B.E. / B.Tech. Mechanical Engineering (Model Curriculum) Semester-IV

# PCC-ME204 - Strength of Materials

P. Pages : 3 **GUG/S/25/14064**

Time : Three Hours * 2 3 8 1 * Max. Marks : 80

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Notes : 1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.
5. Solve Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6, Q. 7 or Q. 8, Q. 9 or Q. 10.

**1.** a) Define lateral strain, longitudinal strain, and Poisson's ratio. **6**

b) A steel specimen having 20 mm diameter and a' gauge length of 200 mm is tested for destruction. It has an extension of 0.25 mm under a load of 80 kN and a load at the elastic limit 102 kN. The maximum load is 130 kN. The total extension at fracture is 56 mm and the diameter at the neck is 15 mm find: **10**

i) The stress at the elastic limit
ii) Young's modulus
iii) Percentage elongation
iv) Percentage reduction in area
v) Ultimate tensile stress.

**OR**

**2.** a) The stresses on two perpendicular planes through points in a body are 30 MPa & 15 MPa both tensile along with a shear stress of 25 MPa. By Using Mohr's circle method, find: **8**

i) The magnitude and direction of principal stresses.
ii) The planes of maximum shear stress
iii) The normal and shear stresses on the planes of maximum shearing stress

b) The state of stress at point is shown in fig. 2(b). Determine principal stresses and Maximum shear stress and the plane on which they act by both analytical and graphical methods. Indicate the direction of all the above by the sketches. **8**

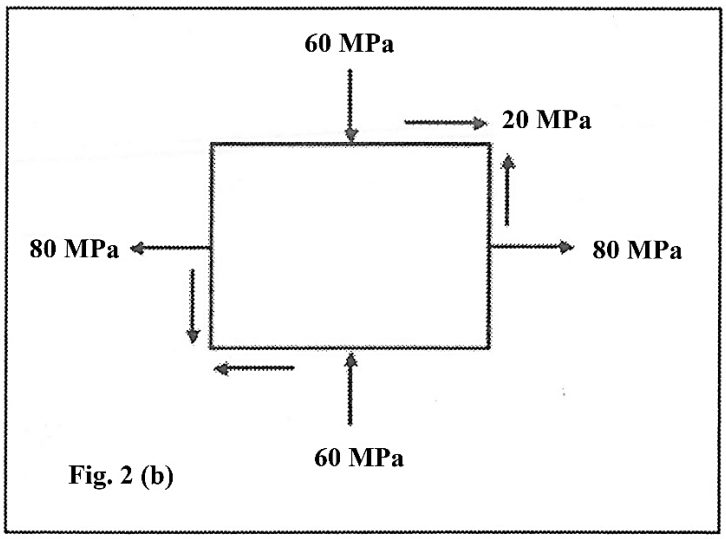

Fig. 2 (b)

**3.** A beam of span 6 meters carries a UDL of 1.5 KN per meter run over the entire span and two-point loads of 4 KN and 5 KN at 2 meters and 4 meters from left-hand support. Draw SFD and BMD. Find the position and magnitude of the maximum bending moment. **16**

**OR**

**4.** a) A cantilever beam, span 2m carries a UDL of 5 kN/m over its entire span and also a point load of 4 kN at its free end. Determine the bending stresses induced in the beam at its midsection and a fixed end, assuming the beam has: i) Rectangular cross-section with b = 150 mm and d = 250 mm, ii) Circular cross-section with a diameter of 200 mm **8**

b) Derive the expression for the bending equation. Also, state the assumptions. **8**

**5.** a) Derive the slope and deflection equations for the simply supported beam loaded at the center by load 'W'. Use the double integration method. **8**

b) A simply supported beam ABCD, having span of 6 m is supported at ends A and D. It carries UDL of 40 kN/m over its entire span. Find the deflection of the beam at points B and C. Take AB = 1m, BC = 3m and CD = 2m. Take $EI = 17000\,kN.m^2$ **8**

**OR**

**6.** A cantilever 3 meter in length and of uniform rectangular cross-section 150 mm wide and 300 mm deep is loaded with a 30 KN load at its free end. In addition to this, it carries a UDL of 20 KN per unit meter run over its entire length. Calculate i) the maximum slope and maximum deflection ii) the slope and deflection at 2 meters from the fixed end. Take: $E = 210\,GN/m^2$ **16**

**7.** a) i) State the assumptions in the theory of pure torsion. **2**

ii) Give derivation of the torsional equation. **6**

b) The external and internal diameters of n hollow shaft are 50 mm and 40 mm respectively. Find the maximum power that can be transmitted by the shaft at 600 rpm, if the permissible shear stress is $100\,N/mm^2$ and the permissible rate of twist IS $3^o$ per meter. Take $G = 8\times10^4\,N/mm^2$ **8**

**OR**

**8.** a) **8**

i) Define the 'Column' and 'Strut' with examples

ii) Explain the failure of the 'Short column' and 'Long column'.

b) Derive the expression for the crippling load when one end of the column is fixed and the other end free. **8**

**9.** a) A cylindrical shell 3 m long which is' closed at 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 $1.5\,MN/m^2$. Take $E = 200\,GN/m^2$ and $1/m = 0.3$ **8**

b) A vessel in the shape of a spherical shell 40cm in diameter and lcm shell thickness is filled with a fluid at atmospheric pressure. Additional fluid is then pumped in till the pressure increases by $50\,kg/cm^2$. Find the volume of this additional fluid. Given that 1/m=0.25 and $E = 1\times10^6\,kg/cm^2$ for the shell material. **8**

**OR**

**10.** Write short notes on **any four**. **16**

i) Stress-strain Diagram for M.S. and C. I.

ii) Modulus of Elasticity, Modulus of Rigidity and Poisson's ratio and their significance.

iii) Factor of safety and its selection.

iv) Assumptions made in deriving the Bending Equation.

v) Strength and rigidity Criterion for shaft design.

vi) Strength and rigidity criterion for Beam design.

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