1. The center portion of the rubber balloon has a diameter of d=200mm. If the air pressure within it causes the balloon's diameter to become d=230mm, determine the average normal strain in the rubber. (15%)
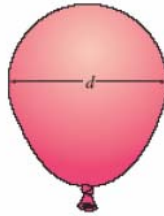

Fig. 1

2. A structural member in a nuclear reactor is made from a zirconium alloy. If an axial load of 30kN is to be supported by the member, determine its required cross-sectional area. Use a factor of safety of 3 with respect to yielding. What is the load on the member if it is 2 mm long and its elongation is 0.5 mm? E_{zr}=100 GPa. σ_y =450 MPa. The material has elastic behavior. (20%)

3. A spherical gas tank has an inner radius of r =1.8 m. If it is subjected to an internal pressure of p =280 kPa, determine its required thickness if the maximum normal stress is not to exceed 15 MPa. (15%)

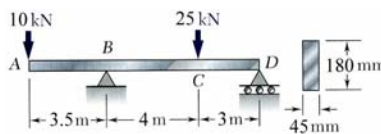4. For the beam and loading shown in Fig. 2, please draw the shear and bending- moment diagrams. (15%)

Fig. 2

5. A torque (T) 600 N-m is applied to shaft AB, see Fig. 3. The allowable shearing stress of this system is 6 MPa. Determine the required diameter of shaft AB and shaft CD under pure twisting effect. (20%)
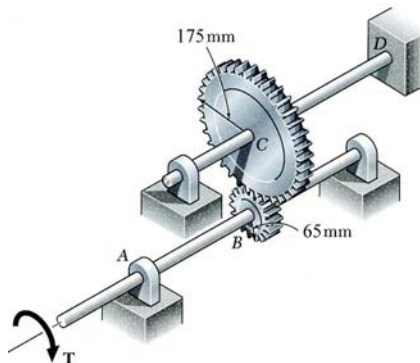

Fig. 3

6. A uniform pressure is applied on all faces of a steel block, see Fig. 4. The change in length AB is -2×10^{-3} cm, determine the change in length of the other two edges, and the uniform pressure. Assume E = 250 GPa and ν = 0.21. (15%)
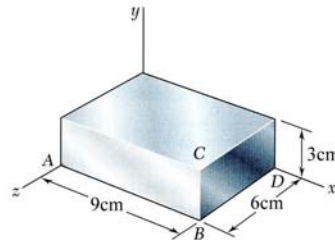

Fig. 4