Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	THERMODYNAMICS
COURSE CODE	:	DAK 10603 / DAK 20703
PROGRAMME	:	DAK
EXAMINATION DATE	:	DECEMBER 2019/JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) Thermodynamic is the science of energy that concerned with the ways in which energy is stored within a body.

(i) State the Zeroth Law of Thermodynamics.

(2 marks)

(ii) List **three (3)** examples of various application of thermodynamic in real life.

(3 marks)

(b) Describe the phase change process of pure substances exist in many practical situations of thermodynamic application.

(5 marks)

(c) A 0.5 m^3 rigid tank containing H_2O at 20 °C and 150 kPa is connected by a valve to another 0.5 m^3 rigid tank that hold H_2O at 150 °C and 400 kPa. Now the valve is opened and the system is allowed to reach thermal equilibrium with the surrounding, which are at 15 °C.

(i) Determine the final pressure in the tank.

(9 marks)

(ii) Analyzed the phase of H_2O at final state.

(1 mark)

Q2 (a) Work is the energy transfer associated with a force acting through a distance.

(i) Define the net work for a cycle process.

(2 marks)

(ii) List **two (2)** types of common process, which involve a work done.

(2 marks)

(b) Distinguish the function of mixing chamber and heat exchanger in terms of thermodynamic system.

(6 marks)

(c) Steam at 5 MPa and 400 °C enters a nozzle steadily with a velocity of 80 m/s, and it leaves at 2 MPa and 300 °C. The inlet area of the nozzle is 50 cm^2, and heat is being lost at a rate of 120 kJ/s. Calculate the exit area of the nozzle in m^2.

(10 marks)

Q3 (a) Define the terms of heat capacity and specific heat along with its unit.

(4 marks)

(b) Distinguish between standard heat of formation and standard heat of reaction.

(4 marks)

(c) One of the most studied chain reaction is that between hydrogen and bromine as the following equation:

$$H\,(g) + Br\,(g) \longrightarrow HBr\,(g)$$

Given the following information.

$H_2\,(g) \longrightarrow 2\,H\,(g)$	$\Delta H^o = 436.4$ kJ
$Br_2\,(g) \longrightarrow 2\,Br\,(g)$	$\Delta H^o = 192.5$ kJ
$H_2\,(g) + Br_2\,(g) \longrightarrow 2HBr\,(g)$	$\Delta H^o = -72.4$ kJ

(i) Calculate the ΔH^o for the following reaction.

(10 marks)

(ii) Determine the heat evolve when 15 g of hydrogen react with bromine gas during the process.

(2 marks)

Q4 (a) The heat engine that operates on the reversible Carnot cycle is called the Carnot Heat Engine.

(i) List **four (4)** reversible processes that makeup the Carnot cycle.

(4 marks)

(ii) Explain each reversible process mentioned in **Q4 (a) (i)**.

(4 marks)

(b) A refrigerator is to remove heat from the cooled space at a rate of 300 kJ/min to maintain its temperature at –8 °C. If the air surrounding the refrigerator is at 25 °C, determine the minimum power input required for this refrigerator in kW.

(7 marks)

(c) Carnot heat engine receives 650 kJ of heat from a source of unknown temperature and rejects 250 kJ of it to a sink at 24 °C. Calculate the thermal efficiency of the heat engine.

(5 marks)

Q5 (a) List the purpose of the Second Law of Thermodynamics, which commonly used in engineering systems.

(3 marks)

(b) A rigid tank consist of a steam heating system has a volume of 20 L and is filled with superheated water vapor at 200 kPa and 150 °C. At this moment both the inlet and the exit valves to the tank are closed. After a while the temperature of the steam drops to 40 °C as a result of heat transfer to the room air. Determine the entropy change (kJ/K) of the steam during this process.

(7 marks)

(c) Air enters an adiabatic turbine at 800 °C and 1.5 MPa at a rate of 1.34 kg/s and exhausts at 200 kPa. If the power output of the turbine is 700 kW, calculate the isentropic efficiency (in percent) of the turbine. Given k = 1.667.

(10 marks)

-END OF QUESTIONS-

FINAL EXAMINATION

SEMESTER/SESSION : I/2019/2020 PROGRAMME : DAK

COURSE NAME : THERMODYNAMICS COURSE CODE : DAK 10603 / DAK 20703

List of formulas and equations

$$(\frac{Q_H}{Q_L})_{rev}=\frac{T_H}{T_L}$$

$$\eta_{th\ rev}=1-\frac{T_H}{T_L}$$

$$\eta_{th}=\frac{W_{net,out}}{Q_{in}}$$

$$\left(\frac{T_2}{T_1}\right)_{s=const.}=\left(\frac{v_1}{v_2}\right)^{k-1}$$

$$\left(\frac{T_2}{T_1}\right)_{s=const.}=\left(\frac{P_2}{P_1}\right)^{(k-1)/k}$$

$$COP_R=\frac{Q_L}{W_{net,in}}=\frac{Q_L}{Q_H-Q_L}$$

$E_{in} - E_{out} = \Delta E_{system}$

$Q-W= \Delta U$

$\dot{m}=\frac{1}{v}(\mathcal{V}A)$

$W=\dot{W}\Delta t$

$PV=mRT$

$$COP_R=\frac{1}{(T_H/T_L)-1}$$

$$COP_{HP}=\frac{Q_H}{W_{net,in}}=\frac{Q_H}{Q_H-Q_L}$$

$W=VI\Delta t$

$Q-W= \Delta U +\Delta KE +\Delta PE$

$$W = P_1V_1 \ln\frac{V_2}{V_1}$$

$\Delta U = U_2 - U_1 = C_v (T_2-T_1)$

$\Delta H = H_2 - H_1 = C_P (T_2-T_1)$

$$\dot{W}_{in}=\dot{m}(h_2-h_1)$$

$$\dot{W}_{out}=\dot{m}(h_1-h_2)$$

$$q_{net}-w_{net}=\left(u_2-u_1+\frac{V_2^2-V_1^2}{2}+\frac{g(z_2-z_1)}{1}\right)$$

$$\left(h_1+\frac{V_1^2}{2}\right)=\left(h_2+\frac{V_2^2}{2}\right)$$