Indian Maritime University

(A Central Univ5ersity, Govt of India)

Sep/Oct'25 SE

Programme Name: B Tech (ME)

Semester: IV

Subject Code: UG11T4408

Subject Name: REFRIGERATION AND AIR CONDITIONING

Date: 06.10.2025	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

General Instructions

(i) All Sections (A, B & C) are to be attempted.
(ii) Options, if any, are specified in the respective section.
(iii) Refrigeration & Air Conditioning Data Tables are allowed.
(iv) Psychrometric charts are permitted.

Section A

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. COP of refrigerator.....with the decrease in the evaporation pressure in a Vapour Compression system

(a) Increase (b) Decrease (c) Remains same (d) Increases and then decreases

2. A refrigerator working on a reversed Carnot cycle has a COP of 4. If it works as a heat pump and consumes 1 kW, the heating effect will be

(a) 1 kW (b) 4 kW (c) 5 kW (d) 6 kW

3. During a refrigeration cycle, heat is rejected by the refrigerant in a.....

(a) Condenser (b) Compressor

(c) Evaporator (d) Expansion valve

4. One ton refrigeration is equivalent to

(a) 3.5 kW (b) 50 kJ/s (c) 1000 J/min (d) 1000 kJ/min

5. On psychrometric chart, what does a vertical downward line represent?
(a) Constant relative humidity lines (b) Constant enthalphy lines
(c) Constant due point temperature lines (d) Constant volume lines

6. In winter air-conditioning, the process is
(a) Heating, humidification and cooling
(b) Heating, humidification and heating
(c) Heating, dehumidification and heating
(d) Cooling, dehumidification and heating

7. During the sensible cooling process, specific humidity
(a) Remains constant (b) Increases (c) Decreases (d) Unpredictable

8. In a domestic refrigerator, periodic defrosting is required because frosting
(a) Causes corrosion of materials (b) Reduces heat extraction
(c) Overcools food stuff (d) Partially blocks refrigerant flow

9. In conventional refrigerants what is the element responsible for ozone deplition?
(a) Chlorine (b) Fluorine (c) Carbon (d) Hydrogen

10. Environment friendly refrigerant R134a is used in the new generation domestic refrigerators. Its chemical formula is

(a) C H Cl F_2 (b) C_2 Cl_3 F_3 (c) C_2 Cl_2 F_4 (d) C_2 H_2 F_4

Section B

Five Questions of 02 Marks each

11. Explain the refrigerant cycle by illustrating it on P-h and T-S diagrams.

12. Define flooded evaporator and starved evaporator.

13. What is One Ton of Refrigeration (1 TR), and how is it defined?

14. Define specific humidity and relative humidity. Explain their significance in air-conditioning applications.

15. Define Dry Bulb Temperature and Wet Bulb Temperature and explain their significance.

Section C

Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. What will be the effect of superheating and subcooling on the performance of a Vapour Compression refrigeration system (expressed with P-h and T-S curves).

17. Explain the working principle of the Ammonia-Water Vapour Absorption Refrigeration System with the help of a neat and labelled diagram. Describe the function of each component in the system.

18. What key properties should an ideal refrigerant possess for marine refrigeration systems? Additionally, explain the methods for detecting refrigerant leaks and the maintenance procedures in a vapour compression refrigeration system.

19. What is the designation system of refrigerants, and how are they classified?

20. (a) Differentiate between an open-type compressor and a hermetic compressor. Discuss their advantages, disadvantages, and applications. (5 Marks)
(b) What is a thermostatic expansion valve? Explain its working principle and describe its key components. (5 Marks)

21. A vapour compression refrigerator works between 60 bar and 25 bar pressure limits. The working fluid is just dry at the end of compression, and there is no under cooling of the liquid before the expansion valve. The properties of the refrigerant are given in Table 1. Determine: (a) Coefficient of performance (COP) of the cycle; and (b) Capacity of the refrigerator (in TR) if the fluid flow is at the rate of 5 kg/min. (5+5 Marks)

The properties of the refrigerant are given in Table 1

Pressure (bar)	Saturated Temperature (K)	Enthalpy (kJ/kg)		Entropy (kJ/kg K)	
		Liquid	Vapour	Liquid	Vapour
60	295	151.96	293.29	0.554	1.0332
25	261	56.32	322.58	0.226	1.2464

22. A cold storage plant is required to store 20 tonnes of fish. The fish is supplied at a temperature of 30 °C. The specific heat of fish above freezing point is 2.93 kJ/kg K. The specific heat of the fish below freezing point is 1.26 kJ/kg K. The fish is stored in cold storage, which is maintained at -8 °C. The freezing point of fish is -4 °C. The latent heat of fish is 235 kJ/kg. If the plant requires 75 kW to drive it, find:
(a) The Capacity of the plant, and (b) Time taken to achieve cooling.
Assume the actual coefficient of performance (COP) of the plant as 0.3 of the Carnot COP. (5+5 Marks)