JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATIONS 2013/2014

SECOND YEAR FIRST SEMESTER EXAMINATION FOR THE DIPLOMA IN BUILDING AND CIVIL ENGINEERING

TBC 2223: HYDRAULICS II

Date:…….. **Time: 2 hours**

Instructions:

- **Attempt Question One and any Other TWO questions**

QUESTION ONE (30 MARKS)

a. The "velocity-area method" is one the most popular techniques of discharge measurements in large water supply plants. Briefly outline the principles (equations) involved.

(5 Marks)

b. Outline the difference between the following flow measurement devices. Use sketches where appropriate.

i. A small and a large orifice **(3 Marks)**

ii. A venturi meter and a pitot tube **(3 Marks)**

iii. A notch and a weir **(3 Marks)**

c. Show from first principles that the simple theoretical rate of flow, Q, through a rectangular weir is given by;

$Q = \frac{2}{3} C_d b \sqrt{2gh^{3/2}}$; where b=width of the weir, h= height of water level above the bottom of the weir, g=gravitational acceleration, C_d=coefficient of discharge. **(10 Marks)**

d. Outline the Francis formula for discharge through a rectangular notch and its application to a Cipolleti weir. Define all parameters used. **(6 Marks)**

QUESTION TWO (15 MARKS)

a. Outline the various components of head loss within a water pipe system. **(5 marks)**

b. Show that the loss of head due to friction, h_f, is given by;

$h_f = \frac{4fL}{d} \frac{v^2}{2g}$; where f is the resistance coefficient, L length of the pipe, v is the mean velocity of flow, d is the pipe diameter and g the gravitational acceleration.

(7 Marks)

Hence find the loss of head due to friction in a pipe 300m long and 80mm radius when the discharge is 2850 litres/min and the resistance coefficient f=0.01 **(3Marks)**

QUESTION THREE (15 MARKS)

a. Derive an expression for the quantity of discharge/flow over a trapezoidal notch and outline how the final expression relates to that of a V-notch. **(10 Marks)**

b. Use the expression derived in question 3.a above to calculate the head, H, in centimeters above the bottom of a V-notch with a total angle (2θ) equal to 70^o and a discharge of 0.0425 m^3/s. Take coefficient of discharge, C_d, as 0.62. **(5 Marks)**

QUESTION FOUR (15 MARKS)

a. By use of continuity and Bernoulli's equations, derive an expression for the discharge through a horizontal venturi meter. Sketch the set up showing possible position of a monometer and define all parameters used. **(10 Marks)**

b. The diameter of a water pipe is suddenly enlarged from 350 mm to 700 mm. The rate of flow through it is 0.25 m^3/s and the pressure in the smaller pipe is 7.5 N/m^2. Calculate the loss of head in the enlargement **(5 Marks)**

QUESTION FIVE (15 MARKS)

a. With respect to an orifice, briefly explain the following terms; (Use sketches where necessary) **(4 Marks)**
   i. Coefficient of velocity
   ii. Vena contracta

b. A 25 mm diameter nozzle discharges $0.8m^3$ of water per minute when the head is 60m. The diameter of the jet is 22.5 mm. Determine the loss of head due to fluid resistance. **(5 Marks)**

c. Water is contained in a large tank whose surface is open to the atmosphere. The water discharges freely to the atmosphere through an orifice 50 mm in diameter. The Coefficient of Discharge (C_d) of the orifice is 0.62. **(6 Marks)**
   i. What is the discharge if the head is maintained at a constant 2.50 m?
   ii. If the head is reduced by 50% to 1.25 m, what is the % decrease in the discharge?