Registration No.:

Total Number of Pages: 02 **Course: B.Tech**
Sub_Code: RME7D005

7th Semester Regular/Back Examination: 2024-25
SUBJECT: Refrigeration and Air Conditioning
BRANCH(S): AG, AE, MECH
Time: 3 Hours
Max Marks: 100
Q.Code: R207

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right-hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What is the Coefficient of Performance (COP) of a reversed Carnot cycle, and how is it mathematically expressed in terms of the temperatures of the heat source and sink?
b) Sketch and explain the P-h diagram for a saturated vapor compression cycle, labeling key processes and state points.
c) Draw and explain the T-s diagrams for vapor compression cycles when the vapor after compression is superheated.
d) What is the function of a flash intercooler in a refrigeration system, and how does it enhance the system's performance?
e) What are the functions of the rectifier and analyzer in an absorption system?
f) What is meant by Peltier cooling?
g) What is an azeotrope, and why is it significant? Provide some examples.
h) What is the commonly used refrigerant in domestic refrigerators?
i) List two-ways of removing moisture from air.
j) How can you get the dew point of the air corresponding T_{db}= 303 K and ϕ = 50%?

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) What is an air-refrigeration system, and where is it typically used?
b) What are sub-cooling and superheating, and how do they impact the performance of a refrigeration system? Explain with the help of P-h and T-s diagrams.
c) What is the difference between wet and dry compression in a refrigeration cycle?
d) Which components of a simple vapor-absorption system replace the compressor in a vapor-compression system? Explain with a sketch.
e) What is thermoelectric refrigeration, and what is the principle behind its working?
f) How can a thermoelectric refrigerator be used as a heat pump?
g) Why are halocarbon refrigerants commonly used?

h) What is the difference between primary and secondary refrigerants?
i) What are the different sources of cooling load in a room?
j) What factors should be considered when selecting a refrigerant for a system?
k) Sketch a 'comfort chart' and indicate the 'comfort zone' on it. Explain its significance in maintaining indoor comfort.
l) What is summer air conditioning, and how is it explained using a psychrometric chart?

Part-III
Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 A two-stage ammonia plant is to achieve a minimum temperature of –30°C when the ambient is at 40°C. The intermediate pressure is 3.413 bar. Obtain COP and tonnage of the system, if the refrigerant flow through evaporator is 0.45 kg/s. The flash intercooler is employed. **(16)**

In the above case the refrigerant at the end of compression from the LP cylinder is cooled to 35°C before it enters the flash intercooler. Sketch system (flow diagram) and the p-h diagram giving relevant property values. Find the improvement in COP over the former. Also get COP and capacity for single-stage compression.

Q4 In a vapour compression refrigeration System using R-22, the evaporator pressure is 1.4 bar and the condenser pressure is 8 bar. The refrigerant leaves the condenser sub-cooled to 30°C. The vapour leaving the evaporator is dry and saturated. The compression process is isentropic. The amount of heat rejected in the condenser is 13.42 MJ/min. Determine: (a) Refrigerating effect in kJ/kg; (b) Refrigerating load in TR; (c) Compressor input in kW; and (d) COP. Show the cycle on T-s and P-h diagram. **(16)**

Q5 Compare the working principles of the NH3-water and Li-Bromide water vapor absorption systems with sketches. Derive the expression for the maximum COP of a vapor absorption system. **(16)**

Q6 In an air conditioner the outdoor air (at 40°C DBT and 40 % RH) is mixed with return (from room) air (at 25°C DBT and 50 % RH) in the ratio of 3:2 before entering the cooling coil. The by-pass factor for the cooling coil is 0.25 and the room sensible heat factor (RSHF) is 0.8. Air flow rate (total) through the cooling coil is 8 kg/s. **(16)**

Determine: (i) ADP, (ii) Condition of air at inlet and exit of the cooling coil, (iii) Tonnage of the plant, and (iv) Rate of condensation.