Printed Pages: 7 NME - 302

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

Paper ID : 2289778 Roll No.

B. TECH.

Regular Theory Examination (Odd Sem-III), 2016-17

MECHANICS OF SOLIDS

Time : 3 Hours *Max. Marks : 100*

Note : Attempt questions as per instructions.

SECTION - A

1. Attempt all parts of the following : (10×2=20)

a) What is Hook's law? Explain.

b) What are thermal stress and thermal strain.

c) What are principal stresses and strains?

d) What is slenderness ratio and equivalent length of a column?

e) What are flitched beam and fixed beam?

f) Differentiate between resilience and proof resilience.

g) What is spring? What are different types of springs?

h) What is the difference between column and strut?

i) Explain:

i) Section Modulus

ii) Modular ratio

j) Differentiate between thin cylinder and thick cylinder.

SECTION - B

Note: Attempt any five questions from this section. (5×10=50)

2. Derive the expression for shearing stress at any section on a beam, also show the distribution of shearing stress over a rectangular section.

3. A simply supported beam of span L is carrying a uniformly distributed load of w per unit length over the entire span. Find the maximum slope and deflection of the beam.

4. A solid shaft of 200mm diameter has the same cross sectional area as the hallow shaft of the same material with inside diameter of 150 mm. Find the ratio of

i) Powers transmitted by both the shafts at the same angular velocity.

ii) Angles of twist in equal length of these shafts, when stressed to same intensity.

5. A cylindrical shell 90 cm long 20 cm internal diameter having thickness of metal as 8 mm is filled with fluid at atmospheric pressure. If an additional 20 cm^3 of fluid is pumped into the cylinder, find

i) The pressure exerted by the fluid on the cylinder and

ii) The hoop stress induced. Take E = 200 GPa and $\mu = 0.3$

6. A short length of tube, 4 cm internal diameter and 5cm external diameter, failed in compression at a load of 240 KN. When a 2 m length of the same tube was tested with the fixed ends, the load at failure was 158 KN. Assuming that the ultimate crushing stress in Rankine's formula is given by the first test, find the value of the constant α in the same formula. What will be crippling load of this tube if it is used as a strut 3m long with one end fixed and other is hinged.

7. What are the various theories of failure? Explain with diagram.

8. A bar of uniform cross section area A and length L hangs vertically, subjected to its own weight. Prove that the strain energy stored within the bar is given by

$$U = \frac{A \times \rho^2 \times L^3}{6E}$$

Where E is modulus of elasticity and ρ is weight per unit volume.

9. A beam of length 6 m is simply supported at its ends and carries two point loads of 48 KN and 40 KN at a distance of 1 m and 3m respectively from the left support. Find:

i) Deflection under each load

ii) Maximum deflection

iii) The point at which maximum deflection occurs.

Give E=200 GPa and I=85 mm^4

10. A rectangular block of material is subjected to a tensile stress of 110 MPa on one plane and a tensile stress of 47 MPa at right angles to the former. Each of the above stresses is accompanied by a shear stress of 63 Mpa and that associated with the former tensile stress tends to rotate the block anticlockwise. Find :

i) The direction and magnitude of each of the principal stress.

ii) Magnitude of greatest shear stress

SECTION - C

Note: Attempt any two questions from this section. **(2×15=30)**

11. **Attempt all parts of the following:** **(3×5=15)**

a) In a hallow circular shaft of outer and inner diameters of 20 cm and 10cm respectively, the shear stress in not to exceed 40 MPa. Find the maximum torque which can be safely transmitted.

b) Determine the poisson's ratio and bulk modulus of a material, for which young's modulus is 120 GPa and modulus of rigidity 4.8 Mpa.

c) At a point in a strained material the principal stresses are 100 MPa (Tensile) and 60 Mpa (Compressive). Determine the normal stress, shear stress and resultant stress on a plane inclined at 50° to the axis of major principal stress. Also determine the maximum shear stress at a point.

12. Attempt all parts of the following : (3×5=15)

a) Derive the expression for elongation of a uniform bar due to its self-weight.

b) Derive the expression for elongation of a conical bar due to its self-weight.

c) A steel rod of 3cm diameter is enclosed centrally in a hallow copper tube of external diameter 5 cm and internal diameter 4 cm. The composite bar is then subjected to an axial pull of 45000 N. If the length of each bar is equal to 15 cm.

Determine:

i) The stresses in the rod and the tube.

ii) Load carried by each load

E for steel =200 GPa and for Copper = 100 GPa.

13. A closely coiled helical spring is to carry a load of 500 N. Its mean coil diameter is to be 10 times that of the wire diameter. Calculate the mean diameter if the maximum shear stress in the material of the spring is to be 80 MPa. If the stiffness of the spring is 20 N per mm deflection and modulus of rigidity = 86000 MPa. Find the number of coils in the closely helical springs.