



(The University of choice)

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

**UNIVERSITY EXAMINATIONS
2023/2024 ACADEMIC YEAR**

**YEAR TWO SEMESTER TWO EXAMINATIONS
(Main examination)
ODEL**

BACHELOR OF SCIENCE IN FOOD SCIENCE AND TECHNOLOGY

COURSE CODE: APT 201

COURSE TITLE: Transport Phenomena 1

DATE: 23RD April, 2024

TIME: 11:30-2:30 PM

Instructions:

- This paper consists of **5** questions
- Section **A** is **compulsory**, Answer any **2 questions** from **Section B**
- Observe the regulations governing clarity in answering the questions

Question One (25 marks)

- (a) Explain the phenomena of surface tension in a liquid **(3 marks)**
- (b) From first principles, show that for a fluid at rest, the pressure is equal in all directions. State also the assumptions that govern this premise **(5 marks)**
- (c) Distinguish between gauge pressure and absolute pressure **(4 marks)**
- (d) Explain the concept of a fluid being termed as a continuum. What is its advantage **(2 marks)**
- (e) Define the following fluid properties
- i. Mass density
 - ii. Specific weight
 - iii. Relative density
 - iv. Specific volume **(4 marks)**
- (f) Distinguish between dynamic and kinematic viscosity of a fluid **(2 marks)**
With the aid of a diagram, show the behaviour of the following Non-Newtonian fluids
- i. Dilatant
 - ii. Pseudoplastic
 - iii. Plastic
 - iv. Thixotropic
 - v. Rheopectic **(5 marks)**

Question Two (15 marks)

- (a) Distinguish between a system and control volume **(2 marks)**
- (b) Describe the characteristics of the following manometer types
- i. Upright U-Tube manometer
 - ii. Inverted U-Tube manometer
 - iii. Inclined Differential manometer
 - iv. Micro manometer **(6 marks)**
- (c) As shown in figure 1 water flows through pipe A and B. The pressure difference of these two points is to be measured by multiple tube manometers. Oil with specific gravity 0.88 is in the upper portion of inverted U-tube and mercury in the bottom of both bends. Determine the pressure difference. **(4 marks)**



(3 marks)

(a) Explain how cavitation occurs and indicate its disadvantage in fluid conveyance systems **(3 marks)**

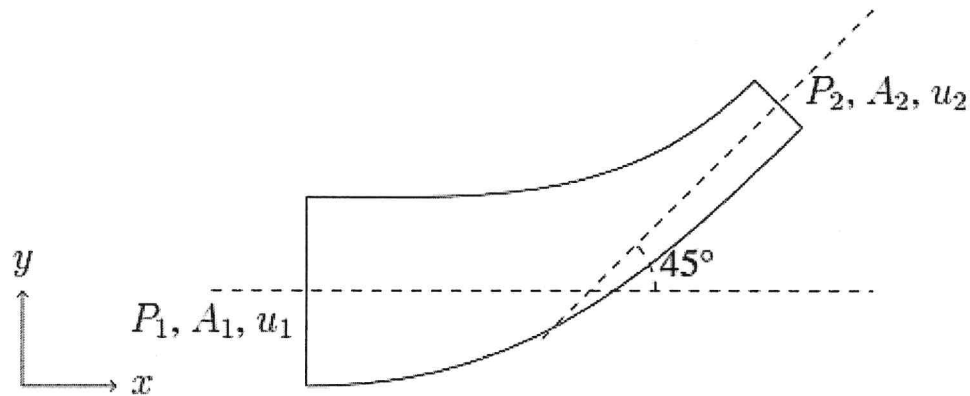
(c) State the Darcy equation give its elements hence state the areas in which it is applicable **(4 marks)**

Question Four (15 marks)

(b) Derive the Bernoulli's equation from first principles and hence state its elements **(6 marks)**

(c) Figure 2 shows a 45° pipe bend with a reducing diameter from 600 mm at the inlet to 300 mm at the outlet. The gauge pressure at the inlet is 140 kPa and the volumetric flowrate of water is $0.425 \text{ m}^3 \text{ s}^{-1}$. As the fluid flows around the bend, it will exert a force which will need to be counterbalanced in order to hold the pipework in place. Ignoring friction forces, and assuming the pipe bends in the horizontal plane, develop an

expression for the magnitude and direction of the force exerted by the fluid on the pipe. **(6 marks)**



Question Five (15 marks)

(a) Describe with the aid of diagrams the following fluid flow measurement devices

- i. Pitot tube
- ii. Venturi
- iii. Orifice plate

(9 marks)

(c) Show that for an orifice plate Q is determined by the expression

$$Q = u_2 A_2 = A_2 \sqrt{\frac{2(\rho_F - \rho) g \Delta h}{\rho \left(1 - \left(\frac{A_2}{A_1} \right)^2 \right)}}$$

(6 marks)