

# 淡江大學 99 學年度轉學生招生考試試題

系別：航空太空工程學系三年級      科目：流體力學

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本試題共 5 大題，1 頁

1. (20%) Determine which of the following pairs of velocity components  $u$  and  $v$  satisfy the equation of continuity for a 2D incompressible flow.
  - (a)  $u = cx/(x^2 + y^2)$  and  $v = -cy/(x^2 + y^2)$ ,
  - (b)  $u = -cx/y$  and  $v = c \ln(xy)$
 where  $c$  is a constant.
  
2. (20%) Given a 2-D flow field:  $V = x^2y \mathbf{i} - xy^2 \mathbf{j}$   
 Please determine the equation of the streamline passing through the point (3, 2).
  
3. (20%) Given a velocity field:  $V = (3x^2 - 2xy) \mathbf{i} + (y^2 - 6xy + 3yz^2) \mathbf{j} - (z^3 + xy^2) \mathbf{k}$ 
  - (a) Please determine the vorticity of the flow at position (2, 3, 1).
  - (b) Is this a rotational flow? Please show it.
  
4. (20%) Calculate the circulation about the square enclosed by  $x = \pm 1$  and  $y = \pm 1$  in the  $xy$ -plane for the 2-D flow of  $V = u \mathbf{i} + v \mathbf{j}$ , where  $u = 3x^2 + y$  and  $v = -(6xy + x)$   
 [Hint: You can use the equation of circulation (1)  $\Gamma \equiv \oint_C \mathbf{V} \cdot d\mathbf{r}$ , or (2)  $\Gamma = -\iint_S (\nabla \times \mathbf{V}) \cdot d\mathbf{S}$  ]
  
5. (20%) Consider an incompressible, irrotational, two-dimensional flow, where the stream function is  $\psi = 2xy^2$ , please find the velocity potential  $\phi$ .