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THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. Degree Programme

APPLIED MATHEMATICS-LEVEL 05

ADU5306- Fluid Mechanics

OPEN BOOK TEST 2017/2018

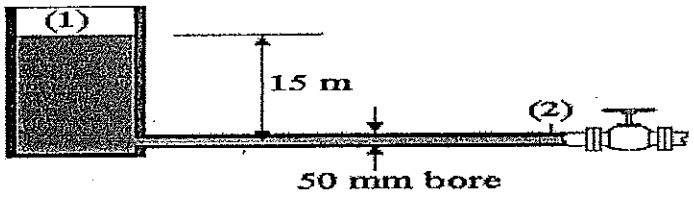
Duration: One Hour

Date: 29.12.2018 Time: **1.00 p.m. - 2.00 p.m.**

Answer **all** questions and also **note that** *standard notation is used throughout the paper.*

1. (a) Given Euler's equation of motion $\underline{\mathbf{F}} - \frac{1}{\rho} grad p = \frac{D\underline{\mathbf{q}}}{Dt}$ for a perfect fluid, show that it can be written in the form $\underline{\mathbf{F}} - \frac{1}{\rho} grad p = \frac{\partial \underline{\mathbf{q}}}{\partial t} + grad\left(\frac{q^2}{2}\right) - \underline{\mathbf{q}} \times curl \underline{\mathbf{q}}$. Hence derive Bernoulli's equation for irrotational motion of an inviscid homogeneous fluid of constant density.

   (b) The diagram shows a tank that is drained by a horizontal pipe. Calculate the pressure head at point (2) when the valve is partly closed so that the flow rate is reduced to $20 dm^3 s^{-1}$. The pressure loss is equal to $2m$ head.



2. (a) Derive the continuity equation of the form $\frac{D\rho}{Dt} + \rho div(\underline{\mathbf{q}}) = 0$, for any arbitrary control volume of a moving fluid irrespective of its shape and size. Hence deduce the continuity equation, for an incompressible fluid in terms of Cartesian coordinates.

   (b) The x-component of velocity in a two dimensional incompressible flow over a solid surface is given by $u = 1.5y - 0.5y^2$, y is measured from the solid surface in the direction perpendicular to it. Verify whether the flow is irrotational; if not, estimate the rotational velocity at $(3,2)$.

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