博士班資格考流力(A) 4-6-98

1. Explain the Physical meaning of "Moody Chart". (10%)

2. Laminar Boundary Layer, Blasius Equation, $2f''' + ff'' = 0$,
$f \equiv \frac{\psi}{\sqrt{\nu x U}}$, $\eta \equiv y\sqrt{\frac{U}{\nu x}}$, $f' = \frac{u}{U}$
由其 Solution (右表), 求
① boundary layer thickness $\equiv \delta$,
② wall shear stress $\equiv \tau_w$,
③ skin friction coefficient $\equiv C_f$,
④ drag $\equiv D$,
⑤ 平均 $\bar{C}_f$,
(其中 $\psi \equiv$ stream function, $\nu \equiv$ Kinematic viscosity
U = free stream velocity, u = fluid velocity) (20%)

Table The Function $f(\eta)$ for the Laminar Boundary Layer along a Flat Plate at Zero Incidence

$\eta = y\sqrt{\frac{U}{\nu x}}$	f	$f' = \frac{u}{U}$	f''
0	0	0	0.3321
0.5	0.0415	0.1659	0.3309
1.0	0.1656	0.3298	0.3230
1.5	0.3701	0.4868	0.3026
2.0	0.6500	0.6298	0.2668
2.5	0.9963	0.7513	0.2174
3.0	1.3968	0.8460	0.1614
3.5	1.8377	0.9130	0.1078
4.0	2.3057	0.9555	0.0642
4.5	2.7901	0.9795	0.0340
5.0	3.2833	0.9915	0.0159
5.5	3.7806	0.9969	0.0066
6.0	4.2796	0.9990	0.0024
6.5	4.7793	0.9997	0.0008
7.0	5.2792	0.9999	0.0002
7.5	5.7792	1.0000	0.0001
8.0	6.2792	1.0000	0.0000

3. 利用 momentum integral equation, $\tau_w = \rho U^2 \frac{d}{dx}\left[\int_0^\delta \frac{u}{U}\left(1-\frac{u}{U}\right)dy\right]$
用 $u = a+by+cy^2$ (=分佈), B.C.s, $\begin{cases} y=0, u=0 \\ y=\delta, u=U, \frac{\partial u}{\partial y}=0 \end{cases}$
求第2類以上5個變數, 並比較兩者 (20%)

Fluid Mechanics Qualify Exam /4/2009 (B)

(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%)