THE OPEN UNIVERSITY OF SRI LANKA
B.Sc/B.Ed DEGREE PROGRAMME
OPEN BOOK TEST 2004/2005
LEVEL 05- APPLIED MATHEMATICS
AMU 3181/AME 5181 FLUID MECHANICS

DURATION: ONE AND HALF HOURS

Date: 26.01.2006 **Time : 4.00p.m – 5.30p.m**

Answer All Questions.

1. (a) Define the following terms
   (i) irrotational flow
   (ii) incompressible flow

   (b) Determine whether each of the following three velocity vector fields
   - $\underline{u} = v\cos\alpha\,\underline{i} + v\sin\alpha\,\underline{j}$
   - $\underline{u} = (\frac{-ky}{x^2+y^2}, \frac{kx}{x^2+y^2}, 2xy)$
   - $\underline{u} = k\cos\theta(1-\frac{a^2}{r^2})e_r - k\sin\theta(1+\frac{a^2}{r^2})e_\theta$

   represent
   (i) irrotational flow,
   (ii) incompressible flow.
   (a, v and k are constants.)

2. (a) Describe the difference between streamlines and path lines. Which of these is applicable to describe the motion of a paper boat put in water flowing in a stream? Explain your answer.

   (b) A two dimensional flow field is described by the stream function $\psi = x - y^2$
   (i) Calculate the horizontal and vertical component of the velocity.
   (ii) Obtain an expression for velocity of flow at a point (x,y) in the field.

   (c) Determine whether the flow with velocity components in the x,y and z directions given by
   $$u = 2x^2 - xy + z^2$$
   $$v = x^2 - 4xy + y^2$$
   $$\omega = -2xy - yz + y^2$$
   satisfies the continuity equation.

3. (a) In a two dimensional of an incompressible fluid , the velocity components in the x and y directions are

$u = x - 4y$ and

$v = -y - 4x$ respectively.

Show that the velocity potential exits and determine its form. Find the stream function for the above given flow.

(b) The velocity potential of a two dimensional irrotational motion is given by

$$\phi = \frac{k}{2}(y^2 - x^2).$$

Sketch the stream line of this flow.