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10ME752

Seventh Semester B.E. Degree Examination, Dec.2016/Jan.2017
Theory of Plasticity

Time: 3 hrs.

Max. Marks: 100

Note: Answer FIVE full questions, selecting at least TWO questions from each part.

PART – A

- 1 a. Explain the following :
 i) Deviatoric stress
 ii) Octahedral stress
 iii) Spherical stress. (09 Marks)

- b. State of stress at a point is given by the following stress tensor.

$$\sigma_{ij} = \begin{bmatrix} 50 & 50 & -40 \\ 50 & -30 & 30 \\ -40 & 30 & -100 \end{bmatrix} \text{ MPa}$$

Calculate the stress invariants, principal stresses, spherical and Deviatoric stress tensor.

(11 Marks)

- 2 a. Explain the various factors affecting plastic deformation. Give examples. (10 Marks)
 b. Explain strain hardening phenomenon? What is the effect of strain hardening on plastic deformation? (10 Marks)

- 3 a. Explain cubical dilation of strain. (05 Marks)
 b. Strain tensor at a point is given by

$$\epsilon_{ij} = \begin{bmatrix} 0.0001 & 0.0002 & 0.0005 \\ 0.0002 & 0.0003 & 0.0004 \\ 0.0005 & 0.0004 & 0.0005 \end{bmatrix}$$

Determine octahedral normal and shearing strain, deviator and spherical strain tensor.

(15 Marks)

- 4 a. Explain the different stress – strain diagram employed to describe elastic – plastic behaviour of materials. (10 Marks)
 b. Explain the various theories of plastic flow. (10 Marks)

PART – B

- 5 a. If the state of stress at a point is given by $\sigma_x = 70\text{MPa}$, $\sigma_y = 120\text{MPa}$, $\tau_{xy} = 35\text{MPa}$. If the yield stress is 125MPa . Determine whether yielding will occur or not according to Tresca and Von Mises yield criteria's.. (10 Marks)

- b. What do you understand by a yield criteria? Explain any two yield criterias commonly used. (10 Marks)

- 6 a. Explain the properties of slip line. (14 Marks)
 b. What assumptions are necessary to slip line field theory? (06 Marks)

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- 7 a. Derive the relation $\frac{M}{I_n} = \frac{\sigma}{y^n} = \frac{H}{R^n}$ in plastic bending for a material, following the non-linear stress strain law. (10 Marks)
- b. A rectangular beam of 80mm wide, 100mm deep and 3m long is simply supported at its ends, carrier a concentric load w . Determine magnitude of load w , if the beam is to yield at the outermost fibers by taking $\sigma_o = 250\text{MPa}$. Determine the value of the concentric load applied at the 20mm is to yield plastically and the whole of beam yields. Assume linear stress strain curve for the beam. (10 Marks)
- 8 a. Derive equation for theory of plastic torsion of a circular bar subjected to torsion for the following cases.
i) Incipient yielding
ii) Elasto plastic yielding
iii) Fully yielding (10 Marks)
- b. A circular shaft of inner radius 40mm and outer radius 100mm is subjected to a twisting couple so that the outer 20mm deep shell yields plastically. Determine the twisting couple applied to the shaft. Yield stress in shear for the shaft material is 145 N/mm^2 . Also determine the couple for full yielding. (10 Marks)
