually perpendicular directions accompanied by a shear stress.

2. What is Macaulay's method ? Where is it used ? Find an expression for a simply supported beam with an eccentric point load, using Macaulay's method.

3. Find the expression for cripping load for a long column when one end of the column is fixed and other end is hinged.

4. What do you mean by a thick compound cylinder ? How will you determine the hoop stresses in a thick compound cylinder ?

5. Derive an expression for neutral axis of circular cross section.

Section-C

Attempt *all* questions. 10×5=50

1. At a certain point in a strained material, the intensities of stresses on two planes at right angles to each other are 20 N/mm^2 and 10 N/mm^2 both tensile. They are accompanied by a shear stress of magnitude 10 N/mm^2. Find graphically, the location of principal planes and evaluate the principal stresses.

Or

The load on a bolt consists of an axial pull of 15 kN together with a transverse shear of 7.5 kN.

Determine the diameter of the bolt according to (i) maximum principal stress theory (ii) maximum shear stress theory (iii) maximum strain theory (iv) strain energy theory and (v) shear strain energy theory. Elastic limit in tension is 285 N/mm^2, and a factor of safety of 3 is to be applied. Take $\mu = 0.3$.

2. A beam of square section is used as a beam with one diagonal horizontal. The beam is subjected to shear force F, at a section. Find the maximum shear in the cross section of the beam and draw the shear distribution diagram for the section.

Or

A solid circular shaft is subjected to a bending moment of 3000 N-m and a torque of 10000 N-m. The shaft is made of 45C8 steel having ultimate tensile stress of 700 MPa and a ultimate shear stress of 500 MPa. Assuming a factor of safety as 6, determine the diameter of shaft.

3. 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 by Rankine's formula using a factor of safety of 4. Calculate the slenderness ratio of Euler's and Rankine's critical loads. Take 550 N/mm, $\alpha = 1/1600$ in Rankine's formula and $E = 9.4 \times 10^4$ N/mm^2.

Or

An open coiled helical spring, made out of 20 mm, diameter steel rod has 10 complete turns at a mean diameter of 150 mm, the angle of helix being 15°. An axial load of 400 N is applied. Compute (i) deflection under load and (ii) maximum intensities of direct and shear stresses, induced in the section of the wire. Take $N = 0.84 \times 10^5$ N/mm^2 and $E = 2 \times 10^5$ N/mm^2.

4. In a cylindrical shell of 0.6 m diameter and 0.9 m long is subjected to an internal pressure 1.2

N/mm^2. Thickness of the cylinder wall is 15 mm. Determine longitudinal stresses, circumferential stress and maximum shear stresses induced and change in diameter, length and volume. Take $E = 200$ GPa and 1/m=0.3.

Or

The external diameter of a steel collor is 200 mm, and the internal diameter increases by 0.125 mm when shrunk on to a solid steel shaft of 125 mm diameter. Find the reduction in diameter of the shaft, the radial pressure between the collar and the shaft and hoop stresses at the inner surface of the tube. Take $E = 210$ GPa and Poisson's ratio=0.3.

5. A beam of T-section (flange 100×20, web 150×10) is 2.5 m in length and is simply supported at the ends. It carries a load of 3.2 kN inclined at 20° to the vertical and passing through the

centroid of the section. Its $E = 200$ GPa. Calculate :

(i) Maximum tensile stress

(ii) Maximum compressive stress

(iii) Deflection due to load

(iv) Position of neutral axis.

Or

Determine the maximum stress in the frame of the 100 kN punch press as shown in the figure below.