

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VII (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2171916

Date: 29/04/2017

Subject Name: Applied Mechanics of Solid(Department Elective - I)

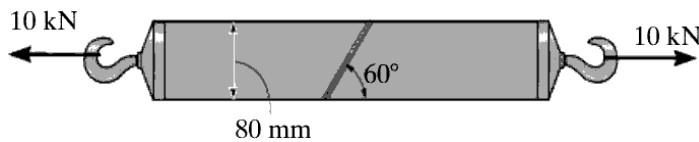
Time: 02.30 PM to 05.00 PM

Total Marks: 70

Instructions:

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

- Q.1 (a)** The 25-mm thick rectangular bar is subjected to the axial load of 10 kN. If the bar is joined by the weld, which makes an angle of 60° with the horizontal, determine the shear stress parallel to the weld and the normal stress perpendicular to the weld. **07**



- (b)** Enlist theory of failures and explain any two. **07**

- Q.2 (a)** The stresses are defined in xy system are $\sigma_x = 40 \text{ MPa}$, $\sigma_y = -30 \text{ MPa}$, and $\tau_{xy} = -20 \text{ MPa}$. A new coordinate system $x'y'$ is obtained by rotating xy system, by 30 degrees @ Z-axis in counter-clockwise direction. Determine $\sigma_{x'}$, $\sigma_{y'}$, and $\tau_{x'y'}$ and stress invariants. **07**

- (b)** Derive equation of Principal stresses in 2D. **07**

OR

- (b)** Relative to xyz coordinate system, a state of stress at a point in a structure is given by: **07**

$$\sigma = \begin{bmatrix} 25 & 10 & 15 \\ 10 & 0 & 0 \\ 15 & 0 & -20 \end{bmatrix} \text{ MPa. The } x'y'z' \text{ system is defined by: } \frac{1}{9} \begin{bmatrix} 1 & -8 & 4 \\ 4 & 4 & 7 \\ -8 & 1 & 4 \end{bmatrix}$$

Determine: Stress matrix in $x'y'z'$ system.

- Q.3 (a)** Explain following terms: Stress Invariants, Octahedral Stresses, Strain Hardening. **07**

- (b)** Write and discuss incremental constitutive relation for elastic – plastic material. Also state basic assumptions for the theory. **07**

OR

- Q.3 (a)** Derive Biharmonic equation in Polar coordinate. **07**

- (b)** Derive stress distribution using Airy's stress function in a simply supported beam subjected to pure bending. **07**

- Q.4 (a)** State stress compatibility equations in 2D and explain their significance. **07**

- (b)** With the help of neat sketch, explain strain measurement using Digital Image Correlation technique. **07**

OR

- Q.4** (a) Explain the Principle of virtual work and prove the relation for elastic solids. **07**
(b) Explain convexity, normality and uniqueness for work hardening materials. **07**
- Q.5** (a) Discuss flow rules associated with von Mises yield function for perfectly plastic material. **07**
(b) For nonlinear elastic solid with isotropic behaviour, derive Cauchy stress and Green strain relations. **07**
- OR**
- Q.5** (a) Explain material stability, convexity, normality and uniqueness for elastic solids. **07**
(b) Explain the procedure of stress transformations using Mohr's circle. **07**
