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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Second Semester, M.Tech. - Mechanical Engineering (MMDN)

Semester End Examination; May/June - 2019

Theory of Plasticity

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Define stress at a point and explain the significance of; 10
i) Stress tensor ii) Spherical stress tensor iii) Deviator stress tensor

b. What is a stress invariant? Derive invariants of the deviator stresses in terms of invariants of the stress tensor. 10

2 a. State advantages of using true strain over engineering strain in metal forming analysis. 4

b. Explain cubical dilation and prove it is equal to $\varepsilon_{xx} + \varepsilon_{yy} + \varepsilon_{zz}$. 16

UNIT - II

3 a. Explain the factors affecting plastic deformation. 8

b. At a point in a member the state of stress is as shown in Fig. 3(b). The tensile elastic limit is 413.7 MPa and shearing stress at a point is 206.85 MPa. At yielding, what is the tensile stress according to; i) Tresca's criteria ii) Von-Mises criteria 12

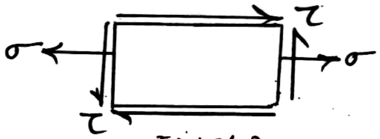

Fig: 3(b)

4 a. Explain Haigh-West guard stress space. 10

b. Define the following : 10
i) Yielding ii) Strain Hardening iii) Recovery
iv) Grain Growth v) Recrystallization

UNIT - III

5 a. Write stress strain diagrams and mechanical models for the following materials : 8
i) Elasto plastic ii) Linear elastic
iii) Rigid strain Hardening iv) Elasto plastic with strain Hardening

b. Explain Saint Venant's theory of plastic flow. 12

6 a. Explain the concept of plastic potential and proove that plastic strain increments are equal in magnitudes for Tresca's yield function. 10

b. Explain experimental verification of Prandtl-Reuss theory. 10

UNIT - IV

7 a. Derive the relations,

$\frac{M}{I_n} = \frac{\sigma}{y^n} = \frac{H}{R^n}$ in plastic bending for a beam material following the nonlinear stress strain law. 10

b. A rectangular beam having linear stress-strain behavior is 6 cm wide and 8 cm deep. It is 3 m long, simply supported at the ends and carries a uniformly distributed load over the whole span. The load is increased so that the outer 2 cm depth of the beam yields plastically. If the yield stress for the beam material is 240 MPa, plot the residual stress distribution in the beam. 10

8 a. For an elastic work hardening material, derive an expression for torque to cause elasto plastic yielding and show stress distribution. 8

b. Derive an expression for work consumption in drawing of rod and strip. 8

c. Estimate the force required to extrude aluminum curtain rail of I-section 12 mm high with 6 mm wide flanges, all 1.6 mm thick from 25 mm diameter bar stock. Take yield stress as 150 MPa. 4

UNIT - V

9 a. Write the assumption made in slip line theory and derive Geiringer's continuity equation. 10

b. State and prove Hencky's first theorem. 10

10. Write short note on : 20

i) Convention for sliplines

ii) Chord method for constructing slipline nets

iii) Properties of sliplines

iv) Hencky's Equations

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