Universiti Malaysia PAHANG
Engineering • Technology • Creativity

FACULTY OF MECHANICAL ENGINEERING

BMM4783 COMPUTATIOINAL FLUID DYNAMICS

Assignment 1

1. Consider a steady, incompressible, inviscid, and two-dimensional flow that is created by superposition of uniform and doublet flows. The flow can be approximated as laminar flow past a circular cylinder of diameter $D = 2\ m$ as shown in Figure 1. At some point in the flow, the velocity field can be given by the following components in the *xy*-plane:

$$u = \mathrm{U}\left(1 - \frac{R^2\left(y^2 - x^2\right)}{\left(x^2 + y^2\right)^2}\right), \text{ and} \qquad v = -2\mathrm{U}\frac{R^2 xy}{\left(x^2 + y^2\right)^2}$$

where *u*, and *v*, are the *x* and *y* components of the velocity vector, U is the uniform upstream velocity, and *R* is the radius of the cylinder.

   i. Find expressions for acceleration components a_x and a_y along the line (*x*,0). Discuss the results.

   ii. Calculate the acceleration at the point $(x, y) = (-5,0)$ if U is equal to 5 m/s.

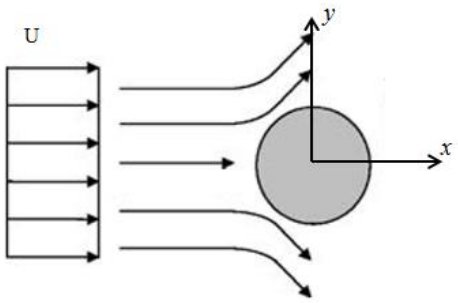

Figure 1: Flow over past a cicular cylinder

2. For fluid flow through a tapered tube, consider a small part of the fluid (section ABCD) as shown in Figure 2. Derive the general two-dimentaional (2D) contnuity equation for the flow, showing full step of each derivation.

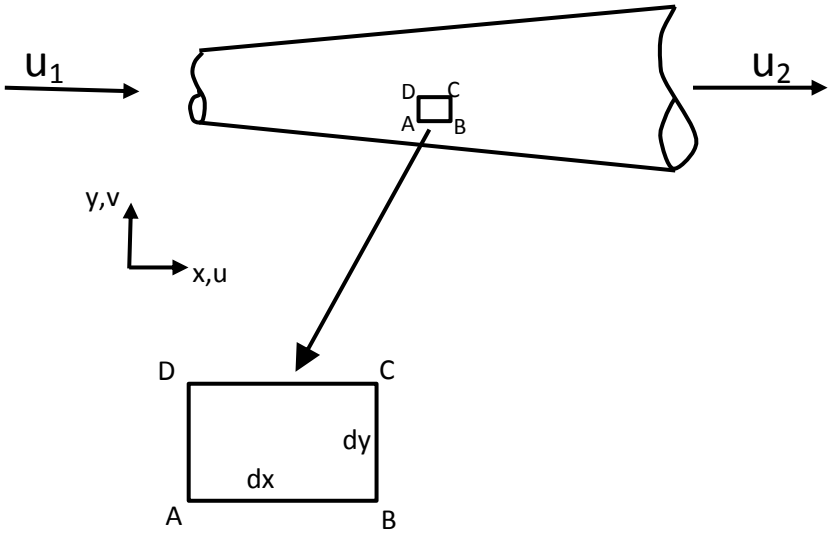

Figure 2: Schematic of fluid flow through a tappered tube