

1. In a two-dimensional flow field, the velocities in the x and y directions are $u = x$ and $v = -y$, respectively. Determine the streamline and plot the streamline diagram. (30%)
2. A Newtonian fluid is flowing in two long and parallel plates, as shown in Fig. 1, the velocity distribution is given by

$$u(x, y) = \frac{U_o}{2} \left(1 - \frac{y^2}{h^2}\right)$$

If the fluid is moving with $U_o = 0.35$ m/s and $h = 0.2$ m, calculate the vorticity at the middle of the two plates. (20%)

3. A rectangular tank is divided by a partition into two chambers, as shown in Fig. 2. A 6-in-diameter orifice, for which C is 0.65, is located near the bottom of the partition. At a certain time, the water level in chamber A is 10.0 ft higher than that in chamber B. Find the time it will take for the water surfaces in the two chambers to be at the same level. (25%)
4. Consider flow in a wide channel over a bump, as shown in Fig. 3. One can estimate the water-depth change or transition with frictionless flow.
 - (a) Use continuity and the Bernoulli equation to show that (15%)

$$\frac{dy}{dx} = -\frac{dh}{dx} \left(1 - \frac{V^2}{gy}\right)$$

- (b) Explain under what conditions the surface might rise above its upstream position y_0 . (10%)

Fig. 1

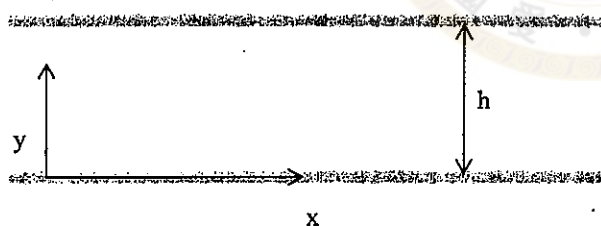


Fig. 3

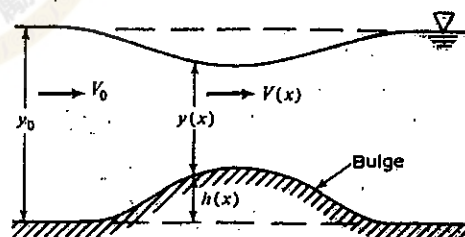


Fig. 2

