NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONS) DEGREE
Part Two Supplementary Examination August 2007

TCE2105 Fluid Flow

Duration of Examination 3 Hours

Instructions to Candidates:

1. Answer ALL FIVE questions.
2. Each question carries equal marks.
3. Show all steps clearly in your calculation.
4. Start the answers for each question on a new page.

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1. (a) Where does most of the energy loss occur in a Venturi meter and why is this the case?

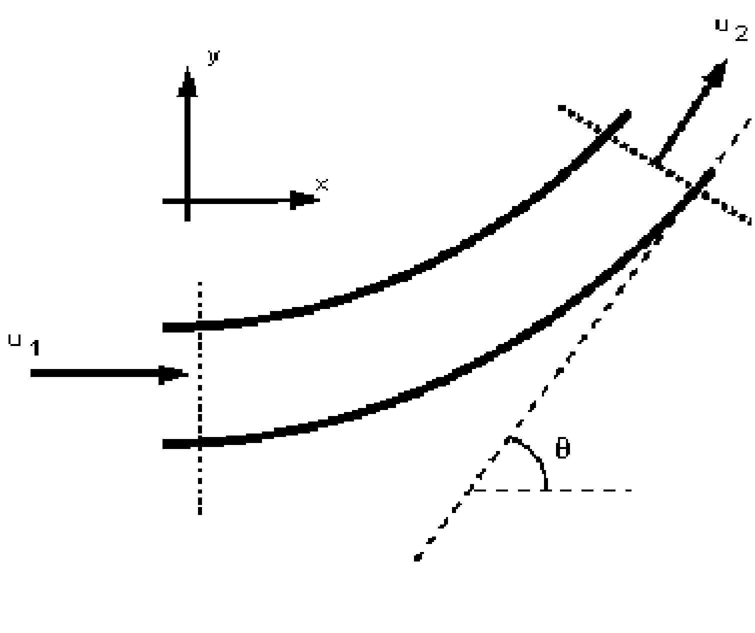
(8 marks)

(b) A Venturi meter is being calibrated in a laboratory. The meter is lying horizontally and has a diameter of 75 mm at the entrance and 50 mm at the throat. The flow rate is obtained by measuring the time required to collect a certain quantity of water. The average number of such measurements gives 0.614 m^3 of water flowing in 55.82 seconds. If the pressure gauge at the throat reads 20 kN/m^2 less than that at the entrance, calculate the head loss due to friction using the Bernoulli equation.

(12 marks)

2. A pipeline of constant 0.6 m diameter with its centre line in the horizontal plane turns through an angle of 75° . The pipeline carries water at the rate of 0.85 m^3/s. A pressure gauge at the bend indicates that the pressure is equivalent to 41.3 m of water. Calculate the force exerted on the bend by the water and the direction it acts.

(20 marks)



3. Explain with a complete description of the mechanisms at work, what is meant by the following phrases.
    a. Laminar flow (5 marks)
    b. Turbulent flow (5 marks)
    c. Boundary layer (5 marks)
    d. Boundary layer separation (5 marks)

4. In an experiment water is flowing over an 80° V-notch - Figure 2 - with a constant head of 0.3 m into a vertical cylindrical tank of diameter 0.5 m.

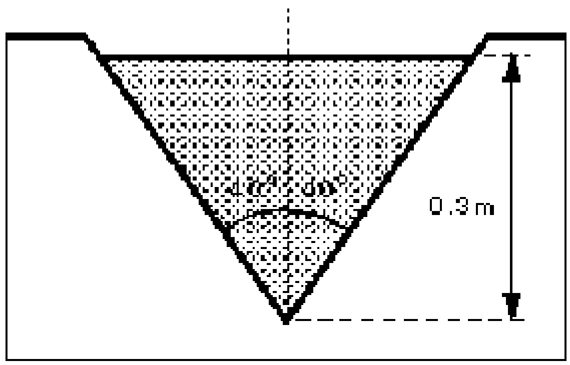


Figure 2

If the level in the tank rises 0.8 m in 20 seconds, deriving all formulae, determine the coefficient of discharge of the notch.

(20 marks)

5. a) 75% sulphuric acid, of density 1650 kg/m^3 and viscosity 8.6 mN.s/m^2, is to be pumped for 0.8 km along a 50mm internal diameter pipe at the rate of 3.0 kg/s, and then raised vertically 15m by the pump. If the pump is electrically driven and has an efficiency of 50%, what is the power required? What type of pump would you use and of what material would you construct the pump and pipe? Take $R/\rho u^2 = 0.004$ (e = 0.046mm) where R is the resistance to flow per unit area of pipe surface.

(15 marks)

b) Describe how an air lift pump works. (5 marks)