



## SECTION-B

2. A steel specimen  $1.5 \text{ cm}^2$  in cross-section, stretches  $0.005 \text{ cm}$  over a  $5 \text{ cm}$  gauge length under an axial load of  $30 \text{ kN}$ . Calculate strain energy stored in the specimen at this point. If the load at the elastic limit for the specimen is  $50 \text{ kN}$ , calculate the elongation at elastic limit and the proof of resilience.
3. A cylinder of  $15 \text{ cm}$  internal diameter and  $20 \text{ cm}$  external diameter is subjected to liquid pressure from inside. There is also a compressive load of  $200 \text{ kN}$  applied at the ends of the cylinder. Find the greatest pressure of the liquid so that the maximum stress in the material may not exceed  $42 \text{ MPa}$ .
4. The thick rim of a wheel is  $90 \text{ cm}$  diameter. Neglecting the effect of spokes, how many revolutions per minute may it make without the hoop stress exceeding  $140 \text{ MPa}$ . The density is  $7800 \text{ kg/m}^3$  and  $E = 200 \text{ GPa}$ . Also find the change in diameter.
5. State and explain Castigliano's theorem.
6. Derive the general formula for distribution of shear stress in beams.

## SECTION-C

7. A solid circular shaft is required to carry a twisting moment of  $2.5 \text{ kN-m}$  and a bending moment of  $7.5 \text{ kN-m}$ . Determine the diameter on the basis that the total strain energy per unit volume is not to exceed that in a material under a pure shear stress of  $28 \text{ MPa}$ .  $E = 204 \text{ GPa}$ , Poisson's Ratio =  $0.25$ .
8. In an open coil helical spring having  $10$  coils, the stresses due to bending and twisting are  $98 \text{ MPa}$  and  $105 \text{ MPa}$  respectively, when the spring is axially loaded. Assuming the mean diameter of the coils to be  $8$  times the diameter of wire, find the maximum permissible load and the diameter of wire for a maximum extension of  $2 \text{ cm}$ .  $E = 210 \text{ GPa}$  and  $G = 82 \text{ GPa}$ .
9. Write short notes on **any two** of the following :
  - (a) Shear strain energy theory and its graphical representation.
  - (b) Maxwell's theorem of reciprocal deflection.
  - (c) Importance and Applications of compound cylinder.