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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 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 (°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 vopour 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 1100°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: $CHCLF_2$, CH_2FCF_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 25^0C 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.