

GUJARAT TECHNOLOGICAL UNIVERSITY**M.E Sem-I Remedial Examination January 2011****Subject code: 712003 Subject Name: Theory of Elasticity & Stability****Date: 02/02/2011****Time: 2:30pm:5:00pm****Total Marks: 60****Instructions:**

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

Q.1 (a) Explain the Resultant stress vector, and normal & Shear stress components. **06**

(b) At a point P in a body subjected to tensile stress $\sigma_x = 15 \text{ N/mm}^2$, $\sigma_y = 25 \text{ N/mm}^2$, $\sigma_z = 5 \text{ N/mm}^2$ and $\tau_{xy} = \tau_{yz} = \tau_{zx} = 5 \text{ N/mm}^2$. Determine the normal and shearing stress on a plane whose normal has the following direction **06**

Case 1 : $n_x = 0.707$, $n_y = 0.707$, $n_z = 0.707$,

Case 2 : $n_x = 0$, $n_y = 0.5$, $n_z = 0.5$

Q.2 (a) Explain plane state of stress on a rectangular element. **06**

(b) Explain the differential equation of equilibrium of small rectangular element. **06**

OR

(b) Explain the stress invariants. **06**

Q.3 (a) Explain octahedral stress. **06**

(b) At a point P, the rectangular stress components are **06**

$\sigma_x = 2 \text{ kPa}$, $\sigma_y = -4 \text{ kPa}$, $\sigma_z = 5 \text{ kPa}$,

$\tau_{xy} = 2 \text{ kPa}$, $\tau_{yz} = -3 \text{ kPa}$, $\tau_{zx} = 1 \text{ kPa}$,

Find the principal stress, also check on the Invariance of I_1 , I_2 , I_3

OR

Q.3 (a) Explain principal stress. **06**

(b) Determine octahedral normal & shearing stress on an octahedral plane. The state of stress given below **06**

$\sigma_x = 10 \text{ kPa}$, $\sigma_y = 6 \text{ kPa}$, $\sigma_z = 4 \text{ kPa}$,

$\tau_{xy} = \tau_{yz} = \tau_{zx} = 5 \text{ kPa}$,

Q.4 (a) Explain deformation in the neighbourhood of point. **06**

(b) Consider displacement field **06**

$U = 2xy^2 \mathbf{i} + 6yz \mathbf{j} + (3x + 2z^2) \mathbf{k}$

Find out the rectangular strain components at a point (1,1,2).

OR

Q.4 (a) (1) Explain the state of strain of a point **03**

(2) Explain plane state of strain **03**

- (b) Two points P & Q in the undeformed body have co-ordinate (0,1,1) & (2,0,0) respectively. The displacement field $U = 2xy^2 i + 6yz j + (3x + 2z^2) k$. Find out the distance between points P & Q after deformation. **06**

- Q.5** (a) Explain various parameters of safety and stability. **06**
 (b) State and explain Euler's theory to calculate critical load and explain limitation of its application. **06**

OR

- Q.5** (a) Explain different types of buckling with P-W curve. **06**
 (b) (1) A shaft of square section is subjected to torque of 1200 N-m. If the maximum shear stress is limited to 50 N/mm^2 . Find size of the square shaft, also find the angle of twist for a length of 3m. Take $C = 8 \times 10^4 \text{ N/mm}^2$. **04**
 (2) A shaft of rectangular section 50mm x 30mm and it is subjected to a torque of 300 N-m. Find the maximum shear stress induced in the shaft **02**
