BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING) FOURTH YEAR FIRST SEMESTER-2024

REFRIGERATION AND AIR CONDITIONING **Time-Three Hours Full Marks-100**

Answer any FIVE questions. All questions carry equal marks.
Use of Steam Tables, Refrigerant Tables and Psychrometric charts are allowed.
Psychrometric charts carrying solutions if any, are to be enclosed with the answerscripts.

1.(a) Define COP of a a Refrigerator and a Heat Pump. When a Refrigerator and a Heat Pump are working between the same two reservoirs of high-temperature and low-temperature, what will be the relation between their COPs. 6
(b) Define one Ton of refrigeration. 4
(c) A refrigerator working on the Reversed Carrot Cycle has 45°C and 15°C as the High-temperature and low-temperature respectively. For a cooling capacity of 5 kw, what will be the power input to the refrigerator? If the same device is used as a heat pump with a power input of 5 kw, what will be the heat transfers with the two reservoirs? 10

2.(a) A R12 vapour compression system operates in the simple saturated cycle between a condenser temperature of 40°C and an evaporator temperature of 0°C. It develops 10 TR of refrigeration.Calculate for this refrigerator: 10
i) The refrigerating effect in kJ/kg and COP.
ii) The power of compression in Kw

iii) the mass flow rate of the refrigerant through the system
(b) Write the effects of subcooling of the refrigerant in the condenser on the performance of the cycle with sketches of (P-h) and (Ts) diagrams. 10

3.(a) Why the COP in a Air Refrigeration System is much less compared to the COP obtained with a Reversed Carnot cycle? Explain with a (T-s) diagram. 10
(b) Derive the Expression of COP of a Bell-Coleman Cycle. 10

4.(a) In a Bell-Coleman refrigerator,air enters into the compressor at I Bar and 25°C. It is compressed isentropically to a pressure of 7 Bar and then cooled in an air-cooler to 30°C, and then expands isentropically in an expander to a pressure of 1 Bar. Calculate the COP of the refrigerator and the mass flow rate of air for a capacity of 10TR. 10
(b) Derive the expression of COP for a Vapour Absorption refrigeration system using standard notations. 10

5.(a)In a Vapour Absorption System, dry saturated steam at 2 bar is used in the generator to supply heat. The evaporator is maintained at 2°C and the heat rejection occurs in the condenser at 30°C. Determine the maximum COP for the system. Aiso if the steam leaves the generator as saturated liquid,determine the consumption of steam per hour for 15 TR refrigeration capacity. 14

(b)Define specific humidity, percentage humidity and relative humidity of moist air. 6

6.(a) Moist air exists at one atmospheric pressure and 35°C DBT and 25°C WBT. Find the specific humidity, relative humidity, percentage humidity and dew point temperature for this air from a psychrometric chart. 12

(b) Derive a relation between the relative humidity and percentage humidity of moist air. 8

7.(a) Moist air at 760 mm Hg pressure and 35°C DBT exists with 50% degree of saturation. Find the specific humidity ,dew point temperature, relative humidity and density of the moist air.Solve without using the Psychrometric chart. 10

b) Write short notes on: 10

i) Liquid refrigerant-Suction vapour heat exchanger

ii) Dry versus Wet compression.