NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION

DEPARTMENT OF TECHNICAL AND ENGINEERING EDUCATION AND TRAINING

PTE: 2146 FLUID MECHANICS

Main Examination

November 2024

This examination paper consists of THREE (3) printed pages

Time allowed:	3 hours
Total marks:	100
Special Requirements:	NIL
Examiner:	Mr. A. Sithole
External Examiner:	Dr. Kahanji

INSTRUCTIONS

1. Answer any **FOUR** questions.
2. Sub-division marks are shown in brackets
3. Begin each question on a fresh page and number it.
4. Unless otherwise stated, all dimensions are in millimetres. Dimensions not given are left to your discretion.
5. Credit will be given for accuracy, legibility and neatness.

MARK ALLOCATION

QUESTION	MARKS
1	25 marks
2	25 marks
3	25 marks
4	25 marks
5	25 marks
6	25 marks

Question 1

a) Define the following terms used in connexion with the flow of a liquid:

    i.   Uniform flow   [2marks]

    ii.   Steady flow   [2marks]

    iii.   Unsteady flow   [2marks]

    iv.   Mean velocity   [2marks]

    v.   Discharge   [1marks]

    vi.   Mean flow rate   [1marks]

b) What is meant by continuity of flow and under what conditions does it occurs?

                                                                   [3marks]

c) Oil flows through a pipe line which contracts from 450mm diameter at A to 300mm diameter at B and then forks, one branch being 150mm diameter discharging at C and the other branch 225mm discharging at D. If the velocity at A is 1.8m/s and the velocity at D is 3.6 m/s, what will be the discharges at C and D and the velocities at B and C?   [12marks]

Question 2

a) State the law of conservation of mass   [3marks]

b) Why does the velocity of a gas increases with the increase in temperature while that of a liquid decrease with increase in temperature?   [5marks]

c) State Bernoulli's Theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli equation from first principle and state the assumptions made for such a derivation.   [17marks]

Question 3

a) Define the term Fluid mechanics   [1marks]

b) State any four (4) areas covered in the study of fluid mechanics   [4marks]

c) A 45° reducing bend is connected to a pipe line, the diameters at inlet and outlet of the bend being 600mm and 300mm respectively. Find the force exerted by water on the bend, if the intensity of pressure at the inlet to the bend is 8.829 N/cm^2 and rate of flow of water is 600 litres/second.   [20marks]

Question 4

a) Define the term momentum equation   [1marks]

b) What is the relationship between Bernoulis'equation and Eulers' equation?

[4marks]

c) Determine the dimensions of the following physical quantities.

   i)   Discharge   [2marks]

   ii)   Force   [2marks]

   iii)   Kinematic viscosity   [2marks]

   iv)   Specific weight   [2marks]

d) Water is flowing through a pipe having a diameter 300mm and 200mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is $24.525N/cm^2$ and the pressure at the upper end is 9.81 N/cm^2. Determine the difference in datum head if the rate of flow through is 40 litres/second.

[12marks]

Question 5

a) State and prove Pascal's law of pressure at a point.   [6marks]

b) Define the following terms as used in fluid mechanics.

   i)   Atmospheric pressure   [2marks]

   ii)   Gauge Pressure   [2marks]

   iii)   Absolute pressure   [2marks]

c) A pipe 250m long slopes down at 1 in 100 and tapers from 600mm diameter at highest end to 300mm diameter at lower end and carries 100l/s of oil of specific gravity 0.85. if the pressure gauge at the higher end reads 65KN/m² determine.

   i)   The velocity of flow at the both ends   [3 marks]

   ii)   Pressure at the lower end neglecting losses   [2 marks]

d) With the aid of neat diagrams, discuss the operation of the following mechanical gauges used in pressure measurements

   a. Bourdon gauge   [4marks]
   b. Diaphragm gauge   [4marks]

Question 6

(a) Describe the following structures i) Notch and ii) weir   [4marks]

(b) Explain how a venturimeter operates [6marks]

(c) A horizontal venturimeter with inlet diameter 20cm and throat diameter 10cm is used to measure the flow of water. The pressure at the throat is 30cm of mercury. Find the discharge of water through venturimeter, take coefficient of discharge Cd =0.98 [12marks]

"End of Examination Paper "