U.S.N | | | | | | | | | | |

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

(An Autonomous Institution affiliated to VTU, Belagavi)

Seventh Semester, B.E. - Mechanical Engineering

Semester End Examination; Feb. - 2022

Theory of Plasticity

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Develop the equation for stress transformation, spherical, deviator, octahedral stresses and strains, and Solve the same.

CO2: Explain factors affecting plastic deformation, strain hardening, recovery, recrystalization, cubical dilation and true stress and strain. Solve for Yield stress.

CO3: Explain St. Venant's theory of plastic flow and concept of plastic potential.

CO4: Develop basic equation for incompressible two dimensional flows, continuity equation and Explain geometry of slip line field and super position of slip line field, properties of the slip lines.

CO5: Explain Linear and non linear stress strain curve, shear stress distribution, residual stresses in plastic bending, and plastic torsion of circular bar and Solve residual stresses.

***Note**: I) PART - A is compulsory. **Two** marks for each question.*

*II) **PART - B**: Answer any **Two** sub questions (from a, b, c) for Maximum of **18 marks** from each unit.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
I a.	Write2D compatibility equation for strain.	2	L1	CO1	PO1
b.	Define plastic deformation of metals.	2	L1	CO2	PO1
c.	Mention any four different material models.	2	L1	CO3	PO1
d.	List any two properties of slip lines.	2	L1	CO4	PO1
e.	List any two assumptions made in the analysis of beams.	2	L1	CO5	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	Derive the equation of equilibrium considering the body forces.	9	L2	CO1	PO1
b.	For the following state of stress, find the state $(\sigma_{ij}) = \begin{bmatrix} 100 & 80 & 0 \\ 80 & -60 & 0 \\ 0 & 0 & 40 \end{bmatrix} kpa$ of stress with respect to an axis, obtained by rotating the Z-axis, through 30° CCW.	9	L3	CO1	PO1,3
c.	The strain component of a point are given by, $\in_x = 0.01$, $\in_y = -0.02$, $\in_z = 0.03$, $\gamma_{x_y} = 0.015$ $\gamma_{y_z} = 0.02$, $\gamma_{z_x} = -0.01$. Determine the normal and shearing strain on the octahedral plane.	9	L3	CO1	PO1,3
	UNIT - II	**18**			
2 a.	List and explain factors affecting plastic deformation.	9	L2	CO2	PO3
b.	Briefly discuss the experimental verification of yield criteria by lode's experiment.	9	L2	CO2	PO3
c.	Explain Haigh westergaard stress space.	9	L2	CO2	PO2

Contd....2

	UNIT - III	**18**			
3 a.	Explain stress-strain diagram for different material models.	9	L2	CO3	PO1
b.	Briefly discuss the experimental verification of Saint-Venant's theory of plastic flow.	9	L2	CO3	PO3
c.	Explain the concept of plastic potential and maximum work hypothesis.	9	L3	CO3	PO3
	UNIT - IV	**18**			
4 a.	Define slip line and discuss the assumptions made in slip line theory.	9	L2	CO4	PO1
b.	State and prove Hencky's theory for slip line field.	9	L2	CO4	PO3
c.	Derive Geiringer equations for a slip-line field.	9	L2	CO4	PO2
	UNIT - V	**18**			
5 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 stream-strain law.	9	L3	CO5	PO2
b.	Derive equations for theory of plastic bending for a bar of rectangular cross-section subjected to bending moment, for the following cases i) Incipient Yielding ii) Elasto plastic yielding iii) Fully plastic yielding	9	L2	CO5	PO2
c.	A cantilever beam of 100 mm wide and 150 mm deep is 5 m long is subjected to an end load of 6000 N. If the stress strain curve for beam material is given by $\sigma = 7000\, f^{0.25}$, determine the maximum stress induced in the beam.	9	L3	CO5	PO3

* * * *