

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Semester Final Examination

Course Number: MCE 4713

Course Title: Refrigeration and Air conditioning

Winter Semester: 2022 - 2023

Full Marks: 150

Time: 03 Hours

There are **06 (six)** questions. Answer **all** questions. The symbols have their usual meanings. Assume reasonable condition and data for any missing information and values

1. A refrigerant R-22 vapour compression system includes a liquid-to-suction heat exchanger that superheats saturated vapour coming from the evaporator from -10°C to 5°C by subcooling of the liquid coming from the condenser at 30°C . The compression is isentropic in both the cases listed below. (25)
(CO2)
 - a) Draw the thermodynamic cycle as a h-p plot.
 - b) Calculate the COP of the system without the liquid-to-suction heat exchanger but with condenser temperature of 30°C and evaporator temperature of -10°C .
 - c) Calculate the COP of the system with the liquid-to-suction heat exchanger.
 - d) If the compressor is capable of pumping 12.0 L/s measured at the compressor suction, find the refrigeration capacity of the system without the liquid-to-suction heat exchanger.
 - e) with the same compressor capacity as in (c), find the refrigeration capacity of the system with the liquid-to-suction heat exchanger.

2. The catalogue of a refrigerant R-22, 4-cylinder, hermetic compressor operating at 29 r/s, with a condensing temperature of 40°C , and a evaporating temperature of -4°C shows a refrigerating capacity of 115 kW . At this operating point the motor (whose efficiency shows 90%) draws 34.5 kW . The bore diameter of the cylinder is 87 mm and the piston stroke 70 mm .
The performance data are based on 8°C subcooling of the liquid leaving the condenser. Compute the following. (25)
(CO2)
 - a) the amount of superheating in $^{\circ}\text{C}$
 - b) the actual volumetric efficiency
 - c) the isentropic work of the compressor
 - d) isentropic compression efficiency η_c

3. What do you mean by thermal comfort? Explain details of different features of cooling load estimation. (25)
(CO5)

4. An air-conditioned room that stands on a well-ventilated basement measures 3 m wide, 3 m high and 6 m deep. One of the two 3 m walls faces west and contains a double-glazed glass window of size 1.5 m by 1.5 m, mounted flush with the wall with no external shading. There are no heat gained through the walls other than the one facing west. Calculate the sensible, latent, and total heat gains on the room, room sensible heat factor from the following information. What is the required cooling capacity? (25) (CO5)
- | | |
|---|--|
| Inside conditions: | 25°C DBT, 50 percent RH |
| Outside conditions: | 43°C DBT, 24°C WBT |
| U-value for wall: | 1.78 W/m ² K |
| U-value for roof: | 1.316 W/m ² K |
| U-value for floor: | 1.2 W/m ² K |
| Effective Temp. Difference (ETD) for wall: | 25°C |
| Effective Temp. Difference (ETD) for roof: | 30°C |
| U-value for glass | 3.12 W/m ² K |
| Solar Heat Gain (SHG) of glass; | 300 W/m ² |
| Internal Shading Coefficient (SC) of glass: | 0.86 |
| Occupancy: | 4 (90 W sensible heat/person) (40 W latent heat/person) Lighting load: 33 W/m ² of floor area |
| Appliance load: | 600 W (Sensible) + 300 W (latent) |
| Infiltration: | 0.5 Air Changes per Hour |
| Barometric pressure: | 101 kPa |

5. Find chemical composition of following refrigerants. (25) (CO3)
- R-263, R-134

Designate the following refrigerant:
Sulfur dioxide, Neon

6. Make comparison between Vapor compression and Vapor Absorption refrigeration cycle. (12.5)

The operating temperatures of a single stage vapour absorption refrigeration system are: generator: 90 °C; condenser and absorber: 40 °C; evaporator: 0° C. The system has a refrigeration capacity of 100 kW and the heat input to the system is 160 kW. The solution pump work is negligible. (12.5) (CO4)

- Find the COP of the system and the total heat rejection rate from the system.
- An inventor claims that by improving the design of all the components of the system he could reduce the heat input to the system to 80 kW while keeping the refrigeration capacity and operating temperatures same as before. Examine the validity of the claim.

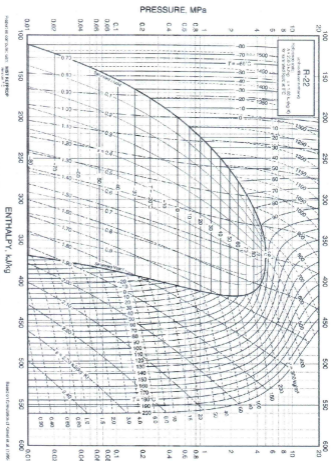


Fig. 1 Pressure-Enthalpy Diagram for Refrigerant 22