國立成功大學

112學年度碩士班招生考試試題

編　號：120

系　所：工程科學系

科　目：流體力學

日　期：0207

節　次：第 2 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。

15% (1). True (T)/False (F) questions, 1% for each question.

1. If a fluid deforms continuously under a shear stress, then it is a fluid.
2. We define a fluid as a substance that deforms continuously under a normal stress.
3. Conservation of Mass is a basic law of fluid mechanics.
4. The mass of a control volume is constant.
5. The volume of a system is constant.
6. A pathline shows the path of a given fluid particle.
7. A streakline shows the path of fluid particles that pass through a given location.
8. A streamline shows the direction of the fluid flow at a moment in time.
9. A streakline shows the direction of the fluid flow at a moment in time.
10. A streamline shows the path of fluid particles that pass through a given location.
11. In a stationary fluid, the shear stress on a fluid element is zero.
12. The force produced by a shear stress is a body force.
13. The weight of a fluid element is a body force.
14. $\vec{V}$ is a velocity in a flow field, if $\nabla \cdot \vec{V} = 0$, then the fluid density ρ = constant.
15. If ρ = constant then $\nabla \cdot \vec{V} = 0$

    (請在答案卷上將答案依下列方式寫在題號下面)

    (1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15)

15% (2) Explain/answer the following questions: (5 % each)

(a) What is continuum assumption in fluid mechanics?

(b) What is Newtonian Fluid? Why do fluids have viscosity?

(c) Explain why surface tension may exist between air and liquid interface.

20% (3) A small object is tested in a 2D wind tunnel. The object is located and fixed in the center of the tunnel. Assume the flow field is incompressible and steady shown below. The in-flow has uniform velocity V, density ρ and pressure P_1. The out-flow has uniform pressure P_2, linear velocity with zero velocity at center and maximum velocity V_{max} at top and bottom surfaces. Find (a) the maximum velocity V_{max} =? (5%), and (b) the exerted force of the object (15%). Neglect viscous resistance at the tunnel walls.
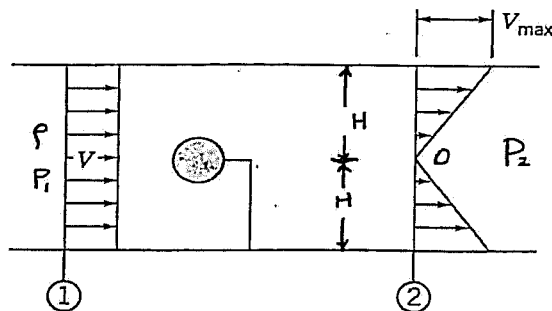
25% (4) In a steady flow field we can draw streamlines and define stream functions ψ. For a **2-D incompressible irrotational flow**, we can also define a potential function φ. (a) Write down the relation between the velocity component (u, v) and the stream function. (5%). (b) Write down the relation between the velocity component and the potential function (5%). (c) Explain the physical meaning for the values difference between two stream functions (5%). (d) Prove that the associated potential lines are orthogonal(正交) to the streamlines. (10%) (Note: use Cartesian coordinate system).

25% (5) For a **steady 2-D incompressible inviscid** fluid flow problem without gravity effect, the x component of velocity in given by u = Ax (A is a constant), the density is ρ. Determine the y velocity component (5%) if u=0 and v=0 at (x=0, y=0) and the pressure is P_o. Calculate the fluid acceleration (5%)and determine the pressure gradient (5%)and pressure (10%) at any (x, y) location. [Use 2-D Euler equations in Cartesian coordinate system to answer this question].