DEPARTMENT OF MECHANICAL ENGINEERING

UNIVERSITY INSTITUTE OF ENGINEERINGAND TECHNOLOGY, CSJM UNIVERSITY, KANPUR

Advanced strength of materials (MEE –S206)

Semester: 2021-22 (Odd Semester) **Year: 2nd Year (2K21)**

END Semester Examination

Time: 3 h **Maximum marks: 50**

All questions are compulsory

Section A

1. The state of stress at a point P is

$$\sigma = \begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix}$$

(a) Draw the 2D- mohr circle

(b) Find the principal stress and principal directions

2. The state of stress at a point P is

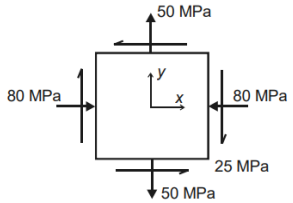
$$\sigma = \begin{bmatrix} 10 & -10 \\ -10 & 20 \end{bmatrix}$$

(a) Find the normal strain and shear strain

E = 220 GPa and passion ratio = 0.3

(b) Find the volumetric strain

3. The state of plane stress at a point is represented by the stress element below. Determine the stresses acting on an element oriented 450 clockwise with respect to the original element.



4. How many independent stress components are there for a two dimensional body?

(a) 1 (b) 3 (c) 6 (d) 9

5. The strain energy stored in a solid circular shaft subjected to shear stress (τ), is: (Where, G = Modulus of rigidity, V = volume of shaft)

(a) $\frac{\tau^2 V}{2G}$

(b) $\frac{\tau V}{2G}$

(c) $\frac{\tau^2 V}{4G}$

(d) $\frac{\tau V}{4G}$

6. Strain energy is used to find:

(a) Section modulus
(b) Moment of inertia
(c) Deflection
(d) Mass moment of inertia

7. The shape of the area for strain energy found for a linear elastic material within the elastic limit

(a) Triangle
(b) Trapezium
(c) Rectangular
(d) None

8. Strain energy stored in an uniform bar of length (L), area of cross section (A) under normal stress (σ) is given as: (where E is Young's modulus of elasticity)

(a) $\frac{\sigma E}{2AL}$

(b) $\frac{\sigma L}{2AE}$

(c) $\frac{\sigma^2 AL}{4E}$

(d) $\frac{\sigma^2 AL}{2E}$

9. A cylindrical steel pressure vessel 400 mm in diameter with a wall thickness of 20 mm, is subjected to an internal pressure of 5 MPa. Calculate the circumferential stresses (σ_x) and longitudinal stress (σ_y) in the steel vessel

10. A 10 mm thick cylinder is filled with a fluid at atmospheric pressure. The cylinder has an internal diameter of 180 mm and is 1 m long. If 20000 mm^3 of fluid is additionally pumped into the cylinder, find the hoop stress induced in the cylinder. (E = 200 GPa, $\mu = 0.3$)

Section B

1. The principal stresses at a point across two perpendicular planes are 180 MPa and 140 MPa. Find the normal and tangential stress, the resultant stress and its obliquity on a plane at 20^0 with major principal plane. Find also the intensity of stress which acting alone can produce the same maximum strain.

2 . The major principal stress is 175 MPa and the minor principal stress is compressive at a point in a steel member. If the yield point in tension of steel is 230 MPa, determine the value of the minor principal stress at which the yielding will commence according to the following theories of failure.
(a) Maximum shearing stress
(b) Maximum distortion energy theory
Poisson ratio = 0.26

3. Find the thickness of metal necessary for a steel cylindrical shell of internal diameter 140 mm to withstand an internal pressure of 60 MPa

4. Derive the expression for shear stress distribution in rectangular beam.

5. Using strain energy method, find the deflection of beam at mid point in simply supported beam subjected to point load at mid point of beam.

[**5 x 4**]

Section C

1. (a) Derive the expression for volumetric strain
(b) Derive the expression of normal stress and shear stress in arbitrary plane.

2. (a) State the castiligino theorem and find the slope of cantilever beam subjected to end moment M.
(b) Explain the traction vector in any arbitrary plane.

[**2 x 10**]