BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING) FOURTH YEAR FIRST SEMESTER-2025

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 answer scripts.

1) (a) A Reversed Carnot Refrigerator works between two thermal reservoirs at temperatures of 40°C and 5°C respectively. For a power input of 3kW what will be the refrigerating effect? If the same device works as a heat pump between the same two thermal reservoirs with the same power input, what will be the heat supplied to the high temperature reservoir. 10
(b) Define one Ton of refrigeration. 4
(c) Show that for a hear pump and a refrigerator working between the same two thermal reservoirs, $COP_{heatpump}$-$COP_{refrigerator}$=1. 6

2) (a) A R22 vapor compression system operates in the simple saturated cycle between a condenser temperature of 45°C and an evaporator temperature of 5°C. It develops 15 TR of refrigeration. Calculate for this refrigerator: 15
   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 change of evaporator pressure keeping the condenser pressure constant on the performance of a Simple Saturated Vapor Compression Cycle. 5

3) (a) Derive the expression of COP for a Reversed Brayton Cycle. 10

(b) What will be the effects of super heating of the refrigerant in the evaporator on the performance of a Simple Saturated Vapor Compression Refrigeration System. 10

4) (a) In a Reversed Brayton Cycle refrigerator, air enters into the compressor at 1.1 Bar and 30°C. It is compressed isentropically to a pressure of 10 Bar and then cooled in an air-cooler to 30°C, and then expands isentropically in an expander to a pressure of 1.1 Bar. Calculate the COP of the refrigerator and the mass flow rate of air for a planned capacity of 20TR. 10

(b) With a neat sketch explain the working of a Liquid Refrigerant-Suction vapor heat exchanger in a Vapor Compression Refrigeration System. 10

5) (a) Moist air at 101.325 kPa has a Dry bulk temperature of 35°C and a percentage humidity of 50%. Determine the following for this air without using psychrometric chart:

(i) Relative humidity.
(ii) Dew point temperature.
(iii) Specific humidity.
(iv) Specific volume. 15

(b) Derive the expression of specific humidity. 5

6) (a) Moist air exists at one atmospheric pressure and 32°C DBT and 28°C WBT. Find the specific humidity, relative humidity, percentage humidity and dew point temperature for this air from a psychrometric chart. 15

(b) Derive a relation between the relative humidity and percentage humidity of moist air. 5

7) Write short notes on (any two): 10+10

(i) Air Refrigeration System has much less COP compared to the Reversed Carnot Refrigeration system.
(ii) Desirable properties of Refrigerants.
(iii) Advantages of dry compression over wet compression.