淡江大學八十八學年度碩士班招生考試試題

系別：航空及太空工程學系　　科目：流體力學　　本試題共 / 頁

1. (20%) What's the force driving a balloon up to the sky, and how? Please explain in detail.

2. (20%) Steady, frictionless, and incompressible flow from left to right over a stationary circular cylinder, of radius a, is represented by the velocity field

$$\vec{V} = U[1-(\frac{a}{r})^2]\cos\theta\vec{e}_r - U[1+(\frac{a}{r})^2]\sin\theta\vec{e}_\theta$$

Obtain an expression for the pressure distribution along the streamline forming the cylinder surface, $r = a$. Determine the locations where the static pressure on the cylinder is equal to the freestream static pressure. Evaluate the net pressure force on the cylinder.

3. (20%)The component of velocity in a steady, incompressible flow field in the xy plane is $u = A/x$, where $A = 2$. Show that the simplest y component of velocity for this flow field is $v = Ay/x^2$. Evaluate the acceleration of a fluid particle at point $(x, y) = (1, 3)$.

4. (20%)A sky diver with a mass of 75 kg jumps from an aircraft. The aerodynamic drag force acting on the sky diver is known to be $F_D = kV^2$, where $k = 0.228\ Ns^2/m^2$. Determine the maximum speed of free fall for the sky diver and the speed reached after 100 m of fall.

5. (20%)A plastic toy rocket is propelled by a jet of water forced out the nozzle by compressed air. As a first approximation, assume that the rate at which the water level drops in the rocket chamber is given by $V = V_0 - kt$. The chamber and exit areas are A_c and A_e, respectively. The area ratio is approximately $A_e/A_c = 0.1$. Assume the initial mass of the rocket is M_0 and neglect the mass of the air. Find (a) the velocity of the water at the nozzle exit, (b) the mass of the rocket, M, and the acceleration of the rocket, as functions of time. Hint: Use a different control volume for each calculation.