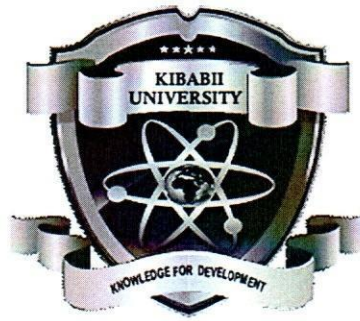# KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF B.SC (RENEWABLE ENERGY AND BIOFUELS TECHNOLOGY)

COURSE CODE: REN 215

COURSE TITLE: BASIC FLUID MECHANICS

DATE: 01/02/2022   **TIME:** 2-4PM

INSTRUCTIONS TO CANDIDATES

TIME: 2 Hours

Answer question ONE and any TWO of the remaining

Question One (Compulsory)

a) Define the following terms.   (4 marks)

    i)   Fluid

    ii)   Fluid mechanics

b) What is meant by the term "no-slip condition".   (2 marks)

c) Define the following properties of fluids.   (4 marks)

    i)   Specific volume

    ii)   Viscosity

d) Distinguish between the following types flows.   (4 marks)

    i)   Laminar and Turbulent Flow

    ii)   Compressible versus Incompressible Flow

e) Define the following terms as used in fluid mechanics.   (4 marks)

    i)   System

    ii)   Control volume

f) State the conservation of mass principle.   (2 marks)

g) State the Bernoulli's equation.   (2 marks)

h) Differentiate between a venturi meter and a pitot tube.   (4 marks)

i) What is Reynold's number and give its significance in fluid mechanics.   (4 marks)

Question Two

a) A garden horse attached with a nozzle is used to fill a 27.854-litre bucket. The inner diameter of the horse is 2cm, and it reduces to 0.8cm at the nozzle exit. If it takes 50 seconds to fill the bucket with water, determine;   (8 marks)

    i)   Volume and mass flow rates of water through the horse.

    ii)   The mean velocity of water at the nozzle exit.

b) Water is flowing through a pipe having diameter 20cm at one end of it A and on the other end B its diameter is 10cm. the rate of flow through the pipe is 35liters/second and section A of the pipe is 6cm above the datum line and at section B it is 4m above the datum. If the

pressure at cross section A is 29.24N/cm2, find out the intensity of pressure at section B.

(12 marks)

Question Three

a) Using a diagrammatic arrangement, describe the flow through an orifice.   (8 marks)

b) Describe the following hydraulic coefficients.   (6 marks)

   i)   Coefficient of velocity

   ii) Coefficient of contraction

   iii) Coefficient of discharge

c) The head of water over an orifice of diameter 40mm is 10m. Find the actual discharge and actual velocity of jet at vena-contracta. Take $C_d = 0.6$ and $C_v = 0.98$.   (6 marks)

Question Four

a) Describe the energy losses that occur in a flow through a pipe.   (4 marks)

b) A pipe 1 m diameter and 15 km long transmit water of velocity of 1 m/sec. The friction coefficient of pipe is 0.005. Calculate the head loss due to friction?   (4 marks)

c) Water flows in a steel pipe (d = 40 mm, k = 0.045x10-3 m, μ = 0.001 k/ms) with a rate of 1 lit/s. Determine the friction coefficient and the head loss due to friction per meter length of the pipe using: (12 marks)

   i) Moody chart

   ii) Smooth pipe formula.

Question Five

a) Water is flowing through a pipe at the end of which a nozzle is fitted. The diameter of the nozzle is 100mm and the head of water at the center of the nozzle is 100m. Find the force exerted by the jet of water on a fixed vertical plate. The coefficient of velocity is given as 0.95.   (8 marks)

b) A jet of water of diameter 50mm strikes a fixed plate in such a way that the angle between the plate and jet is 30°. The force exerted in the direction of jet is 1471.5N. Determine the rate of flow of water.   (12 marks)

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Appendix 1: Moody Chart

Moody chart showing friction factor f versus Reynolds number $Re = \dfrac{\rho V D}{\mu}$ for various relative roughness $\dfrac{\epsilon}{D}$. Regions labelled: Laminar flow, Transition range, Wholly turbulent flow, and Smooth.