Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER I
SESSION 2020/2021

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	DAM 22003
PROGRAMME CODE	:	DAM
EXAMINATION DATE	:	JANUARY/FEBRUARY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY **OPEN BOOK EXAMINATION**

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) Explain the following matters and give an example each

(i) control mass
(ii) control volume
(iii) first law of thermodynamics
(iv) adiabatic process
(v) isobaric process

(10 marks)

(b) **Figure Q1(b)** showed a river flowing steadily at a rate of 270 m^3/s is considered for hydroelectric power generation. It is determined that a dam can be built to collect water and release it from an elevation difference of 70 m to generate power. [Given: Gravitational acceleration, g =9.81ms^{-2};
Density of water, ρ = 1000 kg/m^{-3}]

(i) calculate the potential energy (PE) of the river water per unit mass (kJ / kg);

(5 marks)

(ii) determine the power generated ($\dot{W}$) from the river water after the dam is filled in *MW* unit.

(5 marks)

Q2 (a) Find the internal energy, $\underline{u}$ (kJ/kg) of water at the given states below for 6 *MPa*

(i) saturated vapour, $\underline{u}_g$
(ii) saturated liquid , u_f
(iii) quality (x) = 0.65
(iv) T = 635 °C
(v) T = 100 °C

(10 marks)

(b) A piston cylinder device has a mass of 10 grams consists an oxygen gas at 100 °C and 20 kPa. The device is then cooled down until the temperature is 0 °C. The pressure of the final state is isobaric.
[Given: Gas constant of oxygen is R = 0.2598 $kJ/kg \cdot K$]

(i) state your assumption

(1 mark)

(ii) determine the change in the device's volume as the result of the cooling.

(9 marks)

Q3 (a) List **four (4)** types of steady flow engineering devices.

(4 marks)

(b) Explain steady state system.

(2 marks)

(c) Steam enters a nozzle at 400°C and 800 kPa with a velocity of 10 m/s, and leaves at 300°C and 200 kPa while losing heat at a rate of 25 kW. For an inlet area of 800 cm^2, determine the velocity at the nozzle exit

(7 marks)

(d) Refrigerant-134a enters a diffuser steadily as saturated vapor at 800 kPa with a velocity of 120 m/s, and it leaves at 900 kPa and 40°C. The refrigerant is gaining heat at a rate of 2 kJ/s as it passes through the diffuser. If the exit area is 80 percent greater than the inlet area, determine the mass flow rate of the refrigerant.

(7 marks)

Q4 (a) Name and draw the schematic diagram for steady state devices based on the function given below:

(i) to transfer heat between one or more fluids which is separated.

(2 marks)

(ii) to cause significant pressure and temperature drop in a fluid.

(2 marks)

(iii) to increases the pressure of a fluid by slowing it down.

(2 marks)

(b) The function of compressor in air conditioning unit is to compress and circulate refrigerant gas throughout the system. Refrigerant-134a (R-134a) enters an adiabatic compressor, as saturated vapor at 24°C and leaves at 0.8 MPa and 60°C. The mass flow rate ($\dot{m}$) of the refrigerant is 1.2 kg/s. Determine:

(i) the power input ($\dot{W}$) to the compressor in kJ/s

(5 marks)

(ii) the volume flow rate ($\dot{v}$) of the refrigerant at the compressor inlet in m^3/s.

(2 marks)

(c) Mixing chamber are devices that mix two streams of fluid with different temperature into one single stream with equilibrium temperature. Liquid water at 300 kPa and 20°C is heated in a chamber by mixing it with superheated steam at 300 kPa and 300°C. Cold water enters the chamber at a rate of 1.8 kg/s. If the mixture leaves the mixing chamber at 60°C, determine:

(i) the enthalpy (h) for cold water, superheated steam and mixture in kJ/kg.

(3 marks)

(ii) the mass flow rate ($\dot{m}$) of the superheated steam required in kg/s

(4 marks)

Q5 (a) Explain difference between heat engine, heat pump and refrigerator based on working principle and function.

