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

PCC-ME204 - Strength of Materials

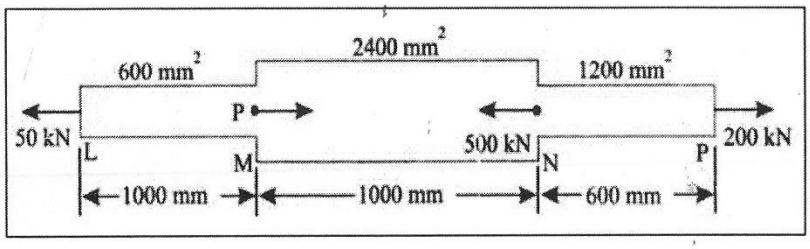
P. Pages : 3 **GUG/W/24/14064**

Time : Four Hours * 5 5 8 1 * Max. Marks : 80

Notes : 1. All questions carry marks as indicated.
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. Use Drawing instruments non programmable electronic calculator is allowed.
6. Attempt Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.

1. a) Derive the relation between young's modulus and the bulk modulus & poisons ratio. **8**

b) The Member LMNP is subjected to point loads as shown in fig. below. **8**
Calculate : (i) Force P necessary for the equilibrium. (ii) Total elongation of member, take E=210 GN/m^2.



OR

2. a) Explain the following terms in detail: **6**
i) Principal planes.
ii) Principal stresses.
iii) Planes of maximum shear and maximum shear 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 method. Indicate the direction of all the above by the sketches. **10**

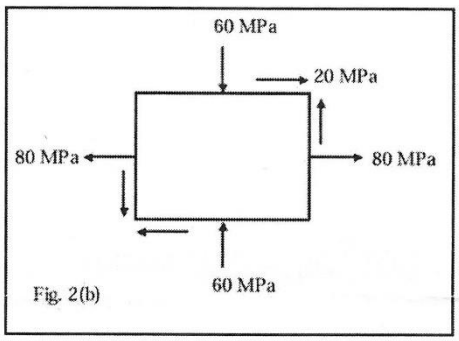
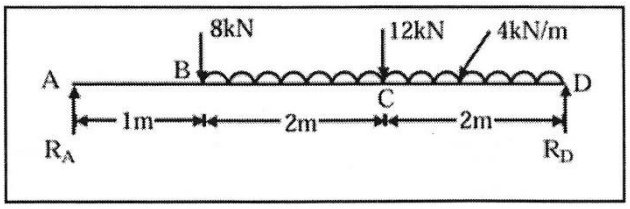


Fig. 2(b)

3. A simply supported beam ABCD is supported at its ends A and D and carries a load as shown in fig. Draw S.F. and B.M. diagram for the beam and determine the maximum B.M. acting on beam. Also locate point of contra-flexure if any. **16**



OR

4. a) Derive the equation of simple bending of a beam i.e. $M/I = \sigma/y = E/R$ where, notations have their usual meanings. Also give the assumptions in theory of simple bending. **8**

b) A cantilever beam of span 2m is carrying 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 beam at its mid-section and fixed end, assuming beam has : **8**

i) Rectangular c/s with b = 150 mm and d = 250 mm,

ii) Circular c/s with diameter 200 mm.

5. a) A simply supported beam subjected to the central concentrated load 'W'. Determine maximum slope and deflection in beam. **8**

b) A cast iron beam 40mm wide and 80mm deep is simply supported on a span of 1.2m. The beam carries a point load of 15KN at the center. Find the deflection at the center. Take $E = 108 \times 10^3 \text{ N/mm}^2$. **8**

OR

6. A beam ABCD is simply supported at its ends A and D. It carries a point load of 22 kN at B and UDL of 12kN/m. on span CD. Determine : **16**

i) Deflections at point B and C

ii) Slope at point A.

iii) Max^m deflection in beam and where it occurs. Take AB = 1.5m, BC = 0.5m and CD = 2m, $E = 200*10^6 \text{kN/m}^2$ and $I = 20*10^{-6} \text{ m}^4$.

7. a) Derive the torsion equation for the circular shaft. Also write down the assumptions made while deriving the equation. **8**

b) A solid circular shaft of diameter 'D' transmits 75 kW power at 200 rpm. Calculate the shaft diameter, if the angle of twist is not to exceed 1^o in 2m length of shaft and torsional shear stress is limited to 50 MPa. Take modulus of rigidity for shaft material (G) = 100 GPa. Use strength and Rigidity criterion to find 'D'. **8**

OR

8. a) Define the 'Column' and 'strut' with example. **4**

b) Explain the failure of 'short column' and 'Long column'. **4**

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

9. A closed cylindrical vessel made of steel plates 4 mm thick with plane and carries fluid under a pressure of $3N/mm^2$. The diameter of the cylinder is 250 mm & length is 750 mm. Calculate. **16**

i) Longitudinal & hoop stresses in the cylinder wall.

ii) Changes in diameter, length & volume of cylinder.

Take $E = 2 \times 10^5 N/mm^2$ & $\mu = 0.286$.

OR

10. a) A cylindrical thin drum 800 mm in diameter and 3 m long has a shell thickness of 10 mm. If the drum is subjected to an internal pressure of 2.5 N/mm, determine: **12**

i) Change in diameter.

ii) Change in length.

iii) Change in volume. $E = 2 \times 10^{5N} / mm^2$, $\mu = 1/4$.

b) A vessel in the shape of spherical shell 40 cm in diameter and 1 cm shell thickness is completely 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 $E = 1 \times 10^6 kg/cm^2$ for the shell material. **4**

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