# 991 機械系博士班資格考試題目

| 考試科目 | 方式 | |
|---|---|---|
| 流體力學 | **Closed Book**<br>可使用計算機 | **Part I** |

1. The velocity distribution for laminar flow between parallel plates is given by

$$\frac{u}{u_{max}} = 1 - \left(\frac{2y}{h}\right)^2$$

(10%) where $h$ is the distance separating the plates and the origin is placed midway between the plates. Consider flow of water at 15°C with maximum speed of 0.05 m/s and $h = 5$ mm. Calculate the force on a 0.3 $m^2$ section of the lower plate and give its direction.

$\mu = 1.2 \cdot 10^{-3}$ N·sec/$m^2$

2. Consider the flow field given by $\vec{V} = ax^2y\hat{i} - by\hat{j} + cz^2\hat{k}$, where $a = 1\ m^{-2} \cdot s^{-1}$, $b = 3\ s^{-1}$, and $c = 2\ m^{-1} \cdot s^{-1}$. Determine (a) the number of dimensions of the flow, (b) if it is a possible incompressible flow, and (c) the acceleration of a fluid particle at point $(x, y, z) = (3, 1, 2)$.

(10%)

3. Explain the Physical meaning of "Moody Chart".

(10%)

4. 求解 momentum integral equation

$$\tau_w = \rho U^2 \frac{d}{dx}\left[\int_0^\delta \left(\frac{u}{U}\right)\left(1 - \frac{u}{U}\right)dy\right]$$

(20%) find (1) $\delta$, (2) $\tau_w$, (3) $C_f$, (4) $D$, and (5) $\bar{C}_f$

# 991 機械系博士班資格考試題目

| 考試科目 | 方式 | |
|---|---|---|
| 流體力學 | Closed Book<br>可使用計算機 | Part II |

(1) What is the " vortex"? Please write down the expression of velocity potential and stream function for the vortex motion. Also explain the difference between free vortex and forced vortex. (15%)

(1) Please use Navier-Stokes equations (cylindrical coordinates) to derive the expression for the axial velocity for the flow through a horizontal circular tube with radius R . (assume the flow is parallel to the walls so that $V_r = 0$ & $V_\theta = 0$) (15%)

(2) The pressure drop needed to force water through a horizontal 1-in. diameter pipe is 0.6 psi for every 12-ft length of pipe. Determine the shear stress on the pipe wall. Determine the shear stress at distance 0.3 and 0.5 in. away from the pipe wall. (20%)