國立成功大學
111學年度碩士班招生考試試題

編　號：143

系　所：環境工程學系

科　目：流體力學

日　期：0219

節　次：第 2 節

備　註：不可使用計算機

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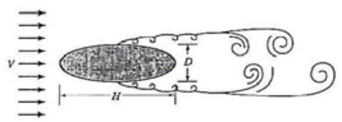
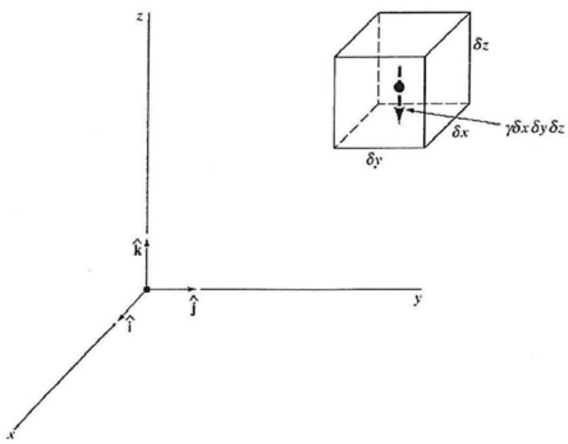
※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Please define the following items:
(1) Fluids (3%); (2) Kinematic viscosity (3%); (3) Specific weight (3%); (4) Reynolds number (3%); (5) Froude number (3%)

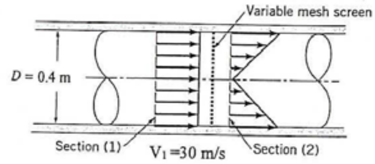
2. A long structural component of a bridge has an elliptical cross section shown below. It is known that when a steady wind blows past this type of bluff body, vortices may develop on the downwind side that shed in a regular fashion at some definite frequency. Since these vortices can create harmful periodic forces acting on the structure, it is important to determine the shedding frequency (ω). For a specific structure of interest, **D** = 0.1 m, **H** = 0.3 m and a representative wind velocity (**V**) is 36 km/h. The shedding frequency is to be determined through the use of a small-scale model that is to be tested in a water tunnel. For the model D_m = 10 mm and the water temperature is 20 °C. (For air at standard condition, $\mu = 1.23\times10^{-5}$ kg m^{-1} s^{-1}, $\rho = 1.23$ kg m^{-3}. For water at 20 °C, $\mu = 1.00\times10^{-3}$ kg m^{-1} s^{-1}, $\rho = 1000$ kg m^{-3}). Please determine
(a) the model dimension (H_m) and the velocity at which the test should be performed. (10%)
(b) What is the corresponding frequency for the prototype if the shedding frequency for the model is found to be 50 Hz. (10%)



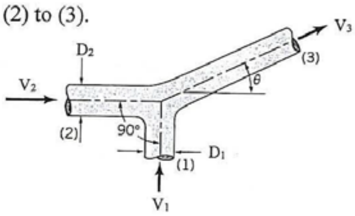
3. Please derive the general equation of motion $-\nabla p - \gamma\hat{\mathbf{k}} = \rho\mathbf{a}$ for a liquid in which there are no shearing stresses. (15%)



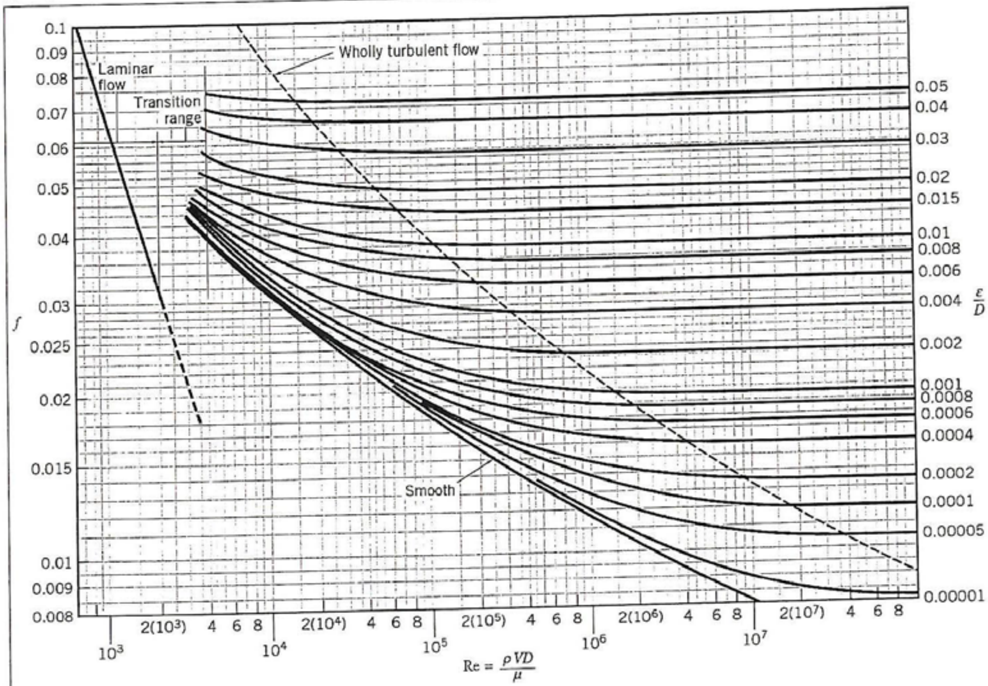
4. A variable mesh screen produces a linear and axisymmetric velocity profile as below in the airflow (density = 1.2 kg/m^3) through a 0.4 m diameter circular cross-sectional duct. The static pressures upstream and downstream of the screen are 1300 Pa and 1000 Pa and are uniformly distributed over the flow cross-sectional area. Neglecting the force exerted by the duct wall on the flowing air, calculate the screen drag force. (20%)



5. Two water (density = ρ) jets collide and form one homogeneous jet as shown below. Gravity is negligible.
(a) Determine the direction (θ) (please express as V_1, V_2, D_1 and D_2) and speed (V_3) (please express as θ, V_1, V_2, D_1 and D_2) (10%)
(b) Determine the loss for a fluid particle flowing from (1) to (3) and (2) to (3).
(please express as ρ, V_1, V_2, V_3, D_1 and D_2) (5%)



6. At a ski resort, water at 4.5°C ($\gamma = 9800\ N\ m^{-3}$, $\nu = 1.58 \times 10^{-6}\ m^2\ s^{-1}$) is pumped through a 0.075 m diameter, 750 m long steel pipe from a pond at an elevation of 1300 m to a snow-making machine at an elevation of 1400 m at a rate of 0.0075 m^3 s^{-1}. If it is necessary to maintain a pressure of 980 kPa at the snow-making machine, determine the power added to the water by the pump. Neglect minor losses. Note that you may use the Moody chart and roughness shown below. (15%)



Equivalent Roughness for New Pipes

Pipe	Equivalent Roughness, ε Millimeters	Equivalent Roughness, ε Feet
Riveted steel	0.9–9.0	0.003–0.03
Concrete	0.3–3.0	0.001–0.01
Wood stave	0.18–0.9	0.0006–0.003
Cast iron	0.26	0.00085
Galvanized iron	0.15	0.0005
Commercial steel or wrought iron	0.045	0.00015
Drawn tubing	0.0015	0.000005
Plastic, glass	0.0 (smooth)	0.0 (smooth)