



Printed Pages : 7

TME – 606

(Following Paper ID and Roll No. to be filled in your Answer Book)

**PAPER ID : 4097**

Roll No.

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**B. Tech.**

(SEM. VI) EXAMINATION, 2006-07

**REFRIGERATION & AIRCONDITIONING***Time : 3 Hours]**[Total Marks : 100*

- Note :*
- (1) *Attempt all the **five** questions.*
  - (2) *All questions carry **equal** marks.*
  - (3) *Use of steam tables, Psychrometric chart for Air, refrigerant's properties tables and charts, is permitted.*
  - (4) *In case of numerical problems, assume data wherever not provided.*

**1** Attempt any **four** of the following : **5×4=20**

- a) What is the importance of refrigeration and which are the different methods of producing refrigeration? Also define the terms and unit of refrigeration.
- b) How a Carnot cycle is used as a refrigeration cycle, and what is the value of **C.O.P.** of a Carnot refrigeration cycle in terms of higher and lower temperatures ? A scientist claims to have developed a refrigerator which maintains a freezer temperature of **-15°C** in a room whose temperature is **35°C** and have a **C.O.P.** of **6.5**. Justify, whether his claim is True or False.

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- c) What is the basic difference between open and closed Air refrigeration cycles? Describe a Bell Coleman or Reversed Joule air refrigeration cycle with the help of a neat labelled sketch and also explain the basic difference between this cycle and a reversed Carnot air refrigeration cycle.
- d) An air refrigeration system following Bell-Coleman cycle is operating between pressure limits of **1.04** bar and **8** bar respectively. Air is drawn from the cold chamber at **9°C** and after compression it is cooled to **28°C**, before entering the expansion cylinder. If expansion and compression process follow the law  $PV^{1.28} = \text{constant}$ , determine the theoretical **C.O.P.** of the above refrigeration system. Take  $\gamma = 1.4$  and  $C_p = 1.005 \text{ kJ/kg-K}$  for Air.
- e) Discuss the different classification of Aircraft refrigeration systems and explain the working of a simple aircraft refrigeration system with the help of **(T-S)** diagram.
- f) A simple aircraft refrigeration system has to undertake a load of **20TR**. The ambient pressure and temperatures are **0.9** bar and **22°C** respectively. The pressure of air is increased to **1** bar due to isentropic ramming action. The air is further compressed in a compressor upto **3.5** bar and then cooled in a heat exchanger upto **72°C**. Finally the air is passed through a cooling turbine and then supplied to the cabin at a pressure of **1.03** bar. The air leaves the cabin at **25°C**. Calculate the power required and **C.O.P.** of the system take  $C_p = 1.005 \text{ kJ/kg-K}$  and  $\gamma = 1.4$ .

2 Attempt any **two** of the following : **10×2=20**

- a) What are the main characteristics of a vapour compression refrigeration system and what are its advantages over Air Refrigeration system. Draw a single stage simple vapour compression refrigeration cycle on **(T-S)** and **(P-H)** diagrams and show how can you make a thermodynamic analysis of the cycle and calculate its **C.O.P.**
- b) In a simple vapour compression refrigeration system using **R-12** as refrigerant, the evaporator and condenser temperatures are **-10°C** and **35°C** respectively. If the capacity of the system is **15 tons**, and the compression is isentropic, calculate the following with the help of **P-H** chart for **R-12** :
- Mass of refrigerant to be circulated.
  - Power required in the compressor
  - Total heat rejected in the condenser, and
  - C.O.P.** of the cycle
- Also calculate the Carnot **C.O.P.** and show the percentage difference between the two. Draw the cycle on **P-H** chart for **R-12**.
- c)
  - What do you understand by multistage compression and why it is required in a system when the difference between the evaporator and condenser pressures is large? Enumerate the advantages of multistage system over a single stage compression system, in brief.
  - What do you understand by removal of flash gas and what is the function of a flash intercooler in a multistage compression system? Also explain the

basic difference between a multistage vapour compression system and a cascade refrigeration system.

3 Attempt any **two** of the following : **10×2=20**

- a) What is the basic difference between a vapour absorption refrigeration system and a vapour compression system? Explain how, the function of the compressor in vapour compression system is achieved in a vapour absorption system, and by which components? Draw a neat sketch of a practical vapour absorption system and describe its working in brief.
- b) What do you understand by maximum **C.O.P.** of a vapour Absorption refrigeration system and how do you calculate its value in terms of the Evaporator, Generator, Condenser and Absorber temperatures?

In a vapour absorption refrigeration system, the generator is operated by solar heat where the temperature achieved is **100°C**. If the evaporator temperature is **-10°C** and the condenser / absorber temperature are **35°C**, what is the maximum possible **C.O.P.** of the system?

- c) i) Explain in brief, the concept of Adiabatic mixing of two streams, as related to vapour absorption Refrigeration system. Also discuss the significance of Temperature – Concentration diagram.
- ii) Enumerate the classification of Refrigerants. What are the desirable properties of refrigerants? Name some

common refrigerants generally used in refrigeration systems. What do you understand by CFC free refrigerants?

**4** Attempt any **two** of the following : **10×2=20**

- a) i) What is 'air conditioning' and what is the basic difference between refrigeration and air conditioning? Define the terms; 'specific humidity', 'relative humidity', 'dew point temperature' and 'degree of saturation', as related to psychrometrics.
- ii) On a particular day, the atmospheric air at a pressure of **1.0132** bar, was found to have a dry bulb temperature of **35°C** and relative humidity of **65%**. Using STEAM TABLES only, calculate: the partial pressure of water vapour and air in moist air, the specific humidity, the degree of saturation, and the dew point temperature (psychrometric chart not allowed).
- b) i) Why psychrometric chart is most commonly used in solving the problems of air conditioning? Which are different psychrometric processes commonly used in air conditioning? Show them on psychrometric chart.
- ii) Explain the concept of cooling and heating loads. What do you understand by selection of inside and outside design conditions and what are the different factors considered in load estimation for comfort air conditioning?

- c) i) Explain in brief, the concept of thermal analysis of human body, being used for comfort air conditioning. Also give the concept of Effective temperature & comfort chart, in brief.
- ii) Describe in brief, the effect of solar radiation in heat transfer through walls and roofs of the building, explaining the effect of infiltration/ ventilation air on cooling loads.

**5** Attempt any **four** of the following : **5×4=20**

- a) Enlist various refrigeration equipments used in a vapour compression refrigeration system. Which are the different types of compressors generally used in refrigeration and air conditioning units?

What do you understand by hermetically sealed compressors and what are its main advantages over ordinary coupled units?

- b) With the help of a neat sketch, explain the working of an 'Air washer', showing how you can calculate its humidifying efficiency.
- c) What is 'food preservation' and what are its advantages? Enumerate some common methods being used for food preservation, in brief.
- d) What is the importance of Ducts and Fans in transmission and distribution of air in a central air conditioning system? Describe in brief, the concept of air flow through ducts, explaining the different factors which leads to pressure drop in ducts.

- e) What is the importance of cold storages in today's life? Describe a cold storage, in brief. What is the importance of storage period and preservation conditions in the design of a cold storage?
- f) What is the basic difference between the requirements of comfort and industrial air conditioning? In a room, a **1 Ton** capacity air conditioner is installed which supplies **12m<sup>3</sup>/min.** air at dry bulb temperature **18°C** and wet bulb temperature of **15°C**. If it sucks air at **DBT** of **28°C** and relative humidity of **60%**, determine the actual capacity of air conditioner, with the help of psychrometric chart.
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