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國立成功大學九十六學年度碩士班招生考試試題　　共 一 頁，第一頁

編號： 159　系所：工程科學系丁組、乙組　　科目：流體力學

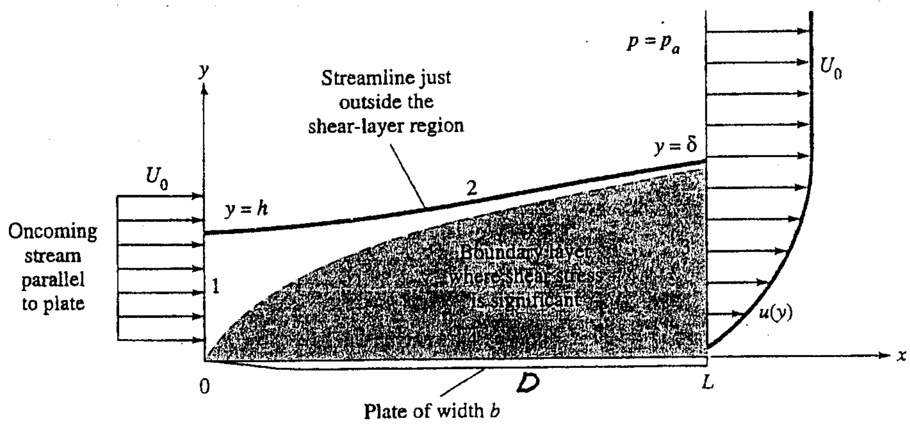
本試題是否可以使用計算機： ☑可使用 ， ☐不可使用 （請命題老師勾選）

1. State and explain the Reynolds Transport Theorem. 15%

2. What is the concept of total time derivative (or substantial derivative) in fluid mechanics? Derivative it for the case of the total time derivative of fluid velocity in Cartesian coordinates. What then are the local acceleration and convective acceleration? 15%

3. Derive the governing equations for a two-dimensional, incompressible potential flow in Cartesian coordinates. How to determine the pressure for this flow? 15%

4. Determine the viscous drag force, D, on a flat plate due to a steady, incompressible boundary layer flow as shown below. Find D in terms of $\rho, U_0, \delta, u, L, and\ b$. 17%



5. The pressure drop due to friction for flow in a long smooth pipe is a function of average flow velocity, density, viscosity, pipe length and diameter: $\Delta p = fcn(V, \rho, \mu, L, D)$. We wish to know how Δp varies with V. Apply the Buckingham pi theorem to rewrite this function in dimensionless form. 15%

6. Given:

$$u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} = -\frac{1}{\rho}\frac{\partial p}{\partial x} + \nu\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}\right)$$

$$u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} = -\frac{1}{\rho}\frac{\partial p}{\partial y} + \nu\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2}\right)$$

$$\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 0$$

Carefully derive the incompressible laminar flat plate boundary layer equations. In this process, show that the boundary layer thickness grows as the square root of the distance from the leading edge. 23%