(6 marks)

(b) The second law of thermodynamic can be expressed by Kelvin Planck Statement and Clasius Statement. Explain both statement using your own words.

(4 marks)

(c) Refrigerant-134a enters the evaporator coils placed at the back of the freezer section of a household refrigerator at 120 kPa with a quality of 20 percent and leaves at 120 kPa and -20°C. If the compressor consumes 450 W of power and the COP the refrigerator is 1.2, determine

(i) the mass flow rate of the refrigerant

(4 marks)

(ii) the rate of heat rejected to the kitchen air.

(2 marks)

(d) A heat pump used to heat a house runs about one third of the time. The house is losing heat at an average rate of 22,000 kJ/h. If the Coefficient of Performance (COP) of the heat pump is 2.8, determine the power the heat pump draws when running.

(4 marks)

Q6 (a) A system undergoes a process between two fixed states first in a reversible manner and then followed by an irreversible manner.

(i) explain reversible process and irreversible process in term of thermodynamics principle

(7 marks)

(ii) for which case is the entropy change greater? Why?

(2 marks)

(b) Prof Z claims to have invented a newly concept of a heat engine that develops a thermal efficiency of 85 percent when operating between two heat reservoirs at 1000 K and 300 K. Proof and evaluate whether Prof Z claim is true or false.

(4 marks)

(c) A 0.5-m^3 rigid tank contains refrigerant-134a initially at 200 kPa and 40 percent quality. Heat is currently transferred now to the refrigerant from a source at 35°C until the pressure rises to 400 kPa. Determine;

(i) the entropy change of the refrigerant

(5 marks)

(ii) the entropy change of the heat source,

(4 marks)

(iii) the total entropy change for this process.

(3 marks)

- END OF QUESTION –

FINAL EXAMINATION

SEMESTER/SESSION: SEMESTER 1 / 2020/2021 PROGRAMME CODE: DAM
COURSE NAME: FLUID MECHANICS COURSE CODE: DAM 22003

TABLE 1 : PHYSICAL PROPERTIES OF WATER (SI UNITS)

Temperature (°C)	Density, ρ (kg/m³)	Specific Weight[b], γ (kN/m³)	Dynamic Viscosity, μ (N·s/m²)	Kinematic Viscosity, ν (m²/s)	Surface Tension[c], σ (N/m)	Vapor Pressure, p_v [N/m²(abs)]	Speed of Sound[d], c (m/s)
0	999.9	9.806	1.787 E − 3	1.787 E − 6	7.56 E − 2	6.105 E + 2	1403
5	1000.0	9.807	1.519 E − 3	1.519 E − 6	7.49 E − 2	8.722 E + 2	1427
10	999.7	9.804	1.307 E − 3	1.307 E − 6	7.42 E − 2	1.228 E + 3	1447
20	998.2	9.789	1.002 E − 3	1.004 E − 6	7.28 E − 2	2.338 E + 3	1481
30	995.7	9.765	7.975 E − 4	8.009 E − 7	7.12 E − 2	4.243 E + 3	1507
40	992.2	9.731	6.529 E − 4	6.580 E − 7	6.96 E − 2	7.376 E + 3	1526
50	988.1	9.690	5.468 E − 4	5.534 E − 7	6.79 E − 2	1.233 E + 4	1541
60	983.2	9.642	4.665 E − 4	4.745 E − 7	6.62 E − 2	1.992 E + 4	1552
70	977.8	9.589	4.042 E − 4	4.134 E − 7	6.44 E − 2	3.116 E + 4	1555
80	971.8	9.530	3.547 E − 4	3.650 E − 7	6.26 E − 2	4.734 E + 4	1555
90	965.3	9.467	3.147 E − 4	3.260 E − 7	6.08 E − 2	7.010 E + 4	1550
100	958.4	9.399	2.818 E − 4	2.940 E − 7	5.89 E − 2	1.013 E + 5	1543