BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH **SEMESTER : V**
BRANCH: PIE **SESSION : MO/2025**

SUBJECT: PE319 MATERIAL DEFORMATION PROCESSES

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

				CO	BL
Q.1(a)	I.	Differentiate between hot working and cold working.	[2]	CO1	BL2
	II.	Explain the sequential steps involved in impression die forging with the help of neat schematics.	[2]	CO1	BL2
	III.	State the importance of flash and flash gutter in impression die forging.	[1]	CO1	BL1
Q.1(b)	I.	Explain the process of cutting (sheet metal working) operations with the help of neat schematics.	[2]	CO1	BL2
	II.	Differentiate between open die forging and isothermal forging.	[2]	CO1	BL2
	III.	State the applications of explosive forming.	[1]	CO1	BL1
Q.2(a)	I.	Derive the equations of motion for a solid body under static equilibrium.	[3]	CO2	BL3
	II.	In a tension test of steel, a specimen of circular cross section with original diameter 8 mm is used. The loads applied were 16 kN and 21 kN which reduces its diameter to 7.6 mm and 7.1 mm, respectively. Determine a. true stress and true strain for given loads b. strain hardening exponent and strength coefficient	[2]	CO2	BL3
Q.2(b)	I.	Define octahedral stress and relate between the components of the unit vectors in octahedral stress.	[2]	CO2	BL3
	II.	Compute the hydrostatic stress components and von-Mises stresses for the following two states of stress and comment on their relationship. $\sigma_a = \begin{bmatrix} 2 & 2 & 0 \\ 2 & 5 & 0 \\ 0 & 0 & -5 \end{bmatrix}$ $\sigma_b = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -5 & 0 \\ 0 & 0 & 6 \end{bmatrix}$	[3]	CO2	BL3
Q.3(a)	I.	Explain the role of friction in metalworking operations citing a specific example. State the variables upon which friction at the job-die interface depends.	[3]	CO3	BL3
	II.	Determine the pressure distribution during forging of a circular disc considering the case of sticking friction.	[2]	CO3	BL3
Q.3(b)	I.	A solid circular flat disk of 200-mm diameter and 10-mm thickness is homogeneously press-forged between flat dies to a thickness of 6.4 mm. If a solid foil lubricant, causing a constant interface shear factor of m = 0.3 is used and the average uniaxial flow stress of the disk material is 100 MPa, determine the peak pressures required (a) at the commencement and (b) at the completion of forging.	[3]	CO3	BL3
	II.	Explain the Stribeck curve elucidating the three lubrication regimes.	[2]	CO3	BL3

PTO

Q.4(a)	I.	Apply uniform deformation energy method to calculate the ideal deformation load for drawing a cylindrical wire under plain strain conditions. State other factors (work done per unit volume) which should be accounted for other than ideal deformation load for the metal working process.	[3]	CO4	BL3
	II.	State the assumptions of slip line field method.	[2]	CO4	BL1
Q.4(b)	I.	A plate that is 220 mm wide and 22 mm thick is to be reduced in a single pass in a two-high rolling mill to a thickness of 18 mm. The roll has a radius = 450 mm, and its speed = 30 m/min. The work material has a strength coefficient = 240 MPa and a strain hardening exponent = 0.2. Determine (a) roll force, (b) roll torque, and (c) power required to accomplish this operation.	[3]	CO4	BL3
	II.	Explain the conditions of (a) skidding, (b) unaided rolling and (c) aided rolling.	[2]	CO4	BL2
Q.5(a)	I.	Derive an expression for extrusion (ram) pressure for indirect extrusion with the help of a nest schematic.	[3]	CO5	BL3
	II.	State the assumptions of analytical solution for mandrel drawing process.	[2]	CO5	BL1
Q.5(b)	I.	A cylindrical aluminium billet of 150 mm diameter and 380 mm length is extruded by indirect extrusion process to a final diameter of 50 mm through a conical converging die with a total die angle of 120° when the coefficient of friction at the die-billet interface is 0.05. The average compressive flow stress of aluminium is 60 MPa. Two presses, one with a capacity of 5 MN and the other of 2 MN, are available for this operation. Judge through detailed calculations which of the presses can perform the process of extrusion.	[3]	CO5	BL6
	II.	Draw the superimposed pressure distribution and axial stress distribution curves for axisymmetric forging of a cylindrical disc for the case of sliding friction.	[2]	CO5	BL3

::::::25/11/2025::::::M