Name _____ ID _____

Prince of Songkla University
Faculty of Engineering

Final Examination **Semester 1/2550**

9 October 2007 **Time 13:30-16:30**

215-342 MECHANICS OF FLUIDS II **Room: A400, A403**

Directions

- **This is close book examination.**
- **A4 is allowed one sheet (2 side) and hand-writing only.**
- **Dictionary is permitted.**
- **Calculator is permitted.**
- Attempt all 5 questions.

Kittinan Maliwan
Juntakan Taweekun

Instructor

Question	Marks	
1	10	
2	15	
3	15	
4	10	
5	15	
Total	65	

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1. Consider the following steady, two-dimensional, incompressible velocity field.

$$\mathbf{V} = (\mathbf{u}, \mathbf{v}) = (ax + b)\,\mathbf{i} + (-ay + c)\,\mathbf{j}$$

Where a, b and c are constants. Is this flow fluid irrotational? If so, generate an expression for the velocity potential function. (10 Marks)

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2. A laminar flow wind tunnel has a test section that is 40 cm. in diameter and 60 cm. in length. The air is 20 °C ($\upsilon = 1.516 \times 10^{-5}$ m^2/s). At a uniform air speed of 2 m/s at the test section inlet, how much will the centerline air speed accelerate by the end of the test section? Define all assumptions. (15 Marks)

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3. An irrotational region of flow is formed by superposing a line source of strength $q_1 = 3$ m^2/s at $(x, y) = (0, -2)$; a line source of strength $q_2 = -2$ m^2/s at $(x, y) = (2, -2)$; and a line vortex of strength $\Gamma = 2$ m^2/s at $(x, y) = (2, 2)$, where all spatial coordinates are in meters. [source number 2 is actually a sink, since q_2 is negative.]. Calculate the fluid velocity at the point $(x, y) = (2, 0)$ and draw the resultant vector. (15 Marks)

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4. Explain the following words **in details** (10 Marks)

4.1 Displacement Thickness (δ^*)

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4.2 Static Pressure

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4.3 Stagnation Pressure

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4.4 Irrotational Flow Region

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5. Air at 20 °C (υ = 1.516 x 10^{-5} m^2/s) flows at V = 11 m/s over a smooth flat plate of length L = 1.52 m. (15 Marks)

5.1 Compute laminar and turbulent boundary layer thickness at the end of a flat plate.
5.2 Calculate local skin friction coefficient ($C_{f,x}$) for two cases at $x = L$
5.3 Plot and compare the growth of the laminar and turbulent boundary in wording (x in x-axis and δ in y-axis)