

B.TECH
(SEM VI) THEORY EXAMINATION 2022-23
REFRIGERATION AND AIR CONDITIONING

Time: 3 Hours**Total Marks: 100**

- Note:** 1. Attempt all Sections. If require any missing data; then choose suitably.
2. Use of refrigerant table, steam table, psychometric chart is permissible.

SECTION A

1. Attempt all questions in brief.

2 x 10 = 20

- (a) Define Mach number.
- (b) What do you understand by DART?
- (c) Mention the advantages of vapour compression refrigeration system over air refrigeration system.
- (d) How does an actual vapour compression cycle differ from that of a theoretical cycle?
- (e) What are the desirable properties of an ideal refrigerant?
- (f) Explain CFC-free refrigerant.
- (g) Define sensible heat factor.
- (h) Define Heating and Humidification process on Psychrometric chart.
- (i) Explain de-frosting in refrigeration.
- (j) Write the function of capillary tube.

SECTION B

2. Attempt any three of the following:

10 x 3 = 30

- (a) A cold storage is to be maintained at -5°C while the surroundings are at 35°C . The heat leakage from the surroundings into the cold storage is estimated to be 29 kW. The actual COP of the refrigeration plant is one-third of an ideal plant working between the same temperatures. Find the power required to drive the plant.
- (b) What are the advantages of compound compression with intercooler over single stage compression?
- (c) Draw a neat diagram of three-fluid system of refrigeration (Electrolux refrigeration system) and explain its working.
- (d) What is fog? Show on the psychometric chart when two air streams yield fogged state of air.
- (e) Which are the important equipments being used in refrigeration and air-conditioning systems? Describe the basic function and significance of each equipment, in brief.

SECTION C

3. Attempt any one part of the following:

10 x 1 = 10

- (a) An aircraft refrigeration plant has to handle a cabin load of 30 tonnes. The atmospheric temperature is 17°C . The atmospheric air is compressed to a pressure of 0.95 bars and temperature of 30°C due to ram action. This air is then further compressed in a compressor to 4.75 bars, cooled in a heat exchanger to 67°C , expanded in a turbine to 1 bar pressure and supplied to the cabin. The air leaves the cabin at a temperature of 27°C . The isentropic efficiencies of both compressor

and turbine are 0.9. Calculate the mass of air circulated per minute and the C.O.P.
For air, $C_p = 1.004 \text{ KJ/Kg K}$ and $C_p/C_v = 1.4$

- (b) Explain, with a neat sketch, the working principle of boot-strap evaporative type of air refrigeration system with T-S diagram.

4. Attempt any one part of the following:

10 x 1 = 10

- (a) Describe, with the help of schematic and p-h diagrams, the working of a two stage compression system with water intercooler, liquid subcooler and a liquid flash chamber.
- (b) The temperature limits of an ammonia refrigerating system are 25°C and -10°C . If the gas is dry at the end of compression, calculate the coefficient of performance of the cycle assuming no under-cooling of the liquid ammonia. Use the following table for properties of ammonia:

Temperature ($^\circ\text{C}$)	Liquid Heat (KJ/Kg)	Latent Heat (KJ/Kg)	Liquid Entropy (KJ/Kg K)
25	298.9	1166.94	1.1242
-10	135.37	1297.68	0.5443

5. Attempt any one part of the following:

10 x 1 = 10

- (a) With the help of a neat sketch, explain in brief, the working principle of practical vapour Absorption Refrigeration system, obtaining an expression for maximum C.O.P of the cycle. Also determine the C.O.P of a Vapour Absorption system having a Generator temperature of 110°C , evaporator temperature of -15°C and absorber/condenser temperature of 40°C .
- (b) Define primary refrigerant. What are the desirable properties of a primary refrigerant? Give the refrigerant number for the following: CHClF_2 , $\text{CH}_2\text{F}-\text{CF}_3$, and NH_3 .

6. Attempt any one part of the following:

10 x 1 = 10

- (a) Classify different types of air-conditioning system used. Draw a neat diagram of air-conditioning system required for winter season. Explain the working of different components in the circuit.
- (b) Room air having a DBT of 40°C and WBT of 25°C is cooled through sensible cooling process up to a temperature of 25°C show it on a psychometric chart and determine the amount of heat removed (in KJ/kg of dry air).

7. Attempt any one part of the following:

10 x 1 = 10

- (a) Explain the working of ice manufacturing in ice manufacturing plant.
- (b) Explain the methods of food preservation in detail.