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 AND CIVIL ENGINEERING

EBC 3108 FLUID MECHANICS II

SPECIAL/SUPPLEMENTARY EXAMINATIONS

SERIES: MAY, 2011

TIME: 2 HOURS

Instructions to Candidates:

Attempt Question **ONE** (COMPULSORY) and any other **TWO** Questions correctly.

COMPULSORY (30 MARKS)

Question ONE

(a) Water from a large reservoir is discharged to the atmosphere through a 100mm diameter pipe 450m long. The entry from the reservoir to the pipe is sharp and the outlet is 12m below the surface level in the reservoir. Taking $f = 0.01m$ the Darcy formula. Calculate the discharge. (20 Marks)

(b) The discharge over a rectangular notch is to be $0.14m^3/s$ when the water level is 23cm above the fill. If the coefficient of discharge is 0.6. Calculate the width of the notch required. (5 Marks)

(c) A sharp edged artifice of 50mm diameter discharges water under a head of 4.5m. Calculate the coefficient of discharge if the measured rate of flow is $11.45dm^3/s$. (5 Marks)

ANSWER ANY TWO QUESTIONS FROM THIS SECTION (20 MARKS)

Question TWO

(a) (i) Describe the term normal depth. (1 Marks)

(ii) Give the manning's equation for a normal depth of flow. (4 Marks)

(b) (i) Describe the critical depth for flow in an open channel. (2 Marks)

(ii) Give the equation relation of discharge and area when critical depth occurs. (3 Marks)

(d) A discharge of $4.5m^3/s$ occurs in a rectangular channel 18.3m wide with slope s = 0.002 and m = 0.012.

(i) Calculate the normal depth for uniform flow. (4 Marks)
(ii) Calculate the critical depth. (4 Marks)
(iii) Is the flow subcritical or supercritical? (2 Marks)

Question THREE

(a) Show from first principles that the theoretical rate of flow through a rectangular notch is given by:

$$Q = \frac{2}{3} B(2g)^{1/2} H^{3/2}$$

Where B = width of notch and H = height of the water level above the bottom of the notch. Explain why this expression requires modification in practice. (10 Marks)

(b) (i) Calculate the head loss to be produced by sending $0.5m^3$/min of water a distance of 2000m using commercial steel pipes of diameter 50mm. (5 Marks)

(ii) Calculate also the head loss if the diameter is 100mm. The water temperature is assumed to be 20˚C. Assume $\lambda = 0.026$. (5 Marks)

Question FOUR

(a) Derive a formula for the time of emptying a vertical cylindrical tank through an orifice in the bottom. (15 Marks)

(b) If such a tank is 1.8m diameter and the orifice in the bottom in 50mm diameter. Calculate the initial height of the water above the orifice in order that $2.8m^3$ of water will flow out in 395 seconds. Take C_d for the orifice as 0.6. (5 Marks)

Question FIVE

(a) Describe the significance of the Renolds number. (2 Marks)

(b) When water is running in a round tube of diameter 3cm at a flow velocity of 2m/s. Determine whether the flow is Laminar or Turbulent. Assume that the Kinematic viscosity of water is $1\times10^{-6}.m^2/s$.

(6 Marks)

(c) Assuming that the critical Reynolds number of the flow in a circular pipe in 2320. Calculate the critical velocity when water or air at 20˚C is flowing in a pipe of diameter 1cm.(12 Marks)