淡江大學97學年度碩士班招生考試試題

系別：航空太空工程學系　　科目：流 體 力 學

准帶項目請打「V」	
V	簡單型計算機

本試題共　　頁，　　大題

1. The equation for conservation of mass has the form $\frac{\partial \rho}{\partial t} + \nabla \bullet (\rho \bar{V}) = 0$

   Please make the proper assumption and derive the continuity equation for incompressible flow. (15%)

2. Explain the relationship between the flow streamline and the stream function in details. Why these streamlines can be treated as "solid boundaries"? (10%)

3. Write down the expression for the famous Reynolds number and explain its physical meaning. From the view point of Reynolds number, explain why the water flow from the exit of a water faucet(水龍頭) is changing from a clear and transparent flow to an unsteady and chaotic behavior. (15%)

4. The frequently used Navier-Stokes equation is as follow:

   $$\rho \frac{\partial \bar{V}}{\partial t} + \rho \bar{V} \bullet \nabla \bar{V} = -\nabla P + \mu \nabla^2 \bar{V}$$

   Please explain the physical meanings of the entire equation and each term. (15%)

5. Consider the steady flow of water through a pump such that the upstream pressure is 100kPa and the downstream pressure is 200kPa. The inlet pipe diameter is 30cm and the outlet pipe diameter is 15cm, also the volume flow rate through the system is $0.2m^3/sec$. Neglecting changes in elevation, heat transfer, and losses across the pump, what is the power delivered to the pump? (Hint: water density=$1000kg/m^3$) (15%)

6. For an ordinary low speed flow passing over a long cylinder, sooner or later flow separation will happen and creates a certain amount of pressure drag. (15%)
   (a) Could we use the Bernoulli's equation to explain the generation of pressure drag?
   (b) If the flow is changing from laminar to turbulent, this pressure drag will increase or decrease, why?
   (c) If the body is changing from long cylinder to sphere, the total drag will increase or decrease, why?

7. Determine which of the following functions represents a possible velocity potential (flow is irrotational), and sketch their flow pattern. (15%)
   (a) f=kx3　　k=constant
   (b) f=sin(x+y)