

**UNIVERSITY COLLEGE TATI (UC TATI)****FINAL EXAMINATION QUESTION BOOKLET**

COURSE CODE	: DTC 2073
COURSE	: THERMODYNAMICS
SEMESTER/SESSION	: 2- 2024/2025
DURATION	: 3 HOURS

Instructions:

1. This booklet contains **5** questions. Answer **ALL** questions.
2. You are allowed to bring "Appendix A" steam table and **2** pages of A4 paper containing formulas, notes, etc.
3. All answers should be written in answer booklet.
4. Write legibly and draw sketches wherever required.
5. If in doubt, raise your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO
THIS BOOKLET CONTAINS 6 PRINTED PAGES INCLUDING COVER PAGE

THERMODYNAMICS (DTC 2073)

QUESTION 1

- a) A 1.8-m^3 rigid tank contains steam at 220°C . One-third of the volume is in the liquid phase and the rest is in the vapour form. Compute
- i) The pressure of the steam (2 marks)
 - ii) the quality of the saturated mixture (10 marks)
 - iii) the density of the mixture (5 marks)
- b) The piston containing 10 kg of water exist as saturated liquid/vapor at 100 kPa with a quality of 50%. If the system is now heated so that the volume triples at the pressure 200 kPa.
- i) Indicate the thermodynamics properties at initial and final state (8 marks)
 - ii) Compute the heat and work changes (8 marks)

THERMODYNAMICS (DTC 2073)

QUESTION 2

A piston cylinder device initially contains 0.35 kg of steam, superheated at 250°C and 3.5 MPa. Then, the steam loses heat to the surroundings and the piston moves down, hitting a set of stops at which point the cylinder contains saturated liquid water. Compute.

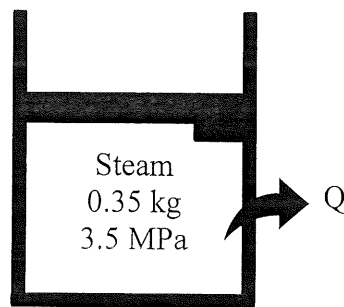


Figure 1

- Indicate the process is control mass or control volume? Develop a continuity equation and energy balance equation for the process with assumptions (3 marks)
- Determine the boundary work, W_{1-2} (9 marks)
- Determine the amount of heat, Q_{1-2} (5 marks)

THERMODYNAMICS (DTC 2073)

QUESTION 3

In engineering application, nozzles are used to break a fluid stream into smaller particles by atomization. Figure 2 shows steam enters a nozzle at 400°C and 800kPa with a velocity of 10 m/s and leaves at 300°C and 200kPa while losing a heat, Q at rate of 25kW. Given an inlet area of nozzle is 800 cm².

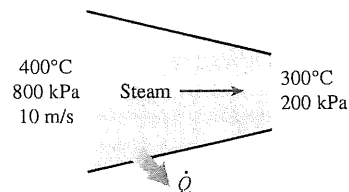


Figure 2

- Express energy equation for the process with all numerical values, state all the assumptions (6 marks)
- Compute the mass flow rate of the steam in kg/s (4 marks)

THERMODYNAMICS (DTC 2073)

QUESTION 4

The second law of thermodynamics claims it is impossible for heat to spontaneously flow from a cold body to hot body, but it can move in that way if some work is done. This is how refrigeration process works as shown in Figure 3. The refrigerator in the kitchen receives an electrical input power of 150W to drive the system, and it rejects 400W to the kitchen air.

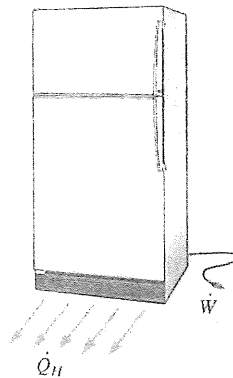


Figure 3

- Illustrate the cycle of the refrigeration process include the directions of temperature inside refrigerator (T_L), Temperature of kitchen air (T_{amb}), Heat release (Q_H), Heat receives (Q_L) and work input (W) (8 marks)
- Compute the energy taken of the cold space (4 marks)
- Compute the COP of the refrigerator (4 marks)

THERMODYNAMICS (DTC 2073)

QUESTION 5

A closed tank with volume $V = 10\text{L}$, containing 5kg of water initially at 25°C is heated to 150°C by a heat pump that is receiving heat from the surroundings at 25°C . Assume that this process is reversible, compute,

- a) The heat transfer to the water (10 marks)
- b) The change in entropy (10 marks)
- c) Illustrate the changes in PV and TS diagram (4 marks)

-----End of questions-----