國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：流體力學【環工所碩士班甲組】

題號：4075

1. A fixed control volume of a stream tube in steady flow has an inlet fluid density ρ_1, cross-sectional area A_1, and velocity $\vec{V}_1$ and an exit fluid density ρ_2, cross-sectional area A_2, and velocity $\vec{V}_2$, as shown in Fig. 1. Determine the net force on the stream tube. (15%)

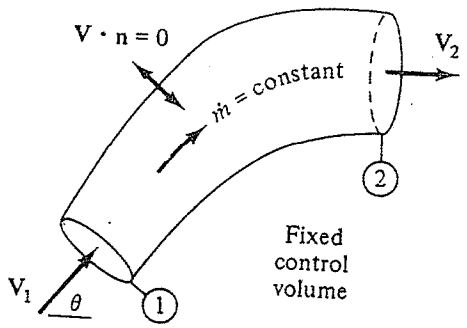

Fig. 1

2. A two-dimensional, steady flow has the velocity component

$$u = U(x^3 - y)$$

where U is a constant. Determine from continuity the velocity component $v(x, y)$. (15%)

3. If the velocity component of a two-dimensional flow in cylindrical coordinates (r, θ) is given by

$$v_r = 0, \quad v_\theta = \frac{\Gamma}{r}$$

where Γ is a constant.

(a) Find the vorticity ω_z (旋量) of the flow, given $\omega_z = \frac{1}{r}\frac{\partial}{\partial r}(r v_\theta) - \frac{1}{r}\frac{\partial v_r}{\partial \theta}$. (15%)

(b) Is the flow rotational (旋轉) or irrotational (不旋轉)? (5%)

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4. A horizontal rectangular clarifier is used for removing suspended particles from the turbid solution. It has a volume of V, cross-sectional area of A, and height of H. Try to determine what the effluent velocity (υ) is for the effluent containing no suspended particles. As an environmental engineer, you are asked to write an equation to express υ in terms of H and residence time (t) for the finest particles to settle out. (20%)

5. An aqueous slurry of fine powdered coal is an example of a fluid exhibiting Bingham plastic behavior, which requires a finite shear stress to initiate flow. Try to draw a figure showing stress-strain rate curves (τ vs. ε) for Newtonian fluids and Bingham plastics. Also try to discuss the relationships between τ/ε and ε for these two types of fluids. (15%)

6. In general, gas phase diffusion through porous media occurs by ordinary and/or Knudsen diffusion. Try to discuss the relationships between the size of pore through which diffusion taking place and above-indicated mechanisms, respectively. (15%)