UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER I
SESSION 2020/2021

COURSE NAME	:	THERMODYNAMICS I
COURSE CODE	:	BDA 20703
PROGRAMME	:	BDD
EXAMINATION DATE	:	JANUARY/FEBRUARY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	**PART A**: ANSWER **TWO (2)** QUESTIONS **ONLY** FROM **THREE (3)** QUESTIONS. **PART B**: ANSWER **ALL** QUESTIONS. **ONLINE EXAMINATION**

THIS QUESTION PAPER CONSISTS OF SEVEN (7) PAGES

PART A: ANSWER TWO (2) QUESTIONS ONLY FROM THREE (3) QUESTIONS.

Q1 (a) Assuming a bathtub is filled with water to the limit at a certain temperature and pressure, how would you describe the state of the water inside the bathtub? And how would you explain the process that the water experiences as it cools to the ambient?

(5 marks)

(b) The temperature of a system drops by 45°F during a cooling process. Express this drop in temperature in K, R, and °C.

(6 marks)

(c) A cylinder contains 3 kg of water and water vapor mixture in equilibrium at a pressure of 500 kN/m^2. The volume of the cylinder is 1 m^3. Calculate:

(i) The temperature of the mixture;

(ii) The volume and mass of water; and

(iii) The volume and mass of vapor.

(14 marks)

Q2 (a) Describe the physical significance of h_{fg}. Explain briefly how it can be obtained from a knowledge of h_f and h_g.

(4 marks)

(b) A group of students founded that a type of sponge can act as a spring. The spring constant for the sponge is equal to 3 kN/m. The sponge then fitted in a big piston-cylinder device, as in **Figure Q2 (b).** Initially, the sponge loaded piston-cylinder fill with 0.7 kg of saturated liquid-vapor water whose temperature is 98°C whose quality is 75%. The piston diameter, D is 40 cm. The water undergoes a process that increases in volume by 24%.

(i) Find the final temperature;

(ii) Determine the enthalpy of the water.

(21 marks)

Q3 (a) Describe what is meant by a quasi-equilibrium process and explain why it is used?

(5 marks)

(b) Air enters an adiabatic nozzle steadily at 300 kPa, 200°C, and 1.8 km/min and leaves at 100 kPa and 10.8 km/min, as shown in **Figure Q3 (b)**. The inlet area of the nozzle is 80 cm^2. Determine:

(i) The mass flow rate through the nozzle;

(ii) The exit temperature of the air;

(iii) The exit area of the nozzle.

(10 marks)

(c) An adiabatic gas turbine, as shown in **Figure Q3 (c)** expands air at 1000 kPa and 500 to 100 kPa and 150. Air enters the turbine through a 0.2 m^2 opening with an average velocity of 40 m/s and exhausts through a 1 m^2 opening. Determine:

(i) The mass flow rate of air through the turbine;

(ii) The power produced by the turbine.

(10 marks)

PART B: ANSWER ALL QUESTIONS.

Q4 (a) Describe briefly the four (4) processes that make up the Carnot cycle. Illustrate and label the process of the Carnot cycle on a P-v diagram.

(4 marks)

(b) It is well established that the thermal efficiency of a heat engine increase as the temperature T_L at which heat is rejected from the heat engine decrease. In an effort to increase the efficiency of a power plant, somebody suggests refrigerating the cooling water before it enters the condenser, where heat rejection takes place. In your opinion, is this a good or bad idea? Explain why?

(4 marks)

(c) A complete reversible heat engine operates with a source at 800 K and a sink at 280 K. At what rate must heat be supplied to this engine, in kJ/h, for it to produce a 4 kW of power.

(4 marks)

(d) 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, determine:

(i) The COP of the heat pump and;

(ii) The rate of the heat absorbed from the outside air.

(13 marks)

Q5 (a) A system undergoes a process between two fixed states first in a reversible manner and then in a reversible manner. For which case is the entropy change is greater? Explain why?

(4 marks)

(b) Is an isothermal process necessarily internally reversible? Explain your answer with an example.

(6 marks)

(c) Steam at 6000 kPa and 500°C enters steady-flow turbine. The steam expands in the turbine while doing work until the pressure is 1000 kPa. When the pressure is 1000 kPa, 10% of the steam is removed from the turbine for other uses. The remaining 90% of the steam continues to expand through the turbine while doing work and leaves the turbine at 10 kPa. The entire expansion process by the steam through the turbine is reversible and adiabatic.

(i) Sketch the process on a T-s diagram with respect to the saturation line;

(ii) If the turbine has an isentropic efficiency of 85% what is the work done by the steam as it flows through the turbine per unit mass of steam flowing into the turbine?

(15 marks)

– END OF QUESTION –

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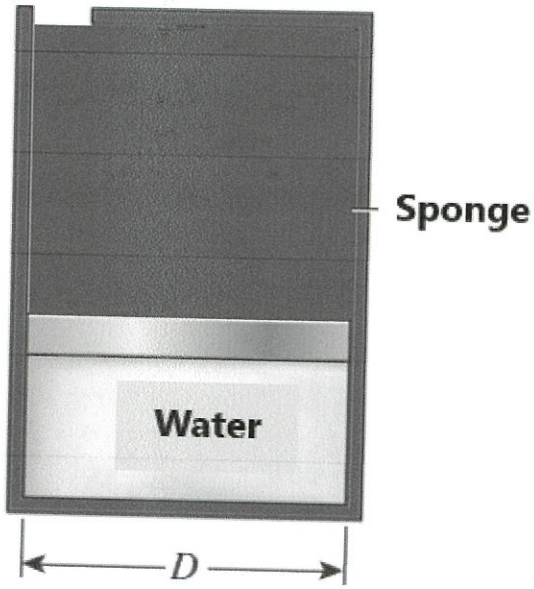

Figure Q2(b)

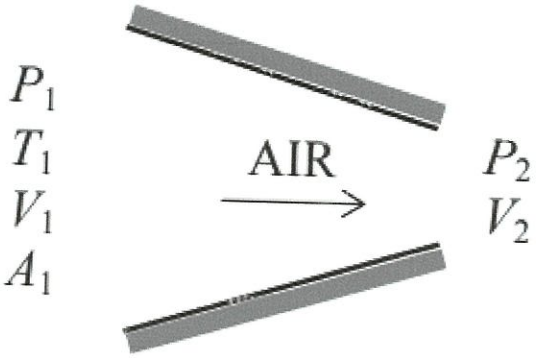

Figure Q3(b)

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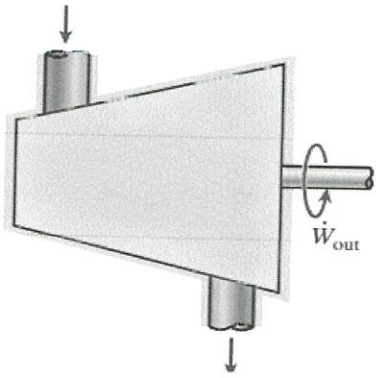

Figure Q3(c)