**TECHNICAL UNIVERSITY OF MOMBASA**

FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF BUILDING & CIVIL ENGINEERING
**UNIVERSITY EXAMINATION FOR:**
BACHELOR OF SCIENCE IN CIVIL ENGINEERING
**ECE2212 : FLUID MECHANICS**
END OF SEMESTER EXAMINATION
**SERIES:** SEPT 2017
**TIME:** 2 HOURS

**Instructions to Candidates**

You should have the following for this examination
*-Answer Booklet, examination pass and student ID*
This paper consists of five questions.
Answer question ONE (COMPULSORY) and any other TWO questions
**Do not write on the question paper.**

**QUESTION ONE (COMPULSORY)**

a) Define the following terms;
   i) Water hammer
   ii) Laminar flow
   iii) Turbulent flow

(6marks)

b) An orifice meter 100mm diameter is fitted to a 250mm diameter pipe delivering oil of specific gravity of 0.8. The pressure difference on the two sides of the meter is measured by a mercury u-tube manometer which records a deflection of 80mm of mercury. If the coefficient of the meter is 0.65, determine the rate of flow in litres/s (6marks)

c) A tank has an upper cylindrical portion of 3m diameter and 4m high attached to a hemispherical base. A small orifice with an area of $8000mm^2$ and with a $C_d = 0.62$ is provided at the base. Determine the time taken to completely empty the tank. Given that the time taken to completely empty a hemispherical tank , $T = \frac{14\pi R^{\frac{5}{2}}}{15C_d a\sqrt{2g}}$

(6marks)

d) A horizontal pipe 40m long is connected to a tank as shown in fig 1. Both the entry into the pipe and expansion are sudden. Darcy's f=0.01 for both pipes. Determine ;
   i) All the losses
   ii) The discharge

(12marks)

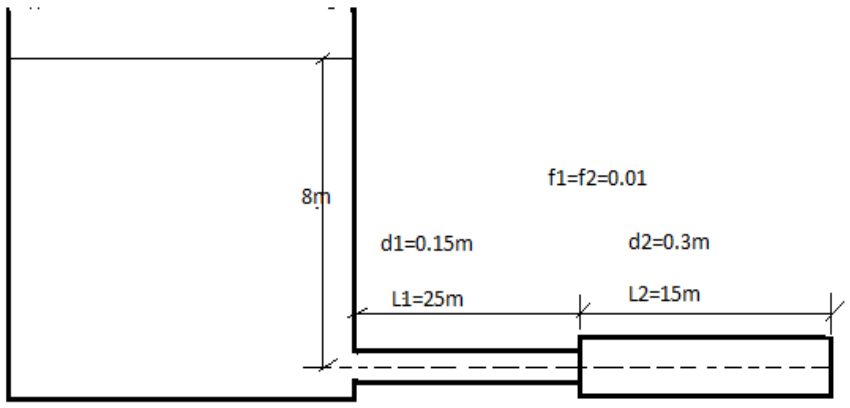


fig 1

**ATTEMPT ANY TWO QUESTIONS**

**QUESTION TWO**

a) A venturimeter with a 150mm diameter inlet and 100mmm diameter throat is laid with its axis horizontal. It is used to measure the flow of oil of specific gravity 0.9. A u-tube mercury manometer connected to the meter shows a deflection of 200mm. if the coefficient of the meter is 0.98, determine the discharge in litres per minute

(6marks)

b) The head of water over an orifice of 100mm diameter is 12m. The water discharging from the orifice is collected in a rectangular tank, 2m x 0.9m. The rise of water level in this tank is 1.2m in 30 seconds. Determine the coefficient of discharge

(4marks)

c) Water is discharging from a tank through a large rectangular orifice 2m wide and 1.2m deep, located on its side. The water level in the tank is 0.6m above the top edge of the orifice and the coefficient of discharge of the orifice is 0.6. determine ;

I. The discharge
II. The error in the discharge if it was treated as a small orifice

(5marks)

d) A 50mm diameter jet moving with a velocity of 30m/s impinges on a flat stationary plate. Determine the normal force on the plate when;

i) The jet is held normal to the plate
ii) The jet is inclined at 60° to the plate

(5marks)

**QUESTION THREE**

a) A 200mm diameter horizontal pipe conveys water under a pressure head of 20m of water. The axis of the pipe turns through 45°, Determine the;

i) Magnitude of the resultant force on the bend
ii) The direction of resultant force on the bend

(14marks)

b) i) With the aid of sketches differentiate an orifice plate from an orifice nozzle
ii) State the main advantage of an orifice nozzle over an orifice plate

(6marks)

**QUESTION FOUR**

a) Oil flows through a 25mm diameter pipe with a mean velocity of0.3m/s. The viscosity of the oil $\mu = 4.8 \times 10^{-3}$kg/ms and the density of oil $\rho = 800kg/m^3$A, determine;
   i) The friction head loss and resultant pressure drop in a 45m length of pipe
   ii) The maximum velocity
   iii) The velocity, 5mm from the pipe wall

(10marks)

b) An oil with a viscosity $\mu = 0.9Ns/m^2$ and a specific gravity of 0.9 is flowing through a horizontal pipe of 60mm diameter. If the pressure drop is $1800KN/m^2 in\ 100m\ length\ of\ pipe$. Given that velocity at any point in a pipe is given by $v = \frac{1}{4\mu}[\frac{D^2}{4} - r^2]\frac{\Delta p}{\Delta l}$ using usual notation,
   Determine;
   i) The rate of flow
   ii) The centre line velocity (max velocity)
   iii) The velocity at 8mm from the pipe wall

(10marks)

**QUESTION FIVE**

a) Water flowing in a certain 200mm diameter pipe becomes turbulent at a velocity of 11.4cm/s. Determine the maximum velocity for flow of air to be laminar in a pipe 40mm diameter of similar construction.
   Assume the following values
   - Viscosity of water $\mu_w$ =$1.12 \times 10^{-3}kg/m/s$
   - Viscosity of air $\mu_a$ =$17.7 \times 10^{-6}kg/m/s$
   - Density of water $\rho_w = 1000kg/m^3$
   - Density of air $= 1.23\ kg/m^3$

(6marks)

b) A rectangular orifice 2m wide and 1.2m deep is fitted on the side of a large tank. The water level on the upstream side is 3m above the top of the orifice, while on the downstream side the water level is 0.5m below the top edge of the orifice. If $C_d = 0.64$ , determine the discharge through the orifice.

(8marks)

c) Define the following terms as used with liquids;
   i) Viscosity
   ii) Compressibility
   iii) Surface tension

(6marks)