

國立成功大學

112學年度碩士班招生考試試題

編 號：108

系 所：水利及海洋工程學系

科 目：流體力學

日 期：0207

節 次：第 1 節

備 註：可使用計算機

※ 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. (12%) Please use the formula $\tau = \mu \frac{du}{dz}$ to derive
 - (a) The unit of the dynamic viscosity μ (in SI system). (6%)
 - (b) The unit of the kinematic viscosity ν (in SI system). (6%)
 (PS τ is the shear stress, and u is the velocity)

2. (28%) Consider a small particle of size δs and δn in the plane of Fig. 2, where δy is normal to the figure. Letting \hat{s} and \hat{n} denote unit vectors along and normal to the streamline direction, respectively,
 - (a) Please derive the Bernoulli equation in tangential direction. (10%)
 - (b) Please derive the Bernoulli equation in normal direction. (10%)
 - (c) Which conditions do you need to get the above equations? (8%)

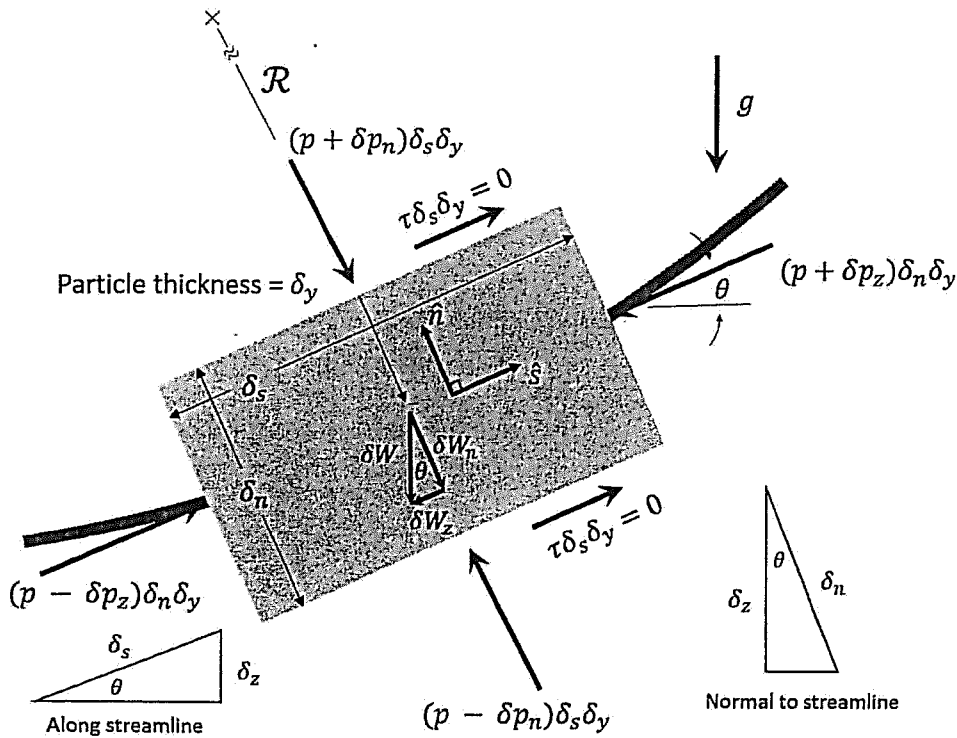


Figure 2

3. (20%) Consider a fully developed horizontal pipe flow of viscosity μ as shown in Fig. 3, where the pressure drop is Δp after a distance L . Please compute
 - (a) The shear stress $\tau(r)$ (PS the wall shear stress is τ_w); (8%)
 - (b) The velocity profile $u(r)$ (PS the diameter of the pipe is D). (12%)

4. Consider a source flow with a strength m and the radial velocity U_r as shown in Fig. 4. Please compute the corresponding velocity potential ϕ and stream function ψ (in m, r and θ). (16%)
5. (24%) A hydraulic (water, $\rho = 1,000 \text{ kg/m}^3$) turbine as shown in Fig. 5, the nozzle angle $\alpha_1 = 60^\circ$ and the inlet rotor tip speed $U_1 = 6 \text{ m/s}$. The ratio of rotor inlet to outlet diameter is 1.8. The absolute velocity leaving the rotor at section is radial with speed $V_2 = 12 \text{ m/s}$.
- Please determine the mass flow rate. (8%)
 - Please compute the transferred power. (8%)
 - Please compute the energy transfer per unit mass. (8%)

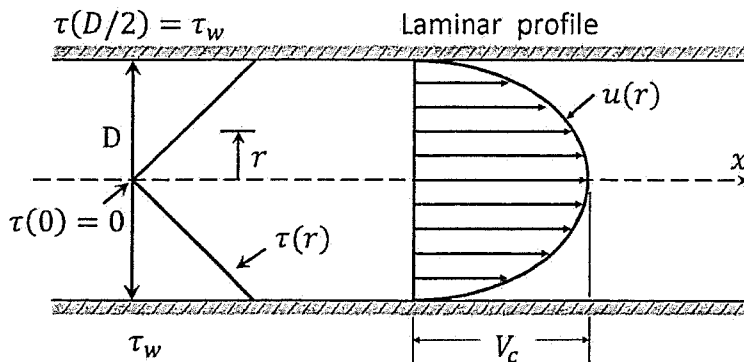


Figure 3

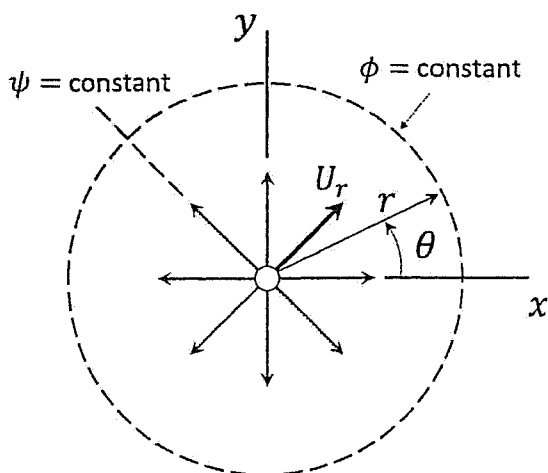


Figure 4

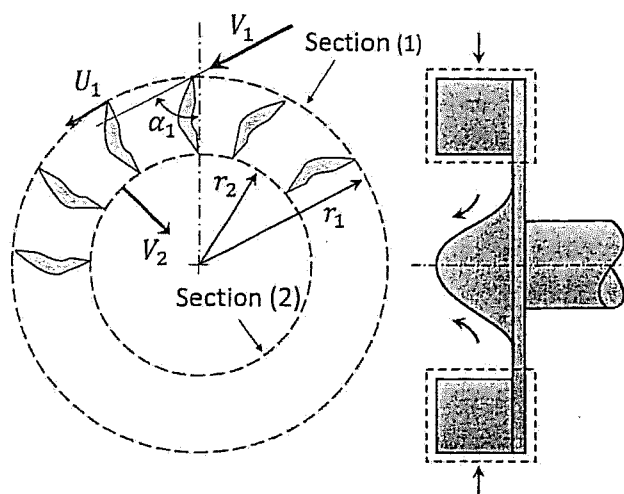


Figure 5