UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET	
COURSE CODE	: BET1133 / BMT2133
COURSE	: THERMODYNAMIC AND FLUID
SEMESTER/SESSION:	1 – 2024/2025
DURATION	: 3 HOURS

Instructions:

1. This booklet contains **4** questions. Answer **all** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, rise up your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 5 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

a) Explain and give example for each below;

i. Archimedes principle (3 marks)

ii. Hydrometer principle (3 marks)

iii. Pascal's principle (3 marks)

b) Determine the atmospheric pressure at a location where the barometric reading is 740 mm Hg and gravitational acceleration is g = 9.81 m/s2. Assume the temperature of mercury to be 10 °C, at which its density is 13,570 kg/m3. (5 marks)

QUESTION 2

a) Explain and give example for each below;

i. Bernoulli equation (3 marks)

ii. Laminar flow (3 marks)

iii. Turbulence flow (3 marks)

b) Water runs through a water main of cross-sectional area 0.4 m^2 with a velocity of 6 m/s. Calculate the velocity of the water in the pipe when the pipe tapers down to a cross-sectional area of 0.3 m^2. (5 marks)

c) Water enters a typical garden hose of diameter 1.6 cm with a velocity of 3 m/s. Calculate the exit velocity of water from the garden hose when a nozzle of diameter 0.5 cm is attached to the end of the hose. (6 marks)

d) A heavy oil flows in a pipe at average velocity of 10 m/s. If the internal diameter of the pipe is 20cm, determine whether the flow is laminar or turbulent. Take the density of the oil is 930 kg/m^3 and its dynamic viscosity as 1.08×10^{-1} Ns/m^2. (7 marks)

QUESTION 3

a) Define:

i. Zeroth law of thermodynamic and its application (3 marks)

ii. First law of thermodynamic and its application (3 marks)

iii. Second law of thermodynamic and its application (3 marks)

b) Equilibrium deals with thermodynamic system, explain each of the term below:

i. Thermal equilibrium (3 marks)

ii. Mechanical equilibrium (3 marks)

iii. Chemical equilibrium (3 marks)

c) A manometer is used to measure the pressure in a tank. The fluid used has a specific gravity of 0.85, and the manometer column height is 55 cm. if the local atmospheric pressure is 96 kPa, determine the absolute pressure within the tank. (4 marks)

d) A rigid tank contains a hot fluid that is cooled while being stirred by a paddle wheel. Initially, the internal energy of the fluid is 800 kJ. During the cooling process, the fluid loses 500 kJ of heat, and the paddlewheel does 100 kJ of work on the fluid. Determine the final internal energy of the fluid. Neglect the energy stored in the paddlewheel. (7 marks)

QUESTION 4

a) Interpret three (3) mechanisms of heat transfer and give an example of an application for each of it. (9 marks)

b) The hydraulic lift has a large cross section and a small cross section. Large cross-sectional area is 20 times the small cross-sectional area. If the small cross section is given an input force of 25 N, then determine the output force. (5 marks)

c) Consider a 3-m-high, 5-m-wide and 0.3-m-thick wall whose thermal conductivity is k = 0.9 W / (m.℃). On a certain day, the temperature of the inner and the outer surfaces of the wall are measured to be 18 ℃ and 4℃, respectively. Determine the rate of heat loss through the wall on that day. (7 marks)

d) Consider a double wall with the same dimension of 3-m-high, 5-m-wide and 0.3-m-thick and also the same thermal conductivity of k = 0.9 W / (m.℃). On a certain day, the temperature of the inner and the outer surfaces of the wall are measured to be 20℃ and 6℃, respectively. Determine the rate of heat loss through the double wall on that day. (9 marks)

.....END OF QUESTION.....

FORMULA

$$Patm = \rho gh$$

$$\rho = SG\ (\rho H2O)$$

$$P = Patm + \rho gh$$

$$F1/A1 = F2/A2$$

$$P + \frac{1}{2}\rho V^2 + \rho gh = constant$$

$$\rho_1 A_1 V_1 = \rho_2 A_2 V_2$$

$$Re = \frac{\rho VD}{\mu}$$

$$Q - W = \Delta U = U_2 - U_1$$

$$Qwall = \frac{T1 - T2}{Rwall}$$

$$Rwall = \frac{L}{kA}$$