

**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;
- $$Q = \frac{2}{3} C_d b \sqrt{2gh}^{3/2}; \text{ where } b = \text{width of the weir, } h = \text{height of water level above the bottom of the weir, } g = \text{gravitational acceleration, } C_d = \text{coefficient of discharge.} \quad \mathbf{(10 Marks)}$$
- d. Outline the Francis formula for discharge through a rectangular notch and its application to a Cipolletti 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;

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

(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° and a discharge of $0.0425 \text{ m}^3/\text{s}$. 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 $0.25 \text{ m}^3/\text{s}$ 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)**
- Coefficient of velocity
 - Vena contracta
- b. A 25 mm diameter nozzle discharges 0.8 m^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)**
- What is the discharge if the head is maintained at a constant 2.50 m?
 - If the head is reduced by 50% to 1.25 m, what is the % decrease in the discharge?