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VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD

M.E. (CBCS : Mech. Engg.) I-Semester Make up Examinations, March-2017

(Advanced Design & Manufacturing)

Theory of Elasticity and Plasticity

Time: 3 hours Max. Marks: 70

Note: Answer ALL questions in Part-A and any FIVE from Part-B

Part-A (10 × 2 = 20 Marks)

1. Define stress at a point.
2. Find out the maximum shear stress if the principal components of stress in tension are 300 MPa, 200 Mpa and 50 MPa in compression.
3. Find the octahedral shear strain for the following strain tensor $\begin{bmatrix} 1 & 2 & 1 \\ 2 & 5 & 4 \\ 1 & 4 & 2 \end{bmatrix} \times 10^{-3}$.
4. Prove that the first invariant of deviatoric strain tensor is zero.
5. State the differential equations of equilibrium for a three dimensional case.
6. State and explain generalized Hook's law? How many material constants need to be defined for a isotropic body in three dimensional stress space to define relation between stress and strain?
7. Find the von-Mise's effective stress for the following stress tensor $\begin{bmatrix} 100 & 100 & 200 \\ 100 & -50 & 100 \\ 200 & 100 & 20 \end{bmatrix}$ MPa.
8. What is isotropic hardening?
9. In a wire drawing process a wire of 12 mm is drawn to a diameter of 10 mm. if the flow stress of the material is 200 MPa, find the load required for drawing operation. Neglect the friction and redundant work.
10. State any two properties of slip lines.

Part-B (5 × 10 = 50 Marks)

11. a) Prove that the stress tensor is symmetric. [4]

    b) Find the principal stresses for the following stress tensor $\begin{bmatrix} 300 & 200 & 100 \\ 200 & 150 & 300 \\ 100 & 300 & 50 \end{bmatrix}$ MPa. [6]

12. a) Derive the expression for the principal components for plane strain condition. [4]

    b) The displacement functions in U, V, W in X Y and Z directions respectively are given by $U = 5xyz$; $V = x^2y + 3y^2 + 4z^2$ and $W = 2xy + 4xz + 3yz$, find out strain tensor. [6]

13. a) What is an orthotropic material? State its material property matrix for a three dimensional case. [4]

    b) Find the stress tensor for the following strain tensor [6]

    $$\begin{bmatrix} 2 & 4 & 1 \\ 4 & 1 & 3 \\ 1 & 3 & 3 \end{bmatrix} \times 10^{-3}$$

    when Young's modulus and Poison's ratio are 200 GPa and 0.25 respectively.

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14. a) Prove that the yield surface of von-Mise's is a cylinder with axis equally inclined to the principal axis and has a radius of $\sqrt{\frac{2}{3}}\ \sigma_0$ [4]

    b) Derive the expression for Prandtle-Reuss relations of plastic flow. [6]

15. a) Derive the expression for the wire drawing force using uniform deformation theory. [4]

    b) Using slab method prove that the variation of pressure distribution along the length of the slab is exponential with maximum at the center in case of slipping condition. [6]

16. a) State the representation and components of stress tensor for a three dimensional case. [4]

    b) What is deformation tensor? Divide the deformation tensor into strain and rotation tensors. [6]

17. Answer any *two* of the following:

    a) Discuss the compatibility equations. [5]

    b) Derive the expression of true stain in terms of engineering strain. [5]

    c) St. Venanat's theory of plastic flow. [5]