CBCS SCHEME

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18ME743

Seventh Semester B.E. Degree Examination, Feb./Mar.2022
Theory of Plasticity

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Derive the three dimensional equilibrium equation in Cartesian co-ordinate system. **(10 Marks)**

b. Rectangular component of stresses at a point are given as follows:
$\sigma_x = 100$ MPa, $\sigma_y = -60$ MPa, $\sigma_z = 25$ MPa, $\tau_{xy} = 50$ MPa, $\tau_{yz} = 25$ MPa, $\tau_{xz} = 10$ MPa.
Determine stresses on a plane which is equally inclined to all the three axis. **(10 Marks)**

OR

2 a. Derive the compatibility equations in terms of strains and state their significance. **(08 Marks)**

b. The following state of stain exist at a point P. Determine the principal strains and the direction of maximum principal strain.
$\in_x = 0.02$, $\in_y = 0.06$, $\in_z = 0$
$\gamma_{xy} = -0.04$, $\gamma_{yz} = 0.02$, $\gamma_{xz} = 0$ **(08 Marks)**

c. Explain the generalized Hooke's law. **(04 Marks)**

Module-2

3 a. What is the mechanism of plastic deformation in metals? Explain with special emphasis on slip and twinning. **(10 Marks)**

b. Derive an expression for the critical resolved shear stress. Explain how this can be used to predict plastic deformation. **(10 Marks)**

OR

4 a. The state of stress at a point is given by $\sigma_x = 70$ MPa, $\sigma_y = 120$ MPa and $\tau_{xy} = 35$ MPa.
If the yield strength for the material is 125 MPa, determined in tensile test, whether yielding will occur according to Tresca's and Von-Mises yield condition or not. **(10 Marks)**

b. Explain Taylor and Quinney's experiment in support of yield criterias. What are the important conclusions to be drawn from these experiments? **(10 Marks)**

Module-3

5 a. Enumerate the various types of materials encountered in practice from plastic flow point of view. Also sketch the corresponding mechanical models. **(10 Marks)**

b. Explain the various empirical equations used to represent the stress-strain curves for the materials. **(10 Marks)**

OR

6 a. Explain the varius theories of plastic flow and give their limitations. **(10 Marks)**

b. Explain the Saint-Venant's theory of plastic flow in detail. What are the limitations of this theory? **(10 Marks)**

Module-4

7 a. Derive the equations for bending moment in Incipient yielding, Elasto-plastic yielding and fully plastic yielding for an idealized stress-strain curve. **(10 Marks)**

b. A Cantilever beam of length L carries an end load W. The stress-strain diagram for the beam material is given by $\sigma = H \in^n$. Determine the end deflection. **(10 Marks)**

OR

8 a. Derive the equation for torque in incipient yielding, Elasto-Plastic yielding and full yielding for elastic-perfectly plastic-materials. **(10 Marks)**

b. A circular shaft of inner radius 40 mm and outer radius 100 mm is subjected to a twisting couple so that the outer 20 mm 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)**

Module-5

9 a. Derive Geiringer's continuity equations. **(10 Marks)**

b. Explain the various properties of slip-lines. How these properties help us in drawing the slip line field. **(10 Marks)**

OR

10 a. State and prove Hencky's first theorem. **(10 Marks)**

b. What do you understand by a slip line? How slip line nets can be drawn? **(10 Marks)**

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