



University of Ruhuna- Faculty of Technology
Bachelor of Engineering Technology Honours Degree
Level 4 (Semester 2) Examination, November/December 2025
Academic year 2023/2024

Course Unit: ENT4252 Refrigeration and Air Conditioning (Written) Duration: 2 hours
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- Answer all **Four (04)** questions. Each question carries fifteen marks.
- Non-programmable calculators are allowed
- P-h diagram of the R134a refrigerant, Psychometric chart required for the cooling load calculations are provided.
- Provide neat sketches and state any reasonable assumptions made.
- Symbols have their usual meaning.

Q1. The ideal vapour compression cycle is the practical adaptation of the reverse Carnot cycle.

- a) State three practical difficulties in implementing the reverse Carnot cycle and how these practical difficulties are addressed in the ideal vapour compression cycle.

(3 Marks)

- b) Using an appropriate cycle diagram, briefly explain the effect of subcooling of refrigerant after condensing on the refrigerating effect of the cycle.

(3 Marks)

- c) Briefly explain what happens to the performance of the ideal vapour compression cycle when the evaporator and condenser temperature difference increases. You may use suitable diagrams to explain the answer.

(4 Marks)

- d) In multistage refrigeration cycles, a flash gas chamber is commonly used. Using appropriate schematic diagrams and cycle graphs (e.g., a P-h diagram), explain the following:

- The primary function of the flash gas chamber.
- The overall effect of using a flash gas chamber on the cycle's performance.

(5 Marks)

Q2.

- a) An Ideal vapour refrigeration cycle operates with the condenser pressure of 8 bar and evaporator pressure of 0.1 bar. Calculate the required work input in kJ/kg and the coefficient of performance (COP) of the refrigeration cycle.

(5 Marks)

- b) The refrigeration cycle mentioned in Q2.a is then modified to a two-stage compression cycle, as shown in Figure Q2.b, by adding a flash gas chamber which operates at an intermediate pressure of 0.4 bar. Assuming the refrigerant leaves both the evaporator and flash chamber as saturated vapour, calculate the required work input of two-stage compression cycle in kJ/kg and COP of the cycle.

(8 Marks)

- c) Based on your answers on Q2.a and Q2.b calculate the percentage change in the COP and the total compressor work due to the modification of the cycle.

(2 Marks)

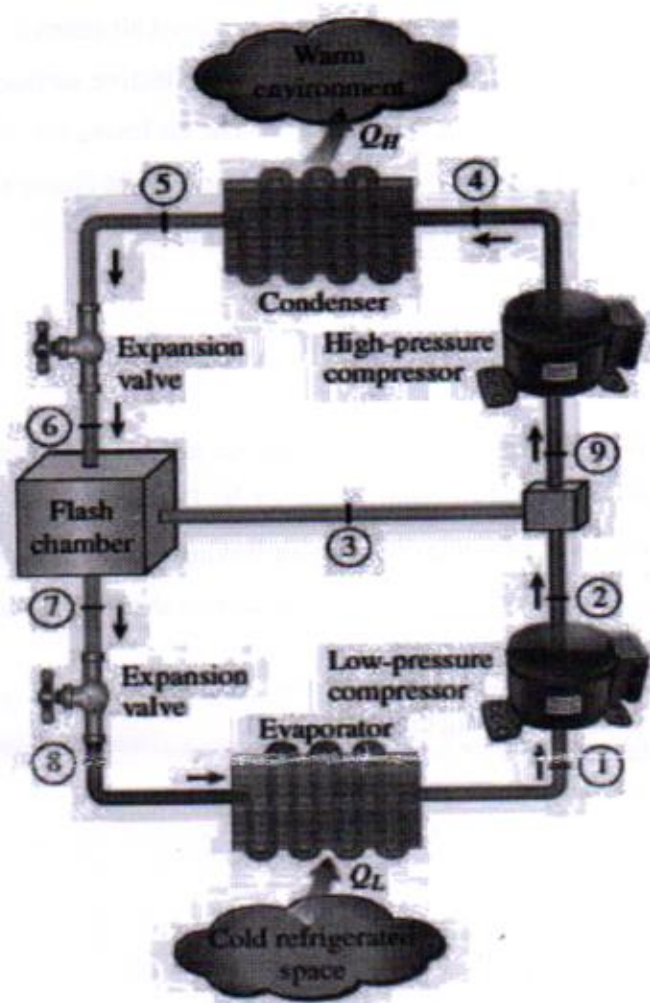


Figure Q2.b Modified Multistage Compression Cycle

Q3.

- a) A summer air-conditioning system mixes two streams of moist air.
- Stream 1: Air at 15 °C Dry-Bulb Temperature and 13 °C Wet-Bulb Temperature.
 - Stream 2: Air at 25 °C Dry-Bulb Temperature and 8 °C Dew Point Temperature.
- The streams are mixed in a mass ratio of one part (Stream 1) to two parts (Stream 2). Using the psychrometric chart, calculate the specific enthalpy (in kJ/kg) and dry bulb temperature of the resulting mixture.

(7 Marks)

- b) A total of 45 CMM (cubic meters per minute) of moist air enters a cooling coil at 32 °C Dry-Bulb (DB) and 20 °C Wet-Bulb (WB). The effective surface temperature of the coil (Apparatus Dew Point, or ADP) is 5 °C. The air leaves the coil at a state of 8 °C DB. Using the psychrometric chart, determine the ByPass Factor (BPF) of the cooling coil and the total refrigeration capacity of the coil in kW.

(8 Marks)

Q4.

An air-conditioning plant mixes 70 CMM of outside air at 35 °C DB temperature and 23 °C WB temperature with 210 CMM of return air at 24 °C DB temperature and 50% RH. The resulting mixture passes over a cooling coil. The air leaving the coil is at 90% RH. The Room Sensible Heat Factor (SHF) is 0.7. Using the psychrometric chart, calculate the following:

- The Apparatus Dew Point (ADP) of the coil, and the dew point and dry-bulb temperatures of the air leaving the coil.
- The total cooling capacity of the coil in kW.
- The sensible and latent cooling loads of the coil in kW.

(15 Marks)

