93學年度國立成功大學 工程科學學系 丁組 流體力學 試題 共 1 頁 第 1 頁
研究所招生考試 戊

1. Explain the following terms: (30%)

(1) Fluid (2) incompressible (3) irrotational
(4) stream line (5) Newtonian fluid (6) creeping motion
(7) Bernoulli equation (8) equation of continuity
(9) d'Alembert's paradox (10) separation point

2. Short answer (20%)

(1) What kind of body can be neutrally buoyant and remain at rest at any point where it is immersed in the fluid?
(2) What's the relationship between stream function and streamlines?
(3) What is the physical meaning of Reynolds number?
(4) What is boundary layer theory?
(5) There are two different kinds of fluid. How do you judge which one has the higher viscosity?

3. Consider a fluid flow inside a tube (fully-developed).

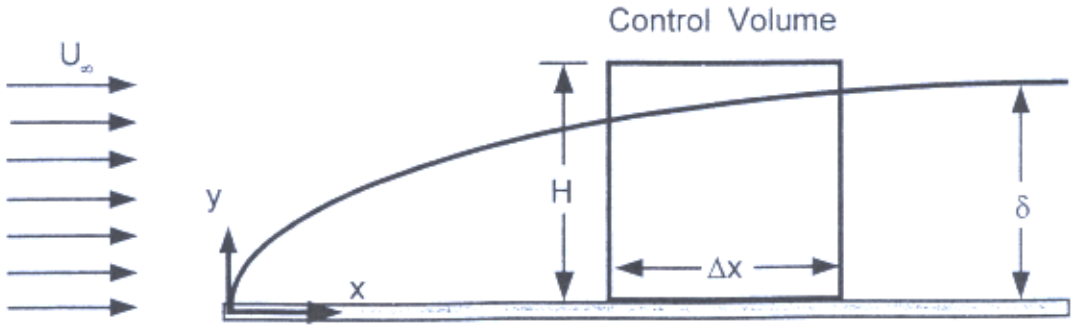
(1) What's the definition or physical meaning of "fully-developed" in the tube flow? (5%)
(2) Derive the velocity distribution of the fully-developed flow. (15%)

Hint: $\rho\left(\frac{\partial v_z}{\partial t}+v_r\frac{\partial v_z}{\partial r}+\frac{v_\theta}{r}\frac{\partial v_z}{\partial \theta}+v_z\frac{\partial v_z}{\partial z}\right)=-\frac{\partial p}{\partial z}+\mu\left[\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial v_z}{\partial r}\right)+\frac{1}{r^2}\frac{\partial^2 v_z}{\partial \theta^2}+\frac{\partial^2 v_z}{\partial z^2}\right]$

4. Consider a steady uniform flow passing over a flat plate, as shown in the following figure.

(1) Derive the (von Kármán's) integral-momentum equation for this problem by using the control volume shown in the following figure. (9%) Hint: U_∞ = constant.
(2) Derive the expression of δ/x, solving the integral equation by assuming (14%)

$$\frac{u}{U_\infty}=a+b\frac{y}{\delta}$$



5. Prove that the equipotential lines are orthogonal to the streamlines. (7%)

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