US

[*University of Choice*]

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY

[MMUST]

MAIN EXAMINATION

2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE

OF

BACHELOR OF SCIENCE IN MECHANICAL AND INDUSTRIAL ENGINEERING

COURSE CODE: TEM 332

COURSE TITLE: FLUID MECHANICS II

DATE: 21-04-2022 **TIME: 12:00-14:00**

INSTRUCTIONS TO CANDIDATES

1. This paper consists of **FOUR** questions
2. Answer Question **ONE [Compulsory]** and any other **TWO** Questions
3. All symbols have their usual meaning

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over

QUESTION ONE [30 marks]

a] Write Bernoulli's equation in pressure head form, and verify that each of the additive terms in the equation has the SI units of metres. **[6 marks]**

b] State and describe the three necessary conditions for complete similarity between a model and a prototype. **[6marks]**

c] A nozzle that discharges a 60-mm-diameter water jet into the air is on the right end of a horizontal 120-mm-diameter pipe. In the pipe, the water has a velocity of 4 m/s and guage pressure of 400 kPa. Determine the **[i]** magnitude and direction of resultant axial force the water exerts on the nozzle **[ii]** head loss in the nozzle. **[8 marks]**

d] For a pump, explain the difference between brake horsepower and water horsepower, and also define pump efficiency in terms of these quantities **[4 marks]**

e] Write the equation that defines actual [available] net positive suction head NPSH. From this definition, explain any four ways you can decrease the likelihood of cavitation in the pump, for the same liquid, temperature, and volume flow rate. **[6marks]**

QUESTION TWO [20 marks]

Consider the flow of a fluid through a horizontal pipe of circular cross-section. The pressure gradient dP_G [Pressure/Length] is a function of fluid density ρ, flow velocity V, pipe diameter D, surface roughness ε and fluid viscosity, μ. Using the Buckingham Pi Theorem, determine a suitable set of dimensionless parameters [and name them] that can be used in this study. For consistency, choose D, rather than ε as one of the repeating variables **[20 marks]**

QUESTION THREE [20 marks]

a] Water under a guage pressure of 350 kPa flows with a velocity of 5 m/s through a right-angle bend that has a uniform diameter of 250 mm. The bend lies in a horizontal plane and water enters from the west and leaves towards the north. Assuming no drop in pressure, determine the magnitude and direction of the resultant force acting on the bend. **[12 Marks]**

b] Briefly discuss the conservation of momentum principle. What can you say about the momentum of a body if the net force acting on it is zero **[4 marks]**

c] Write the momentum equation for steady one dimensional flow for the case of no external forces and explain the physical significance of its terms. **[4 marks]**

QUESTION FOUR [20 marks]

a] The diameter of the pipe on the discharge side of a pump is 100 mm, and that on the intake side is 120 mm. The pressure guage at the discharge reads 240 kPa and the pressure guage at the intake reads 60 kPa. Given that the flow rate is 45 L/s of water and the pump efficiency is 0.82, determine the power delivered to the pump by the drive shaft. The intake of the pump is 350 mm below the discharge side. **[10 marks]**

b] Explain the primary differences between fans, blowers, and compressors in terms of pressure rise and volume flow rate. **[6 marks]**

c] For a turbine, explain the difference between brake horsepower and water horsepower, and also define pump efficiency in terms of these quantities **[4 marks]**

.....The End.....

General information

Standard acceleration: g= 9.81 m/s^2 *Standard atmospheric pressure*: 1 atm=101.325 kPa= 760 mmHg=10.33 mH_2O

1 bar=**10^5** Pa

Specific gas constant of air: R= 0.287 kJ/kg. K

Universal gas constant: R_U = 8.314 kJ/kmol K

Dynamic viscosity μ: **1** kgm^{-1}s^{-1} = **1** N s m^{-2} = **1** Pa.s

Kinematic viscosity: m^{-2} /s