國立臺北科技大學九十八學年度碩士班招生考試

系所組別：1432 能源與冷凍空調工程系碩士班丙組

第二節　流體力學（選考）試題

注意事項：

1. 本試題共五題，配分共 100 分（即每題 20 分）。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Air flows steadily through a converging–diverging rectangular channel of constant width as shown in Fig. 1. The height of the channel at the exit and the exit velocity are H_0 and V_0, respectively. The channel is to be shaped so that the distance, d, that water is drawn up into tubes attached to static pressure taps along the channel wall is linear with distance along the channel. That is, $d = (d_{max}/L)x$, where L is the channel length and d_{max} is the maximum water depth (at the minimum channel height; $x=L$). Determine the height $H(x)$, as a function of x and the other important parameters.

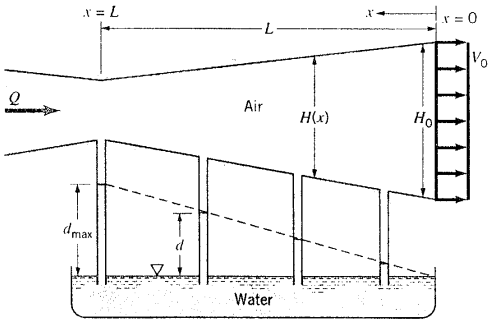

Figure 1

2. The velocity potential

$$\Phi = -k(x^2-y^2) \quad (k\text{=constant})$$

may be used to represent the flow against an infinite plane boundary, as illustrated in Fig. 2. For flow in the vicinity of a stagnation point, it is frequently assumed that the pressure gradient along the surface is of the form

$$\frac{\partial p}{\partial x} = Ax$$

where A is a constant. Use the given velocity potential to show that this is true.

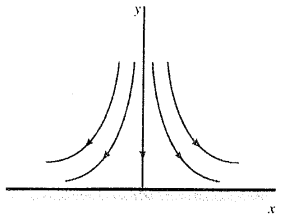

Figure 2

3. The two flat plates shown in Fig. 3 are to have the same drag. Determine the upstream velocity U_b in terms of U_a and n. Assume laminar flow.

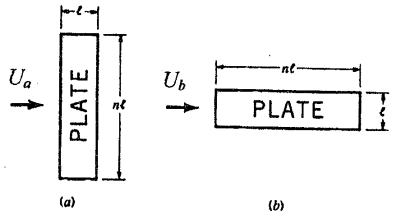

Figure 3

注意：背面尚有試題

4. A fan (see Fig. 4) has a bladed rotor of 12-in. outside diameter and 5-in. inside diameter and runs at 1725 rpm. The width of each rotor blade is 1 in. from blade inlet to outlet. The volume flowrate is steady at 230ft^3/min and the absolute velocity of the air at blade inlet, V_1, is purely radial. The blade discharge angle is 30° measured with respect to the tangential direction at the outside diameter of the rotor. **(a)** What would be a reasonable blade inlet angle (measured with respect to the tangential direction at the inside diameter of the rotor)? **(b)** Find the power required to run the fan. （每小題 10 分）

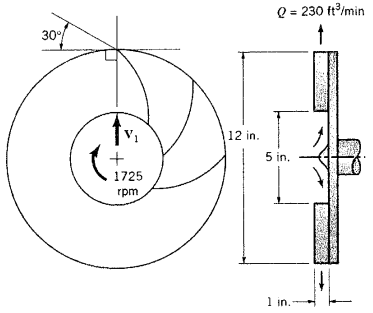

Figure 4

5. An incompressible viscous fluid is placed between two large parallel plates as shown in Fig. 5. The bottom plate is fixed and the upper plate moves with a constant velocity, U. For these conditions the velocity distribution between the plates is linear and can be expressed as

$$u = U\frac{y}{b}$$

Determine: **(a)** the volumetric dilatation rate, **(b)** the rotation vector, **(c)** the vorticity, and **(d)** the rate of angular deformation. （每小題 5 分）

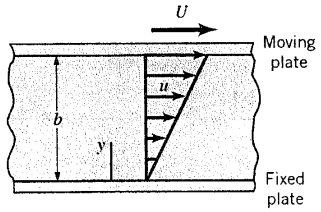

Figure 5