THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

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

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

HIGHER DIPLOMA IN BUILDING & CIVIL ENGINEERING

EBC 3106: 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*
- *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) A venturimeter with a throat diameter of 100mm is connected to a 300mm diameter water pipe. A differential mercury manometer connected to the inlet and throat of the meter reads a deflection of 250mm. If the coefficient of the meter is 0.95, determine the discharge in:
   (i) m^3/s
   (ii) Litres per minute (11 marks)

b) A non uniform pipe gradually tappers from 20cm to 10cm diameter. The average velocity at the 10cm diameter section is 1230 cm/s. Determine:

   (i) The discharge in the pipe in m^3/s
   (ii) The velocity at the 20m diameter section in cm/s (6 marks)

c) A tank has a circular orifice 50mm diameter at a depth of 3m below the constant water level. The jet of water issuing through the orifice is falling down by 540mm in a horizontal distance of 2420mm. If the actual discharge is measured as 1080 litres in 2 minutes, Calculate:

   (i) Coefficient of discharge
   (ii) Coefficient of velocity
   (iii) Coefficient of contraction (13 marks)

SECTION B (Answer any TWO questions from this section)

Question 2 (20 marks)

a) A 200mm diameter orifice plate is installed in a 250mm diameter pipe carrying water. When the flow is 125c/s, the mercury differential gauge reads a deflection of 50mm. Determine the coefficient of the orifice meter (13 marks)

b) A pitot tube is installed in the centre of an 90mm diameter pipe. Water rises in the pitot tube upto a height of 300mm above the centre of the pipe. The coefficient of the pitot tube c = 1. Determine the discharge in the pipe, assuming that the mean velocity in the pipe is 2/3 of the central velocity (7 marks)

Question 3 (20 marks)

a) Define the following terms:
   (i) Steady flow
   (ii) Uniform flow
   (iii) Non uniform flow (6 marks)

b) A rectangular swimming pool 10m long and 5m wide contains water to a depth f 6m. The pool is fitted with an orifice at the bottom whose diameter is 360mm and has a coefficient of discharge cd = 0.6. Determine:

(i) The time required to empty the tank completely through the orifice
(ii) The time required for the water level to fall 3m
(iii) The depth above the bottom to which the water falls in 6 minutes
(iv) The quantity of water discharged in 6 minutes (14 marks)

Question 4 (20 marks)

a) An orifice 1.5m square is provided at the side of a tank. The water level on the upstream side is 1m above the top edge of the orifice and on the downstream side it is 0.5m below the top edge of the orifice. Cd=0.64. Calculate the discharge through the orifice (9 marks)

b) A trapezoidal notch has a base 0.3m long and sides inclined at 30^{o} to the vertical. The head causing flow is 0.16m and the coefficient of the notch 0.62. calculate the discharge over the notch (9 marks)

c) State **ONE** effect of the following on flow over weirs

(i) End contraction
(ii) Velocity of approach (2 marks)

Question 5 (20 marks)

a) Water is siphoned out of a tank by means of a bent pipe ABC 24m long and 25mm diameter. The end A is below the water surface and 150mm above bottom of the tank. The length AB is vertical and 9m long while BC is 15m long with the discharge end c is 1.5m below the bottom of the tank. The atmospheric pressure is 10.3mm of water and the siphon action ceases when the absolute pressure at B is 1.8m of water. The loss of head due to friction is $0.5V^2/2g$ per metre where V= Velocity in the pipe.

25mm

Figure 1

Determine:

(i) The limiting velocity of water in the pipe

(ii) The depth of water in the tank when the siphon action ceases (10 marks)

b) Two reservoirs having a difference in their water levels of 25m are connected by a 0.3m diameter pipe 8000m long. Assuming darcy's f = 0.006, ignoring minor losses, determine:

(i) The velocity in the pipe

(ii) The discharge in the pipe (8 marks)

c) Outline **TWO** ways in which the discharge between the reservoirs in Q5 can be increased (2 marks)