THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)
Faculty of Engineering and Technology

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR DEGREE IN BACHELOR OF SCIENCE IN CIVIL ENGINEERING (YR II, SEM II)

ECE 2212: FLUID MECHANICS II

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2011
TIME: 2 HOURS

Instructions to Candidates:
You should have the following for this examination

- *Answer booklet*
- *Mathematical Table/Pocket Calculator*

This paper consists of **FIVE** questions
Answer question **ONE (COMPULSORY)** from **SECTION A** and any other **TWO** questions from **SECTION B**
Maximum marks for each part of a question are clearly shown
This paper consists of **FOUR** printed pages

SECTION A (COMPULSORY)

Question 1 (30 marks)

a) Explain in detail the **FOUR** classifications of orifices (4 marks)

b) A venturimeter is installed in a pipeline carrying water and is 30cm in diameter. The throat diameter is 12.4cm. The pressure in pipeline is 140kN/m^2, and the vacuum in the throat is 37.5cm of mercury. Four percent of the differential head is lost between the gauges. Working from first principles, find the flow rate in the pipeline in *l/s* assuming the venturimeter to be horizontal. (8 marks)

c) A 3m high tank standing on the ground is kept full of water. There is a small orifice in its vertical side with its centre at a depth *h* metres below the free surface of liquid in the tank as shown in figure 1. Find the value of *h* so that the liquid strikes the ground at the maximum distance from

the tank. Assuming c_v, = 0.97. Calculate the maximum value of the horizontal distance (6 marks)

d) A swimming pool 12m long and 7m wide holds water to a depth of 2m. If the water is discharged through an opening of area $0.2m^2$ at the bottom of the pool, find the time required to empty the tank. Take coefficient of discharge for the opening as 0.6 (6 marks)

e) Oil of absolute viscosity $0.15N\text{-}s/m^2$ and density $848kg/m^3$ flows through a 30cm diameter pipe. If the head loss in 3000m length of pipe is 20m, assuming a laminar flow, determine the Reynolds number (6 marks)

SECTION B (Answer any TWO questions from this section)

Question 2 (20 marks)

$$Q = \frac{A_1 A_2}{\sqrt{A_1 - A_2}} \sqrt{2gh}$$

a) Show that, for horizontal venturimeters the discharge Q is given by, , Where A_1 is the area at inlet and A_2 is the area at the throat. (8 marks)

b) A 300mm x 150mm venturimeter is provided in a vertical pipeline carrying oil of specific gravity 0.9, flow being upward. The difference in elevation of the throat section and entrance section of the venturimeter is 300mm as shown in figure 2. The differential U-tube mercury manometer reads 250mm. calculate:
   (i) The discharge of oil (8 marks)
   (ii) The pressure difference between the entrance section and the throat section (4 marks)

(Take coefficient of discharge as 0.98 and specific gravity of mercury as 13.6)

Question 3 (20 marks)

a) Two sharp ended pipes of diameters 50mm and 100mm respectively, each of length 100m respectively, are connected in parallel between two reservoirs which have a difference of level of 10m. If the friction factor for each pipe is 0.32, calculate the rate of flow for each pipe. (6 marks)

b) Two reservoirs are connected by a pipeline which is 150mm in diameter for the first 6m and 225mm in diameter for the remaining 15m. The entrance and exit are sharp and the change of section is sudden. The water surface in the upper reservoir is 6m above that in the lower. Calculate:

(i) The loss of head which occurs (8 marks)
(ii) The rate of flow in m^3/s (6 marks)

Friction coefficient *f* is 0.01 for both pipes

Question 4 (20 marks)

a) Explain briefly how the coefficient of velocity of a jet issuing through an orifice can be experimentally determined (6 marks)

b) Find an expression for head loss in an orifice in terms of coefficient of velocity and jet velocity (4 marks)

c) The head lost in flow through a 50mm diameter orifice under a certain head is 160mm of water and the velocity of water in the jet is 7.0m/s. If the coefficient of discharge is 0.61, determine:

(i) Head on the orifice causing flow (3 marks)

(ii) The coefficient of velocity (3 marks)

(iii) The diameter of the jet (4marks)

Question 5 (20 marks)

a) Derive the Darcy-Weisbach equation for loss of head due to friction in pipes (8 marks)

b) Water is to be supplied to the inhabitants of Mombasa Polytechnic University College through a supply main. The following data is given:

Distance of the reservoir from the campus = 3000m
Number of inhabitants = 4000
Consumption of water per day for each inhabitant = 180 litres
Loss of head due to friction = 18 m
Coefficient of friction for the pipe, f = 0.007

If half of the daily supply is pumped in 8 hours, determine the size of the supply main. (12 marks)