國立成功大學八十三學年度環工所(甲組)碩士班入學考試(流體力學 試題) 共1頁 第1頁

1. A shear stress of 4 dyn/cm$^2$ causes a Newtonian fluid to have an angular deformation of 1 rad/s. What is its viscosity in centipoises? (10%)

2. (1). The two-dimensional stream function for a flow is $\psi = 9 + 6x - 4y + 7xy$. Find the velocity potential. (5%)
   (2). For $q = i(x+y)+j(y+z)+k(x^2+y^2+z^2)$ find the components of rotation at (1,1,1). (10%)

3. What is the pressure at a point 10 m below the free surface in a fluid that has a variable density in kilograms per cubic meter given by $\rho = 450 + ah$, in which $a = 12$ kg/m$^4$ and h is the distance in meters measured from the free surface? (10%)

4. A pump with a shaft input of 7.5 kW and an efficiency of 70 percent is connected in a wastewater carrying 0.1 m$^3$/s. The pump has a 150-mm-diameter suction line and a 120-mm-diameter discharge line. The suction line enters the pump 1 m below the discharge line. For a suction pressure of 70 kN/m$^2$,
   (1). calculate the pressure at the discharge flange ; (5%)
   (2). calculate the rise in the hydraulic grade line across the pump. (5%)

5. What are the proportions $r_0/h$ of a right-circular cylinder of specific gravity S so that it will float in water with end faces horizontal in stable equilibrium? [$r_0$ and h are the radius and the height of this right-circular cylinder, respectively]. (15%)

6. A fluid-flow situation depends upon the velocity V, the density $\rho$, several linear dimensions l, $l_1$, $l_2$, pressure drop $\Delta p$, gravity g, viscosity $\mu$, surface tension $\sigma$, and bulk modulus of elasticity K. Apply dimensional analysis to these variables to find a set of $\Pi$ parameters. (15%)

7. At section 1 of a canal the cross section is trapezoidal, $b_1 = 10$ m, $m_1 = 2$, $y_1 = 7$ m, and at section 2, downstream 200 m, the bottom is 0.08 m higher than at section 1, $b_2 = 15$ m, and $m_2 = 3$, $Q = 200$ m$^3$/s, $n = 0.035$. Determine the depth of water at section 2.
   [Hint: $\Delta L = \dfrac{(V_1^2 - V_2^2)/2g + y_1 - y_2}{S - S_0}$ ]
   (15%)

8. Compute the kinetic-energy correction factors $\alpha$ for laminar flow between fixed parallel plates. (10%)