Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations– June 2023

Programme Name: B Tech (ME)

Semester: IV

Subject Code: UG11T4408

Subject Name: REFRIGERATION AND AIR CONDITIONING

Date: 08.06.2023	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 respective section.

QP setters to specify the following as applicable:-

(iii) Tables (Steam/Log/Nautical Almanac etc) that can be used.
(iv) Chart Work Booklets to be used.
(v) Psychrometric chart to be used.

Section A

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

Q1. The practical unit of refrigeration "1-TR is the amount of heat removed from one ton of water at 0°C to become ice in
(a) 1 hour
(b) 12 hours
(c) 8 hours
(d) 24 hours

Q2. The halide torch is used for-----
(a) Defrosting of the cooling coil
(b) Detecting leakage of the refrigerant
(c) Superheating the vapour refrigerant
(d) Facilitating better lubrication in the refrigerator

Q3. Which of the following represents sensible cooling on the psychometric chart?
(a) Inclined line
(b) Curve
(c) Horizontal line
(d) Vertical line

Q4. What is the relation between DBT and WBT if the relative humidity is 100%?

(a) DBT = WBT
(b) DBT > WBT
(c) DBT ≫ WBT
(d) DBT < WBT

Q5. When two refrigerants are mixed in the proper proportions, the mixture forms a third refrigerant called,
(a) Synthetic refrigerant
(b) Refrigerant mixture
(c) High pressure refrigerant
(d) Azeotrope

Q6. Environmental protection agencies advice against the use of chloro-fluoro-carbon refrigerants since
(a) These react with water vapour and cause acid rain
(b) These react with plants and cause greenhouse effect
(c) These react with oxygen and cause its depletion
(d) These react with ozone layer

Q7. The refrigerant supplied to a compressor must be
(a) Superheated vapour refrigerant
(b) Dry saturated liquid refrigerant
(c) A mixture of vapour and liquid refrigerant
(d) None of the above

Q8. In case of sensible heating of air, the coil efficiency is given by (where B.P.F. = Bypass factor)
(a) B.P.F.-1
(b) 1- B.P.F.
(c) 1+ B.P.F.
(d) 1/ B.P.F.

Q9. In summer air conditioning, the air is
(a) Cooled and humidified
(b) Cooled and dehumidified
(c) Heated and humidified

(d) Heated and dehumidified

Q10. What should be the appropriate material used for Ammonia refrigerant
(a) Brass
(b) Copper
(c) Bronze
(d) None of the above

Section B

Five Questions of 02 Marks each

Q11. Explain (in brief) the objective of refrigeration and air conditioning on ships.

Q12. In case of refrigerant retrofitting explain how the equipment capacity affects the selection of the refrigerant.

Q13. State the factors that determine human comfort

Q14. Write in brief about defrosting and what are methods for it.

Q15. Define Psychrometric and what the importance of it.

Section C

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

Q16. (a) What will be the effect of superheating and subcooling on the performance of Vapour Compression refrigeration system (express with suitable diagram either in T-S or P-H curve). (5 Marks)
(b) What are the desirable properties of refrigerant for use in ships? Describe refrigerant leak detection maintenance procedures on a vapour compression refrigeration system. (5 Marks)

Q17. A vapour compression (VC-cycle) refrigeration cycle based refrigerator operates between temperature limit of -12 °C and 22 °C. The refrigerant enters the condenser as saturated vapour and leaves as saturated liquid. The properties of the refrigerant are given in the Table. If the flow rate of the refrigerant is 5 kg/min, then find the

(a) Coefficient of Performance and (6 Marks)
(b) Capacity of the refrigerator in TR. (4 Marks)

The properties of refrigerant are given in Table

Saturated Temperature (°C)	h_f (KJ/Kg)	h_g (KJ/Kg)	S_f (KJ/Kg K)	S_g (KJ/Kg K)	specific heat for liquid (KJ/Kg K)	specific heat for vapour (KJ/Kg K)
22	151.96	293. 29	0.554	1.0332	--	2.492
-12	56.32	322.58	0. 226	1. 2464	4.556	2.903

(10 Marks)

Q18. (a) Describe (in brief) refrigeration components, (4 Marks)
i) Evaporator
ii) Compressor

(b) Describe the marine type Ammonia refrigerant system. (6 Marks)

Q19. a. How is the liquid refrigerant added to the refrigeration system when the system is out of refrigerant? (5 Marks) (b) Explain about oil pressure safety controls. What are the advantages of using an electronic oil safety controller over a mechanical safety controller? (5 Marks)

Q20. (a) Describe how the scroll compressor compresses refrigerant gases with the help of simple sketches (5 Marks) (b) Explain thermostatic expansion valve and their components. (5 Marks)

Q21. a. Atmospheric air at 1.013 bar and 35°C (Dry bulb temperature) has a relative humidity of 60% and the saturation pressure of water vapour at 35°C is the 5.628 KPa. Then find the specific humidity of moist air per Kg vapour to per Kg of dry air. (5 Marks)
b. What you understand by the specific humidity and relative humidity and how both are differentiated with each other. (5 Marks)

Q22. a. Explain the following processes and also show on psychometric chart (5 Marks)

(i) Heating with Humidification
(ii) Cooling with dehumidification
b. What is system Evacuation? If some gas will remain in system then what problem you will face. (5 Marks)