編號： 123

國立成功大學 107 學年度碩士班招生考試試題

系　　所：工程科學系

考試科目：流體力學

考試日期：0206，節次：2

※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

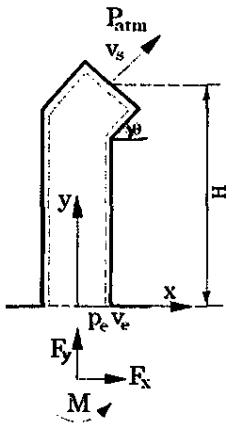
1. [20%] Estimate the pressure at 10000m above the sea level, assuming;

   (i) linearly varying temperatures: $T = -az + T_0$

   (ii) polytropic changes: $p\left(\frac{1}{\rho}\right)^n = const.$

   We may use the ideal gas law for the equation of the state of air: $p = \rho RT$. Considering the specific gas constant R=287 $J/kg \cdot K$. For the above equations, the constants are the lapse rate $a = 0.65 \times 10^{-2}\ K/m$, the standard temperature at sea level which is $T_0 = 288\ K$, the polytropic constant for air is $n = 1.235$ and the standard atmospheric pressure is $p_a = 1.013 \times 10^5\ N/m^2$.

2. [15%] Calculate the force $\boldsymbol{F}(F_x, F_y, F_z)$ and moment $\boldsymbol{M}(M_x, M_y, M_z)$ to hold the nozzle (see the attached figure), which has a constant cross-section S. p_e and v_e are the pressure and flow velocity, respectively, at the cross-section (over the origin of the coordinate). p_{atm} and v_s are the atmospheric pressure and flow velocity, respectively, at the cross-section of the outlet. H is the vertical height.



3. [20%] Explain how one can apply the Bernoulli's theory on the Pitot tube to estimate the flow velocity. Also explain the physical meaning of the stagnation point and its relation to the streamlines. Indicate the position of the stagnation point (around the Pitot tube).

4. [25%] Derive the momentum equation from Newton's second law, $\boldsymbol{F} = m\boldsymbol{a}$. Comment on the relations among the total derivative (also called material derivative), the Lagrangian and Eulerian specifications of the flow field, and the Newton's second law. Derive the Bernoulli's equation from the momentum equation.

5. [10%] Clearly describe how one can estimate the lift and drag coefficients of a moving object in the air flow.

6. [10%] Clearly explain the physical meaning of the Reynolds stress in laminar flow and turbulent flow.