

**Indian Maritime University**  
**(A Central University, Govt of India)**  
**End Semester Examinations – December 2023**  
**Programme Name: B. Tech (Marine Engineering)**  
**Semester: IV**  
**Subject Code: UG11T4408**  
**Subject Name: REFRIGERATION AND AIR CONDITIONING**

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Date: 30.11.2023

Max Marks: 70

Duration: 03 Hrs

Pass Marks: 35

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General Instructions

- (i) All Sections (A, B & C) are to be attempted.
- (ii) Options, if any, are specified in respective section.
- (iii) Steam tables and 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. What is the relation between DBT and WBT if the relative humidity is 100%?
  - (a)  $DBT = WBT$
  - (b)  $DBT > WBT$
  - (c)  $DBT \gg WBT$
  - (d)  $DBT < WBT$
  
2. What should be the appropriate material used for Ammonia refrigerant
  - (a) Brass
  - (b) Copper
  - (c) Bronze
  - (d) None of the above

3. The ratio of Heat Absorbed by the refrigerant while passing through the evaporator to the Work Output required to compress the refrigerant in the compressor is termed as
- (a) Efficiency of Refrigeration System
  - (b) Efficacy of the Refrigerant
  - (c) COP
  - (d) Performance Point
4. 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
5. Which is the desirable physical property of refrigerant
- (a) Toxic
  - (b) Explosive
  - (c) Low boiling point
  - (d) High Freezing point
6. Sensible heating is required for
- (a) vaporise water into steam
  - (b) increase the temperature of liquid or vapour
  - (c) convert water into steam and superheat it
  - (d) measuring dew point temperature
7. 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

8. During a refrigeration cycle, heat is rejected by the refrigerant in a \_\_\_\_\_
- (a) Condenser
  - (b) Compressor
  - (c) Evaporator
  - (d) Expansion Valve
9. 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
10. Which of the following represents sensible cooling on the psychometric chart?
- (a) Inclined line
  - (b) Parabolic Curve
  - (c) Horizontal line
  - (d) Vertical line

**Section B**

Five Questions of 02 Marks each

11. Define a) Dry bulb temperature b) Wet bulb temperature
12. Name the components that require periodic examination and maintenance in marine refrigeration plant.
13. Write in brief about defrosting and what are methods for conducting defrosting.
14. In case of refrigerant retrofitting explain how the equipment capacity affects the selection of the refrigerant.
15. Explain (in brief) the objective of refrigeration and air conditioning on ships.

### Section C

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

16. An air-water vapour mixture enters an adiabatic saturator at  $30^{\circ}\text{C}$  and leaves at  $20^{\circ}\text{C}$ , which is the adiabatic saturation temperature. The pressure remains constant at 100 kPa. Determine the relative humidity and the humidity ratio of the inlet mixture.
17. a) Explain the following process in detail and also illustrate on psychrometric chart:  
i) Heating with Humidification    ii) Cooling with dehumidification  
b) Explain system Evacuation. Mention the major problems created due to residual gases in the system.  
(05 marks + 05 marks)
18. a) How is the liquid refrigerant added to the refrigeration system when the system is out of refrigerant? (05 marks)  
b) Explain about oil pressure safety controls. What are the advantages of using an electronic oil safety controller over a mechanical safety controller? (05 marks)
19. Draw a schematic of single duct system with local reheating and name the major components.
20. a) What are the desirable properties of refrigerant for use in ships?  
b) Explain thermostatic expansion valve and their components.  
(05 marks + 05 marks)
21. Explain the refrigerant cycle by illustrating it on the P-h diagram
22. A vapour compression (VC-cycle) refrigeration cycle based refrigerator operates between temperature limit of  $-12^{\circ}\text{C}$  and  $22^{\circ}\text{C}$ . 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 below:

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

TMM

