COURSE CODE(CREDITS): 12M1WCE211 (3)

MAX. MARKS: 25

COURSE NAME: SOLID MECHANICS IN STRUCTURAL ENGINEERING

COURSE INSTRUCTORS: Dr. Tanmay Gupta

MAX. TIME: 1 Hour 30 Minutes

Note: All questions are compulsory. Marks are indicated against each question in square brackets.

Q.1 At a given point in a material the three-dimensional state of stress is defined as $\sigma_x = \sigma_y = \sigma_z = 10 N/mm^2$. $\tau_{xy} = 20 N/mm^2$, $\tau_{yz} = \tau_{zx} = 10 N/mm^2$. Compute the principal stresses and the principal planes (angles).

[8]

Q.2 With neat diagram explain octahedral stress and with the relevant equations of normal and shear octahedral stresses.

[3]

Q.3 If the deformation at a point is specified by the six strain components, $\varepsilon_{xx}, \varepsilon_{yy}, \varepsilon_{zz}, \gamma_{xy}, \gamma_{yz}$ and γ_{zx} derive all six Saint-Venant's equations of compatibility.

[6]

Q.4 At a point in a stressed material, the principal stress acting are $\sigma_x = 200\ N/mm^2$, $\sigma_y = 150$ N/mm² and $\sigma_z = 120\ N/mm^2$. Given young's modulus of elasticity is 210 kN/mm² and poison's ratio is 0.3, calculate the volumetric strain and the Lame's constants.

[4]

Q.5 The displacement field for a body is given by $u = [(x^2 + y)i + k(y + z)j + k(x^2 + 2z^2)k]\ 10^{-3}$ At a point P(2, 2, 3), consider two-line segments PQ and PR having the following direction cosines before deformation PQ : $n_{x1} = n_{y1} = n_{z1} = 1/\sqrt{3}$, PR: $n_{x2} = n_{y2} = 1/\sqrt{2}$, $n_{z2} = 0$. Determine the angle between the two segments before and after deformation.

[4]