淡江大學 102 學年度日間部轉學生招生考試試題

系別：航空太空工程學系三年級　　科目：流 體 力 學

考試日期：7 月 24 日(星期三) 第 3 節　　本試題共 5 大題，1 頁

1. Write down the definitions for pressure, force, moment, momentum, and stress. Also fully discuss the relation of pressure and shear stress such as their dimensions, directions, vector or scalar, and their usages in fluid dynamics. (20%)

2. The mass conservation equation has the form: $\frac{\partial \rho}{\partial t} + \nabla \bullet \left(\rho \overline{V}\right) = 0$. Now derive the 3-D incompressible continuity equation in Cartesian coordinates form. (20%)

3. First write down the definition for Reynolds number, explain its physical meaning in details. Also explain its relation to laminar flow, turbulent flow, and flow transition. Why flow could **never** change from turbulent to laminar, and always change from laminar to turbulent? Explain reasons in details. (20%)

4. The frequently used Euler equation is as follow:

$$\rho \frac{\partial \overline{V}}{\partial t} + \rho \overline{V} \bullet \nabla \overline{V} = -\nabla P$$

Please explain the physical meanings of the entire equation and **each term**. Now for a 1-D, steady, and incompressible flow, derive the famous Bernoulli's equation from above equation. (20%)

4. For a 2-D, irrotational, incompressible, X-direction uniform flow, its velocity components in Cartesian coordinates have the form of $u=V_\infty$, $v=0$. Now first prove that these velocity components indeed satisfy both the incompressible and irrotational assumptions, and then also derive its velocity potential expression in Cartesian coordinates. (20%)