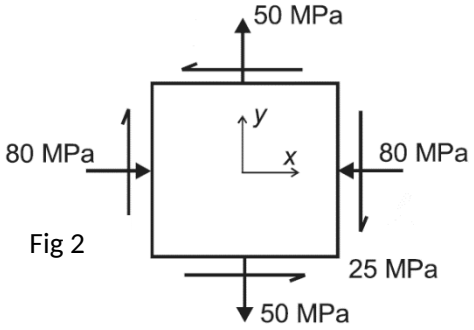
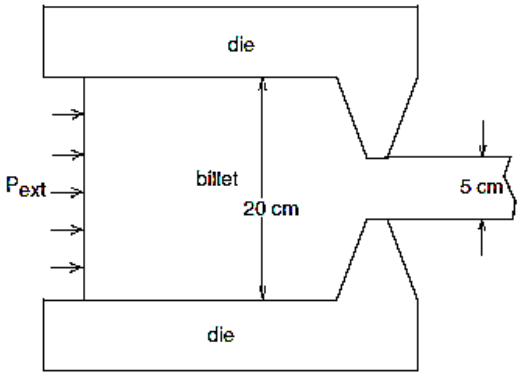
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

Course: Metallurgical aspects of metal forming (MTEG 304) **Semester: VI**
Program: B.Tech MSENT
Time: 03 hrs. **Max. Marks: 100**

Instructions: Choice in Q 9& 10

SECTION-A

S. No.		Marks	CO
Q 1	Describe what is meant by ideal work and write the expression for it.	**4**	**CO2**
Q 2	Define deformation efficiency and how is it calculated?	**4**	**CO4**
Q 3	In a material undergoing a forming operation, define the limiting stress condition for maximum reduction.	**4**	**CO4**
Q 4	A material follows power law strain hardening: $\sigma = 100\ \varepsilon^{0.25}$ MPa During tensile testing, after what strain value will the necking start in this material?	**4**	**CO3**
Q 5	Define hydrostatic pressure.	**4**	**CO1**
	SECTION-B		
Q 6	The state-of-stress at a point is given by the following tensor: $\begin{bmatrix} 9 & 6 & 3 \\ 6 & 5 & 2 \\ 3 & 2 & 4 \end{bmatrix}$ Determine the principal stresses and principal directions. Following equations may be used to calculate invariants: $I_1 = \sigma_{xx} + \sigma_{yy} + \sigma_{zz},$ $I_2 = \sigma_{yz}^2 + \sigma_{zx}^2 + \sigma_{xy}^2 - \sigma_{yy}\sigma_{zz} - \sigma_{zz}\sigma_{xx} - \sigma_{xx}\sigma_{yy},$ and $I_3 = \sigma_{xx}\sigma_{yy}\sigma_{zz} + 2\sigma_{yz}\sigma_{zx}\sigma_{xy} - \sigma_{xx}\sigma_{yz}^2 - \sigma_{yy}\sigma_{zx}^2 - \sigma_{zz}\sigma_{xy}^2$	**10**	**CO1**
Q 7	Examine three advantages of using true strain as compared to engineering strain.	**10**	**CO3**
Q 8	Comparing hot working and cold working, elaborate 3 advantages and 3 disadvantages of hot working over cold working.	**10**	**CO2**
Q 9	The stress (in Pa) acting on an element of a loaded body is shown in figure 1: Construct a Mohr's circle to determine the normal and shear stresses acting on a plane defined by $\theta=30^o$	**10**	**CO1**

	Fig 1 **OR** Draw the Mohr's circle for the stress element shown in Fig. 2. Determine the principal stresses and maximum shear stresses.  Fig 2		
	SECTION-C		
Q 10	An aluminum alloy billet is being hot extruded from 20-cm diameter to 5-cm diameter as sketched in Figure below. The flow stress at the extrusion temperature is 40 MPa. Assume efficiency, η = 0.5. a) What extrusion pressure is required? b) Calculate the lateral pressure on the die walls.  **OR** Calculate the maximum possible reduction in wire drawing for a material whose stress–strain curve is approximated by $\sigma = 200\varepsilon^{0.18}$ MPa. Assume an efficiency of 65%.	**20**	**CO4**
Q 11	Draw a schematic of sheet drawing process. A 2.5 mm thick and 25 cm wide metal sheet is drawn to a thickness of 2.25 mm through a die of included angle 30◦. The flow stress is 200 MPa and the friction coefficient is 0.08. Calculate the drawing force using the von Mises criterion. Following differential equation and other relations may be used.	**5** **15**	**CO2** **CO4**

	$\frac{d\sigma_x}{\sigma_x + P(1+B)} = -\frac{dt}{t}$ $P = 2k - \sigma_x$ $2k = (2/\sqrt{3})Y$ Where t = sheet thickness, Y=flow stress, B= μ cotα , α= included angle of die		