

School of Engineering
B.TECH Mechanical Engineering
Mid Term Examination - May 2024

Duration : 90 Minutes
Max Marks : 50

Sem IV - G3UB401B - Mechanics of Materials

General Instructions

Answer to the specific question asked

Draw neat, labelled diagrams wherever necessary

Approved data hand books are allowed subject to verification by the Invigilator

- 1) Explain the importance of theories of failure. K2 (2)
 - 2) What is strain energy of a material? Derive the expressions for the same in two different forms. K1 (3)
 - 3) Define the principle of superposition. Explain its utility. K2 (4)
 - 4) Deduce an expression among three elastic constants of a material. K2 (6)
 - 5) A boiler of 1.6 m diameter is made of 20-mm thick steel plates. Solve for the permissible steam pressure in the boiler if the efficiency of the longitudinal joint of the boiler is 80% and the maximum tensile stress in the steel plates is not to exceed 80 MPa. What will be the circumferential stress in the solid plate section at this pressure? Also, find the longitudinal stress in the plate section through the rivets of the circumferential joint if the efficiency of the joint is 70%. K3 (6)
 - 6) In a tensile test on a specimen of mild steel 12.5 mm diameter, gauge length 200 mm, the following readings were recorded as given in the table. Solve for the value of Young's modulus. When the specimen was afterwards tested for destruction, the maximum load recorded was 58440 N, the diameter of the neck was 7.37 mm and the length between the gage marks was 260.5 mm. Determine the ultimate tensile strength, percentage reduction in area, and percentage elongation. K3 (9)
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|----------------|-------|--------|-------|-------|--------|-------|-------|--------|
| Load (N) | 5000 | 10000 | 15000 | 20000 | 25000 | 30000 | 35000 | 40000 |
| Extension (mm) | 0.039 | 0.0778 | 0.117 | 0.156 | 0.1945 | 0.235 | 0.273 | 0.3125 |
- 7) A square block is subjected to two perpendicular direct stresses together with complementary shear stress. Calculate the principal stresses and their inclinations. Take $P_1 = 60$ MPa, $P_2 = 20$ MPa, with shear stress = 20 MPa. K4 (8)
 - 8) A bar 30 mm in diameter was subjected to a tensile load of 54 kN and the measured extension on 300 mm gauge length was 0.112 mm and the change in diameter was 0.00366 mm. Calculate Poisson's ratio and the value of the three moduli. K4 (12)

OR

The modulus of the rigidity for a material is 51 GPa. A 10 mm diameter rod of the material was subjected to an axial pull of 10 kN and the change in diameter was observed to be 0.003 mm. Calculate Poisson's ratio and moduli of Elasticity. K4 (12)