

B TECH
(SEM VI) THEORY EXAMINATION 2017-18
REFRIGERATION AND AIR CONDITIONING

Time: 3 Hours

Total Marks: 100

1. Attempt all Sections. If require any missing data; then choose suitably.

2. Use of steam tables, refrigerant's property tables and charts, psychometric charts, and Enthalpy-concentration diagram is allowed.

SECTION-A

1. Attempt *all* questions in brief.

(2x10=20)

- (a) Define Ton of Refrigeration.
- (b) Draw reversed Carnot cycle on T-s and p-v diagram.
- (c) Differentiate between evaporator and condenser.
- (d) Define sub-cooled liquid.
- (e) Explain the function of absorber in vapor absorption refrigeration system.
- (f) Define CFC refrigerants.
- (g) Write the chemical name of R-113.
- (h) Define Relative humidity and Degree of saturation.
- (i) Define GSHF and ERSHF?
- (j) What is the function of capillary tube in refrigerator/ air-conditioner?

SECTION-B

2. Attempt any three part of the following:

(10x3=30)

- a. Explain Reversed Carnot cycle for refrigeration. Also derive its COP relation.
- b. A refrigeration system produces 30 kg/hr of ice at 0°C from water available at 25°C. Find the refrigeration effect per hour and Tonnage of the plant. If it takes 1 kW power as consumption, find COP. Take solidification of water at 0°C as 335 kJ/kg and specific heat of water 4.19 kJ/kg-K.
- c. Differentiate between single stage vapor compression and multistage vapor compression refrigeration system? Draw and explain two-stage compression with water intercooler and liquid sub-cooler and liquid flash chamber. Draw p-h diagram.
- d. Draw and explain practical vapor absorption refrigeration system.
- e. The atmospheric air at 30°C DBT and 75% RH enters a cooling coil at the rate of 200 m³/min. The coil dew point temperature is 14°C and BPF of the coil is 0.1. Determine the (i) Temperature of the air leaving the cooling coil, (ii) The capacity of the cooling coil in TR and KW, (iii) The amount of water vapours removed per min and (iv) Sensible heat factor for the process.
- f. What are different types of expansion devices generally used in refrigeration system? Describe Thermostatic expansion valve with neat sketch.

SECTION-C

3. Attempt any *one* part of the following:

10 x 1 = 10

- a. In an aircraft refrigeration unit of a cooling load of 12 TR, the atmospheric temperature and pressure are 12°C and 0.9 bar respectively. This pressure increases to 1.01 bar due to ramming effect. The air is bled from the engine compressor at 3.5 bar and passed through the air cooled heat exchanger where its temperature is reduced by 50°, the air is then expanded in the cooling turbine, delivered to the aircraft cabin and subsequently leaves the aircraft at 20°C. The pressure in the cabin is 1.03 bar. Calculate the power required to undertake the cooling load and COP of the system.

- b. Compare Air refrigeration system with Vapour compression refrigeration system. Give advantages, disadvantages and applications of air refrigeration system.

4. Attempt any one part of the following: 10 x 1 = 10

- a. Describe the simple vapour compression refrigeration system with neat sketch. Give advantages and disadvantages of vapour compression system.
- b. The following data refer to a two-stage compression ammonia refrigerating system with water intercooler. Condenser pressure=14 bar, evaporator pressure=2 bar, intercooler pressure=5 bar, load on the evaporator=10 TR. If the temperature of de-superheated vapor and sub-cooled liquid refrigerant are limited to 300°C , find: (a) the power required to drive the system and (b) COP of the system. Use p-h chart.

5. Attempt any one part of the following: 10 x 1 = 10

- a. Draw and explain Li-Br vapor absorption refrigeration system.
- b. Define refrigerant and classify the refrigerants in detail.

6. Attempt any one part of the following: 10 x 1 = 10

- a. In an air-conditioning system, the inside conditions are DBT 25°C , RH 50% and outside conditions are DBT 40°C and WBT 27°C . The room sensible heat factor is 0.8. 50% of the room air is rejected to atmosphere and an equal quantity of fresh air is added before air enters the air-conditioning apparatus. If the fresh air added is $100\text{ m}^3/\text{min}$, determine:
- Room sensible and room latent heat load
 - Sensible and latent heat load due to fresh air
 - Apparatus dew point temperature
 - Humidity ratio and DBT of air entering air-conditioning apparatus
- Assume BPF as 0 and density of air 1.2 kg/m^3 at a total pressure of 1.01325 bars.
- b. With the help of psychrometric chart, explain following processes:
- Sensible heating and sensible cooling processes
 - Cooling and dehumidification process
- How are refrigerants classified? What are the desirable properties of refrigerants? Name some common refrigerants generally used in refrigeration system?

7. Attempt any one part of the following: 10 x 1 = 10

- a. Describe a cold storage in brief. What factors are considered in design of a cold storage?
- b. Derive an expression for the equivalent diameter of circular duct corresponding to a rectangular duct of side a and b , for the same pressure loss per unit length, when (i) the quantity of air passing through both the ducts is same and (ii) the velocity of air through the ducts is same.