AC/systems

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The Open University of Sri Lanka
B.Sc/B.Ed Degree Programme
Open Book Test (OBT) 2010/2011
Level 05-Applied Mathematics
AMU 3181/AME 5181 – Fluid Mechanics

Duration :- One and half hours.

Date :- 05-03-2011. **Time:- 4.00 p.m. – 5.30 p.m.**

Answer All Questions.

1. Velocity, in spherical polar coordinates (r,θ,φ), at the point in a fluid is given by $\underline{q}=\left[-U\left(1-\frac{a^3}{r^3}\right)\cos\theta, U\left(1+\frac{a^3}{2r^3}\right)\sin\theta, 0\right]$. Show that this represents a possible motion, and determine the streamlines.

   Verify that the motion is irrotational.

2. With the usual notation, assuming the Euler's equation

$$\frac{\partial U}{\partial t}+\nabla\left(\frac{1}{2}U^2\right)-U\wedge(\nabla\wedge U)=F-\frac{1}{\rho}\nabla P,$$

   show that $\frac{P}{\rho}+\frac{1}{2}U^2-\Omega=\text{Constant}$ along the stream lines. State assumptions you make, if any.

   A stream in a horizontal pipe, after passing a contraction in the pipe at which the sectional area is A, is delivered at atmospheric pressure at a place where the sectional area is B. Show that if a side tube is connected with pipe at the former place, water will be sucked up through it into the pipe from the reservoir at a depth, $\frac{S^2}{2g}\left(\frac{1}{A^2}-\frac{1}{B^2}\right)$, below the pipe, where S is the delivery per second and g is the gravity.

3. Find the components in the two–dimensional motion represented by the stream function $\psi=U\left[y-a\tan^{-1}(y/x)\right]$, verify that the motion is irrotational, and find the velocity potential. Show that the velocity at infinity is U, in the negative Ox–direction.