Assignment #2, Fluid Mechanics 2011

due on Oct. 10, 2011

1: The velocity profile in a two-dimensional flow is $u_1 = U[1 - (x_2/h)^2]$. The stress tensor σ_{ij} is $\sigma_{11} = \sigma_{22} = \sigma_{33} = -5$ and $\sigma_{12} = \sigma_{21} = -2\mu U(x_2/h^2)$. All other components are zero. Here, U, h and μ are constants. Find the stress normal and tangential to a plane located at $x_2/h = \frac{1}{2}$ with its normal at a 30^o angle to the flow direction.

2: Consider a two-dimensional flow with velocity components

$$u_1 = c\, x_1$$
$$u_2 = -c\, x_2$$

find the expression for the vorticity and the strain rate tensor.

3: Consider the two-dimensional flow given in cylindrical coordinates by $v_r = Q/(2\pi r)$, $v_z = v_\theta = 0$. Loop up the expressions in books or websites and compute the components of the strain-rate tensor for this flow.