UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(TAKE HOME)
SEMESTER I
SESSION 2020/2021

COURSE NAME	:	THERMODYNAMCS
COURSE CODE	:	BNJ 20703
PROGRAMME CODE	:	BNM
EXAMINATION DATE	:	JANUARY/FEBRUARY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS **OPEN BOOK EXAMINATION**

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

Q1 (a) Give **TWO (2)** statements of adiabatic process apply in thermodynamics system.
(4 marks)

(b) The absolute pressure in water at a depth of 5 m is read to be 145 kPa. Determine:

(i) the local atmospheric pressure, and
(3 marks)

(ii) the absolute pressure at a depth of 5 m in a liquid whose specific gravity is 0.85 at the same location.
(3 marks)

(c) A water jet that leaves a nozzle at 60 m/s at a flow rate of 120 kg/s is to be used to generate power by striking the buckets located on the perimeter of a wheel. Determine the power generation potential of this water jet
(5 marks)

(d) The water in a large lake is to be used to generate electricity by the installation of a hydraulic turbine-generator at a location where the depth of the water is 50 m as shown in **Figure Q1 (d).** Water is to be supplied at a rate of 5000 kg/s. If the electric power generated is measured to be 1862 kW and the generator efficiency is 95 percent, determine

(i) the overall efficiency of the turbine-generator,
(6 marks)

(ii) the mechanical efficiency of the turbine, and
(2 marks)

(iii) the shaft power supplied by the turbine to the generator.
(2 marks)

Q2 (a) A steam turbine operate at steady and adiabatic condition. The inlet steam are 5000 kPa, 573.15 K and 90 m/s. meanwhile for the exit conditions are 60 kPa, 85% quality and 55 m/s. Give the steam mass flow rate is 25 kg/s.

(i) Calculate the change of kinetic energy.
(6 marks)

(ii) Determine the power output in unit of MW.
(4 marks)

(iii) Calculate the turbine inlet area.
(3 marks)

(iv) Calculate the turbine exit area.

(4 marks)

(b) Carbon dioxide enters an adiabatic compressor at 100 kPa and 300 K at a rate of 0.5 kg/s and leaves at 600 kPa and 450 K. By neglecting kinetic energy changes,

(i) Calculate the volume flow rate of the Carbon Dioxide at the compressor inlet.

(4 marks)

(ii) Determine the power input to the compressor.

(4 marks)

Q3 (a) A household refrigerator with a COP of 1.7 removes heat from the refrigerated space at a rate of 80 kJ/min.

(i) Calculate the electric power consumed by the refrigerator in kW.

(4 marks)

(ii) Calculate the rate of heat transfer to the kitchen air in kW.

(4 marks)

(iii) Construct the refrigerator systems.

(5 marks)

(iv) Briefly, describe how refrigerator systems work.

(5 marks)

(b) Refrigerant-134a enters the condenser of a residential heat pump at 800 kPa and 35°C at a rate of 0.018 kg/s and leaves at 800 kPa as a saturated liquid. If the compressor consumes 1.2 kW of power.

(i) Calculate the COP of the heat pump.

(4 marks)

(ii) Calculate the rate of heat absorption from the outside air.

(3 marks)

Q4 (a) Draw a *P-v* diagram of a Carnot cycle, label accordingly and indicate the heat in (Q_{in}), heat out (Q_{out}) and net work done ($W_{net,\ out}$) during the process of Carnot cycle.

(5 marks)

(b) A Carnot heat engine receives heat at 1000 K and rejects the waste heat to the environment at 30°C. The entire work output from the heat engine is used to drive a Carnot refrigerator as shown in **Figure Q4 (b).** The refrigerator operates by removing heat from cooled space at -10°C, at a rate of 280 kJ/min and rejects the heat to the same environment at same temperature.

(i) Calculate the rate of heat supplied to the heat engine.

(10 marks)

(ii) Determine the total rate of heat rejection to the environment.

(10 marks)

– END OF QUESTIONS –

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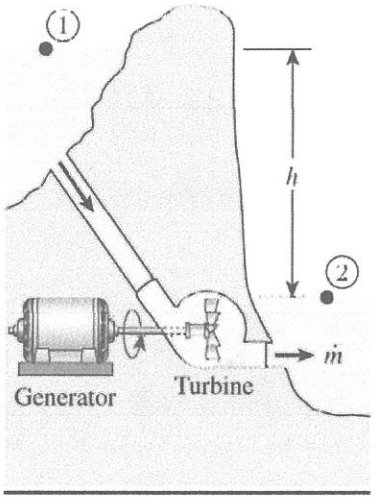

Figure Q1 (d)

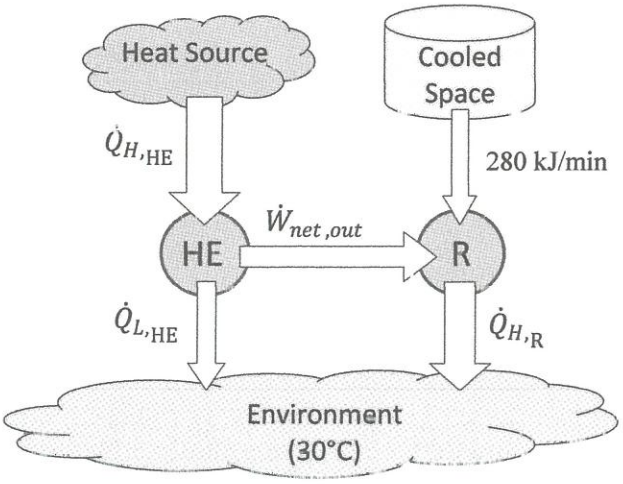

Figure Q4 (b)