Printed Pages : 4 EME302

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

PAPER ID : 0429 Roll No.

B.Tech

(SEM III) ODD SEMESTER THEORY EXAMINATION 2009-10

STRENGTH OF MATERIALS

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

Note : *(1) Attempt all questions.*

(2) Assume any data required, but not given.

1 Attempt any two parts of the following : 10×2=20

(a) At a point in a strained material, there are normal stresses of 30 N/mm^2, tension and 20 N/mm^2, compression on two planes at right angles to one another, together with shearing stresses of 15 N/mm^2 on the same planes. If the loading on the material is increased so that the stresses reach values of K times those given, find the maximum permissible value of K if the maximum direct stress in the material is not to exceed 80 N/mm^2, and maximum shear stress is not to exceed 50 N/mm^2.

(b) A shaft of 15 cm diameter is subjected to a maximum torque of 20 KNm and a maximum bending moment of 18 KNm. Find the factor of safety (i) according to the maximum shear stress theory (ii) according to the maximum strain energy theory if the elastic limit in simple tension is 240 MN/m^2. Take μ =0.3.

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

(i) Castigliano's theorem

(ii) Compatibility equations

(iii) Three-dimensional stresses.

2 Attempt any **two** parts of the following : **10×2=20**

(a) A timber joist of 6 metre span has to carry a load of 15 kN/metre. Find the dimensions of the joist if the maximum permissible stress is limited to 8 N/mm^2. The depth of the joist has to be twice the width.

(b) A beam, simply supported at ends A and B is loaded with two point loads of 60 kN and 50 kN at distance 1 metre and 3 metre respectively from end A. Determine the position and magnitude of maximum deflection. Take $E = 2 \times 10^5$ N/mm^2 and $I = 8500$ cm^4.

(c) Find the internal and external diameters required for a hollow shaft, which is to transmit 40 kW of power at 240 rev/minute. The shear stress is to be limited to 100 MN/m^2. Take outside diameter to be twice the inside diameter.

3 Attempt any **two** parts of the following : **10×2=20**

(a) A leaf spring has 12 plates each 50 mm wide and 5 mm thick, the longest plate being 600 mm long. The greatest bending stress is not to exceed 180 N/mm^2 and the central deflection is 15 mm. Estimate the magnitude of the greatest central load that can be applied to the spring. $E = 0.206 \times 10^6$ N/mm^2.

(b) Determine the section of a cast iron hollow cylindrical column 5 metre long with ends firmly built-in if it carries an axial load of 300 kN. The ratio of internal to external diameter is 3/4. Use factor of safety of 8. Take $\sigma_c = 567$ N/mm^2 and Rankine's constant $a = 1/1600$.

(c) From the first principles derive the expression for the critical buckling for a column having one end fixed and one end hinged.

4 Attempt any **two** parts of the following : **10×2=20**

(a) A cylindrical vessel 1.5 metre in diameter, 2 metre long and 1.5 cm thick is closed at both the ends by rigid plates and this cylinder is filled with water at atmospheric pressure. Find how much additional amount of water is required to be pumped so as to make the final pressure in the cylinder as 70 bar. Take $E = 210$ GN/m^2 and $\mu = 0.3$ for the material of the cylinder. Bulk modulus of the water is 2.4 GN/m^2.

(b) Calculate the thickness of metal necessary for a cylindrical shell of internal diameter of 80 mm to withstand an internal pressure of 25 N/mm^2, if the maximum permissible tensile stress is 125 N/mm^2.

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

(i) Lame's theory of thick cylinders

(ii) Compound cylinders

(iii) Radial, axial and circumferential stresses in thick cylinders.

5 Attempt any **two** parts of the following : **10×2=20**

(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.

(b) A 60 mm × 40 mm × 6 mm unequal angle is placed with the longer leg vertical, and is used as a beam. It is subjected to a bending moment of 12 kN-cm acting in the vertical plane through the centroid of the section. Determine the maximum bending stress induced in the section.

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

(i) Centroidal Principal Axes

(ii) Assumptions for the theory of curved beams

(iii) Application of curved beams with large initial curvature.
