Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**PDDC - SEMESTER–I • EXAMINATION – WINTER • 2014**

**Subject Code: X11901 Date: 01-01-2015**

**Subject Name: Strength of Materials**

**Time: 10:30 am - 01:00 pm Total Marks: 70**

**Instructions:**

1. **Attempt any five questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q.1** **(a)** Define Principal stresses and Principal planes. **02**

**(b)** a) In a tension test on Metal specimen with initial diameter of 20 mm and length of 300 mm, following readings were recorded: **05**

i) Diameter after failure = 18 mm

ii) Length after failure = 325 mm

iii) Failure load = 280 kN

Compute % contraction in area, % elongation in length, True stress at failure, Engineering stress at failure.

**(c)** At a point in a strained material, the stresses are shown in **figure 1**. If the value of Major principal stress is 100 N/mm$^2$ (Tensile), find out the values of $\sigma_y$ and Minor principal stress. Consider $\sigma_x$ = 60 N/mm$^2$, $\tau_{xy}$ = 40 N/mm$^2$. **07**

**Q.2** **(a)** Define Strain Energy and Resilience. **02**

**(b)** Derive an expression for strain energy stored in a body for any loading condition. **05**

**(c)** A 1200 mm long wire of 50 mm$^2$ cross sectional area is hanged vertically. It receives a sliding collar of 250 N weight and stopper at the bottom end. The collar is allowed to fall on stopper through 120 mm height. Determine the instantaneous stress induced in the wire and corresponding elongation. Also determine the strain energy stored in the wire. Take modulus of elasticity of wire as 2 x 10$^5$ N/mm$^2$. **07**

**Q.3** **(a)** Differentiate between Brittle materials & Ductile materials. **02**

**(b)** For torsion of a circular shaft, Prove with usual notations $\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{R}$. **05**

**(c)** A solid steel shaft has to transmit 250 kW at 750 rpm. Find the diameter of the shaft if the shear stress is to be limited to 150 N/mm$^2$. Estimate the possible % saving in the material of the shaft if hollow shaft of internal diameter equals 0.70 times external diameter is replaced against solid shaft. **07**

**Q.4** **(a)** Define Shear force & bending moment. **02**

**(b)** Derive the relation between rate of loading, shear force and bending moment. **05**

**(c)** A cantilever beam of 5 m length, contain 30 kN and 20 kN load at 3 m and 5 m respectively form fixed end. And loaded with UDL with an intensity 10 kN/m over an entire span. Draw S.F. and B.M. diagram for the beam. **07**

**Q.5** **(a)** Enlist different types of riveted connections and Illustrate any one with figure. **02**

**(b)** Derive the expression for the slope and deflection of Simply supported beam subjected to point load at center. **05**

**(c)** Determine deflection at free end for the Cantilever beam as shown in **figure 2**, using any method. Take EI = 32000 kNm$^2$. **07**

**Q.6** **(a)** Enlist different types of welded connections and Illustrate any one with figure. **02**

**(b)** Differentiate riveted and welded connections. **05**

**(c)** Determine the reaction at support for the continuous beam ABC as shown in **figure 3.** Using Moment distribution method. **07**

**Q.7** **(a)** Define Hardness and Toughness **02**

**(b)** Derive the expression for the fixed end moment at the end for the beam subjected to point load at mid point of the beam. **05**

**(c)** Analyse the fixed beam shown in **figure 4**. Draw shear force and bending moment diagram. **07**

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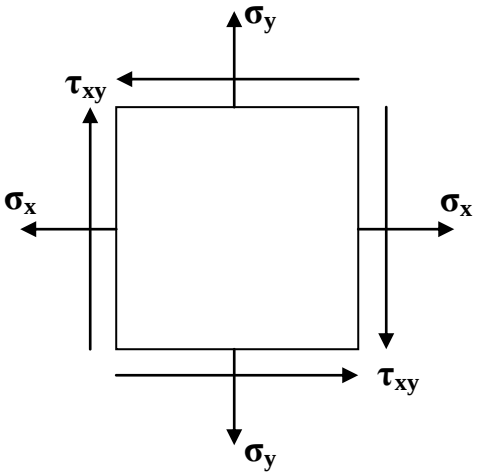


**Figure 1**

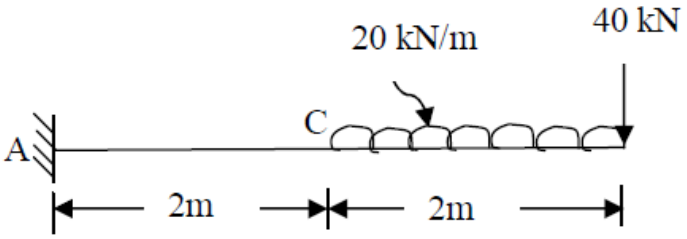


Figure 2

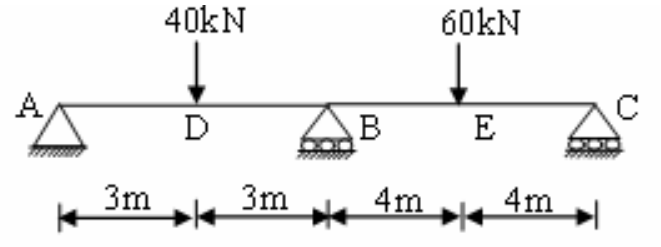


Figure 3

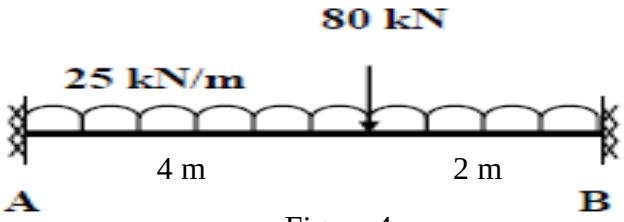


Figure 4