

**Indian Maritime University**  
**(A Central University, Govt of India)**  
**End Semester Examinations– December 2023**  
**Programme Name: B Tech (Marine Engineering)**  
**Semester: IV**  
**Subject Code: UG11T3406**

**Subject Name: MARINE HEAT ENGINE AND AIR CONDITIONING**

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Date: 29.11.2023

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.

**Section A**

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

1. Steam turbines work on \_\_\_\_\_
  - a) Dual cycle
  - b) Rankine cycle
  - c) Otto cycle
  - d) None of the mentioned
  
2. Gas turbines work on which of the following cycle?
  - a) Diesel cycle
  - b) Brayton cycle
  - c) Rankine cycle
  - d) None of the mentioned
  
3. If the COP of refrigerator is 5 then what is the COP of heat pump working between same temperature-
  - a) 5
  - b) 6
  - c) 7
  - d) 8
  
4. A Gas Turbine is which type of combustion plant?
  - a) external
  - b) open
  - c) internal

d) cannot say

5. Which of the following process is used in winter air conditioning?

- a) Cooling and Dehumidification
- b) Heating and Humidification
- c) Dehumidification
- d) Humidification

6. On which of the following cycle the air conditioning systems are based in transport aviation?

- a) Reversed Joule's cycle
- b) Otto cycle
- c) Reversed Carnot cycle
- d) Reversed Brayton cycle

7. Which of the following represents sensible cooling on the psychrometric chart?

- a) Inclined line
- b) Curve
- c) Horizontal line
- d) Vertical line

8. Cornish boiler is an example of which type of boiler?

- a) Fire tube boiler
- b) Water tube boiler
- c) Vertical tube boiler
- d) Externally fired boiler

9. Water level indicator \_\_\_\_\_

- a) indicates the amount of steam in the boiler
- b) indicates the amount of water in the boiler
- c) indicates the amount of water converted to steam
- d) indicates the amount of steam left in the boiler

10. What is the function of fusible plug?

- a) Protects the boiler from overheating
- b) Prevents mixing of water and steam
- c) Regulated the flow of steam outside boiler
- d) It is opened to increase the flow of air for combustion

### **Section B**

Five Questions of 02 Marks each

**11.** Explain the degree of reaction in steam turbine.

**12.** What is the difference between impulse turbine and reaction turbine ?

**13.** Show on the psychrometric chart -

- (a)** heating and dehumidification
- (b)** heating and humidification

14. What is the difference between refrigeration and air-conditioning ?  
 15. Define volumetric efficiency and free air delivery(FAD).

### Section C

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

16. A simple impulse turbine has a mean blade speed of 200m/s . The Nozzles are inclined at 20° to the plane of rotation of the blades. The steam velocity from nozzles is 600m/s . The turbine uses 3500 kg/hour of steam. The absolute velocity at exit is along the axis of the turbine. Determine-

- (i) The inlet and exit angles of the blades.  
 (ii) The power output of the turbine.  
 (iii) The diagram efficiency.  
 (iv) The axial thrust ( per kg steam per second)  
 (v) Draw the velocity diagram

Assume inlet and outlet angles to be equal.

(10 Marks)

17. The following readings were obtained during a boiler trial of 6 hour duration-

mean stem pressure = 12 bar  
 mass of steam generated = 40000 kg  
 mean dryness fraction = 0.85  
 mean feed water temperature = 30°C  
 coal used = 4000 kg  
 Calorific value of coal = 33400kj/kg.

Calculate:-

- (i) Factor of equivalent evaporation  
 (ii) Equivalent evaporation from and at 100° C  
 (iii) Efficiency of the boiler .

(10 Marks)

18. A refrigeration machine using R-12 as refrigerant operates between the pressure 2.5 bar and 9 bar . The compression is isentropic and there is no under cooling in the condenser . The vapour is in dry saturated condition at the beginning of the compression . Estimate the theoretical COP. if the actual COP is 0.65 of the theoretical value, calculate the net cooling produced per hour. The refrigerant flow is 5 kg/min. The properties of refrigerant are-

Pressure(bar)	Saturation temperature °C	Enthalpy(kj/kg) Liquid	Enthalpy(kj/kg) Vapour	Entropy of saturated vapour (kj/kgK)
9	36	70.55	201.8	0.6836
2.5	-7	29.62	184.5	0.7001

Take Cp for superheated vapour at 9 bar as 0.64 kj/kgK

(10 Marks)

**19.** A restaurant with a capacity of 100 % persons is to be air conditioned with the following conditions-

Outside conditions = 30°C DBT and 70% RH

Desired inside conditions = 23°C DBT and 55% RH

Quantity of air supplied = 0.5 m<sup>3</sup>/min/person

The desired conditions are achieved by cooling, dehumidifying and then heating. Determine-

- 1- Capacity of cooling coil in tonnes of refrigeration
- 2- Capacity of heating coil
- 3- Amount of water removed by dehumidifier
- 4- By-pass factor of the heating coil if its surface temperature is 35 °C.

**20.**

(A) What are the factors affecting the optimum effective temperature .(5 Marks)

(B) Define Dew point temperature and wet bulb temperature. (5 Marks)

**21.**

(A) Explain the vapour compression refrigeration cycle. (5 Marks)

(B) Define Absolute humidity and relative humidity. (5 Marks)

**22.**

(A) Write the desirable property of an ideal refrigerant. (5 Marks)

(B) Explain the defrosting in evaporator. (5 Marks)