1. For the flow of an incompressible fluid, the velocity component in the x-direction is
$u = x^2 + 2y$,
and the velocity component in the z-direction is zero. Find the velocity component v in the y-direction, given v =1 at y = 0. (15%)

2. A 3-inches-wide space between two horizontal plane surfaces is filled with an oil (viscosity = o.oo6 lb sec/ft^2). What force is required to drag a very thin plate of 5 ft^2 area through the oil at a velocity of 30 ft/min if the plate is 1 inch from one surface? (25%)

3. A two-dimensional flow field is given by
$u = y$, $v = 2x$
(a)Plot the flow field (velocity components and streamlines). (10%)
(b) Derive the expression for the acceleration. (10%)

4. Water flows through a 100-ft-long, 9-inches-diameter pipe at 4 cfs. At the entry point, the pressure is 30 psi; at the exit point, 15 ft higher than the entry point, the pressure is 20 psi. Between these two points, find (a) the pipe friction head loss, (20%) (b) the wall shear stress, (5%) (c) the friction force on the pipe. (5%)

$h_f = \frac{4\tau_0 L}{\gamma D}$;
h_f = head loss, L = length, D = diameter of pipe,
τ_0 = shear stress at the wall, γ = specific weight of water = 62.4 lb/ft^3
Acceleration due to gravity (g) =32.2 ft/sec^2

5. Given the following incompressible flow. Determine (a) whether the flow is rotational or irrotational, (8%) (b) the vorticity at point (1, 2, 1). (2%)
$u = \frac{y^3}{3} + 2x - x^2 y$,
$v = xy^2 - 2y - \frac{x^3}{3}$,
$w = 3z$.

試題隨卷繳回