TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR DECREE IN:

BACHELOR OF SCIENCE IN CIVIL ENGINEERING (BSCE)

ECE 2212: FLUID MECHANICS II

END OF SEMESTER EXAMINATION
SERIES: APRIL 2015
TIME ALLOWED: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer Booklet*
- *Pocket Calculator*

This paper consists of **FIVE** questions. Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
Use neat, large and well labeled diagrams where required
This paper consists of **THREE** printed pages

Question One (Compulsory)

a) Derive an expression for the discharge through a horizontal venturimeter **(8 marks)**

b) A horizontal venturimeter measures the flow of oil of specific gravity 0.9 in 75mm diameter pipeline. If the difference of pressure between the full bore and throat tapings is 34.5KN/m^2 and the area ratio m is 4, calculate the rate of flow, assuming a coefficient of discharge of 0.97 **(5 marks)**

c) A 300mm by 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. The differential U-tube mercury monomer shows a gauge difference of 250mm. Taking the coefficient of meter as 0.98 and specific gravity of mercury as 13.6, calculate:
(i) The discharge of oil, and;
(ii) The pressure difference between the entrance section and throat section **(11 marks)**

d) Derive from Bernoulli's theorem expression for theoretical velocity and discharge through a small orifice. How does the actual discharge compare with this theoretical value. Explain the reason for their difference. **(6 marks)**

Question Two

a) Derive an equation for the discharge through a large rectangle orifice **(6 mark)**

b) Find the discharge through a rectangular orifice 3.0m wide and 2.0m deep fitted to a water tank. The water level is the tank is 4.0m above the top edge of the surface. Take coefficient of discharge as 0.63 **(3 marks)**

c) A large rectangular orifice 1.5m wide and 1.2m deep is fitted in one side of a large tank. The water level on one side of the orifice is 2m above the top edge of the orifice, while on the other side of the orifice, the water level is 0.4m below its top edge. Calculate the discharge through the orifice if C_d = 0.62 **(6 marks)**

d) A vertical sharp edged orifice 120mm in diameter is discharging water at the rate of 98.2 litres per second under a constant head of 10m. A point on the jet measured from vena contracts of the jet has ordinate 4.5m horizontal and 0.54m vertical. Find:

(i) Coefficient of velocity
(ii) Coefficient of discharge
(iii) Coefficient of contraction **(5 marks)**

Question Three

a) Derive an expression for employing a tank through an orifice at its bottom **(6 marks)**

b) A circular tank of diameter 3m contains water up to a height of 4m, the tank is provided with at the bottom. Assuming coefficient of discharge as 0.6, find the time taken by water:

(i) To fall from 4m to 2m
(ii) For completely emptying the tank **(7 marks)**

c) A horizontal pipe of 250mm diameter suddenly enlarges to 400mm diameter. After some length, it suddenly reduces to 200mm diameter. If the water flowing in the pipe at the rate of 250 litres per second, find:

(i) Loss of head due to sudden enlargement
(ii) Loss of head due to sudden contraction **(7 marks)**

Question Four

a) Define the following types of fluids:

(i) Newtonian fluid
(ii) Non-Newtonian fluid **(4 marks)**

b) Define the following types of flows:

(i) Lamina flow
(ii) Turbulent flow **(3 marks)**

c) An oil having kinetic viscosity of 26.74 stoles is flowing through a pipe of 350mm diameter. Determine the type of flow, if the discharge through the pipe is 25 litres per second . **(4 marks)**

d) A flat plate of area $2.6m^2$ is pulled with a velocity of 0.5m/s relative to another plate located at a distance of 0.32mm from it. Find the force required to maintain this speed, if the soil separating the plates has a viscosity of 2 poise **(4 marks)**

e) An oil of specific weight $10.5KN/m^3$ flows under a head of 7m through 5000m pipe of 400mm diameter. Due to cooling, the viscosity changes along the length and may be taken as 0.166 poise over the first 2500m and 0.332 poise over the second 2500m. Determine the flow of oil through the pipe **(5 marks)**

Question Five

a) A tank has TWO identical orifices in one side of its vertical sides. The upper orifice is 3.0m below the water surface and the lower one is 6.0m below the water surface. If the coefficient of velocity for both orifices is 0.92, calculate the point at which the two jets meet **(6 marks)**

b) An orifice metre consisting of 100mm diameter pipe has coefficient equal to 0.65. The pipe delivers oil of specific gravity 0.8. The pressure difference on the two sides of the mercury plate is measured by a mercury oil differential manometer. If the differential gauge reads 80mm of mercury, calculate the rate of flow **(6 marks)**

c) Derive an expression for measuring a flow of water in a channel by a pitot tube **(3 marks)**

d) An oil of specific gravity of 0.95 is flowing through a pipeline of 200mm diameter at the rate of 50 litres per second. Find the type of flow, if viscosity for the oil is 1 poise **(5 marks)**