Hall Ticket Number:

Code No. : 21805

VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD

M.E. (Mech. Engg.: CBCS) I-Semester Main Examinations, January-2018

(Advanced Design & Manufacturing)

Theory of Elasticity and Plasticity

Time: **3** hours Max. Marks: **60**

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

Part-A (10 × 2 = 20 Marks)

1. Find the second invariant of the following stress tensor.

$$\begin{bmatrix} 300 & 200 & 100 \\ 200 & 150 & 300 \\ 100 & 300 & 50 \end{bmatrix} \text{MPa}$$

2. Determine the octahedral shear stress for the following stress tensor.

$$\begin{bmatrix} 100 & 100 & 200 \\ 100 & -50 & 100 \\ 200 & 100 & 20 \end{bmatrix} \text{MPa}$$

3. Divide the following deformation tensor into strain tensor and rotation tensor.

$$\begin{bmatrix} 1 & 2 & 1 \\ 3 & 5 & 4 \\ 2 & 1 & 2 \end{bmatrix} \text{X } 10^{-3}$$

4. Find out the principal strains for the following strain tensor.

$$\begin{bmatrix} 1 & 2 & 0 \\ 2 & 5 & 0 \\ 0 & 0 & 0 \end{bmatrix} \text{X } 10^{-3}$$

5. Determine the stress tensor for an isotropic material when the strain tensor is given by

$$\begin{bmatrix} 2 & 3 & 0 \\ 3 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \text{X } 10^{-3}$$

   The material constants E = 200 GPa and $\mu = 0.3$.

6. State the compatibility equations for a 2-dimensional state of stress.
7. A bar is reduced to half of its length by applying compressive force. Calculate the True strain experienced by the body.
8. The state of stress at point is given by the following stress tensor.

$$\begin{bmatrix} 100 & 200 & 100 \\ 200 & 150 & -50 \\ 100 & -50 & 200 \end{bmatrix} \text{MPa}$$

   Find out whether the material yields if the yield strength of material is 300 MPa. Use Von-Mise's criteria.

9. What is friction hill?
10. Predict the load required for extrusion operation for extruding a billet of 30mm diameter with an extrusion ratio of 10. The extrusion constant is 300 MPa, assume the ideal deformation.

Part-B (5 × 8 = 40 Marks)

11. a) Prove that the state of stress at a point is ellipsoid. [2]

    b) Determine the normal and shear stresses on a plane having two of the direction cosines are 0.3 and 0.4 when the state of stress is given by [6]

$$\begin{bmatrix} 50 & 70 & 100 \\ 70 & 100 & 30 \\ 100 & 30 & 150 \end{bmatrix} \text{MPa}$$

Contd... 2

Code No. : 21805

12. a) Prove that the first invariant of deviatoric strain tensor is zero. [2]

b) The strain at a point is given by [6]

$$\begin{bmatrix} 2 & 3 & 1 \\ 3 & 4 & 4 \\ 1 & 4 & 5 \end{bmatrix} \times 10^{-3}$$

i) Divide the above tensor into deviatoric and hydrostatic components.
ii) Find out the principal components of deviatoric strain tensor.

13. a) State the differences between body forces and traction forces by giving examples. [2]

b) Deduce the differential equations of equilibrium for a two dimensional case. [6]

14. a) Discus the kinematic hardening. [2]

b) Prove that the yield surface of Tresca is regular hexagonal prism with axis equally inclined to the principal axis and has a side of $\sqrt{\frac{2}{3}}\sigma_0$. [6]

15. a) What are the assumptions of slip line field theory of plastic flow? [2]

b) Deduce the Henky equations of slip line field theory. [6]

16. a) What is plane stress? Deduce the expression for principal stresses in plane stress condition. [4]

b) Determine the principal strains and the principal plane for the state of strain $\varepsilon_x = 0.001$, $\varepsilon_y = 0.002$ and $\gamma_{xy} = 0.003$. [4]

17. Answer any ***two*** of the following:

a) Generalized Hook's law for orthotropic material. [4]

b) St.Venant's theory of plastic flow. [4]

c) Uniform deformation energy theory. [4]