Registration No.: | | | | | | | | | | |

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

7th Semester Regular/Back Examination: 2025-26
SUBJECT: Refrigeration and Air Conditioning
BRANCH(S): AE, AG, MECH
Time: 3 Hours
Max Marks: 100
Q.Code: U386

Answer Q1 (Part-I) 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) Define COP of reversed Carnot Cycle
b) Draw p-v and T-s plot for Bell-Coleman cycle
c) Write down merits and demerits of air refrigeration system.
d) Sketch the T-s and P-h diagrams for vapour compression cycles when the vapour after compression is (i) dry saturated, and (ii) wet.
e) What is the function of a flash intercooler in a refrigeration system, and how does it enhance the system's performance?
f) Draw the schematic of Electrolux system.
g) In a vapor absorption refrigeration system, heating, cooling, and refrigeration take place at the temperatures of 100 °C, 20 °C and –5 °C respectively. Find the maximum C.O.P. of the system.
h) A refrigerator operates on the ideal vapor compression refrigeration cycle with R-134a as the working fluid between the pressure limits of 120 kPa and 800 kPa. If the heat removal from the refrigerated space is 70.75 kJ/s, determine the mass flow rate of the refrigerant.
i) Name the refrigerant commonly used for the following systems:
(i) Domestic refrigerator and (ii) Room air conditioner.
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) A refrigerating system working on Bell-Coleman cycle receives air from cold chamber at – 5 ℃ and compresses it from 1 bar to 4.5 bar. The compressed air is then cooled to a temperature of 37 ℃ before it is expanded in the expander. Calculate the C.O.P. of the system when compression and expansion are (i) isentropic; (ii) follow the law $pv^{1.25}$ = constant.
b) What do you mean by sub-cooling and superheating? Explain both concepts with suitable diagrams. Also discuss why superheating is beneficial in certain applications.
c) Distinguish between a vapor-absorption refrigeration system and a vapor-compression refrigeration system with at least six key points.

d) Describe in detail the fundamental psychrometric terms commonly used in air-conditioning processes.

e) What is the difference between primary and secondary refrigerants?

f) What are eco-friendly refrigerants? Name these refrigerants and give their chemical formula.

g) Draw and explain the actual vapor compression diagram on T-s and p-h plots

h) Discuss the relative merits and demerits of flash and water intercooling used with multiple compression.

i) Briefly discuss on winter air conditioning system.

j) Sketch a 'comfort chart' and indicate the 'comfort zone' on it. Explain its significance in maintaining indoor comfort.

k) What are the different sources of cooling load in a room?

l) The amount of air supplied to an air-conditioned hall is 300 m^3/min. The atmospheric conditions are 35 °C DBT and 55 % RH. The required conditions are 20 °C DBT and 60 % RH. Find out the sensible heat and latent heat removed from the air per minute. Also find sensible heat factor for the system.

Part-III

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

Q3 **a)** Explain the working principle of air refrigerator working on a Bell-Coleman cycle using P-v and T-s diagram. Derive the expression for COP. **(8)**

b) In a vapor compression refrigeration system using R-12, 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 vapor leaving the evaporator is dry and saturated. The compression process is isentropic. The amount of heat rejected in the condenser is 23.42 MJ/min. Determine (i) refrigerating effect in kJ/kg; (ii) refrigerating load in TR; (iii) compressor input in kW; and (iv) C.O.P. **(8)**

Q4 **a)** What are the desirable properties of a good refrigerant? **(8)**

b) In a 15 TR ammonia plant, compression is carried out in two stages with water and flash intercooling and water subcooling. The particulars of the plant are as follows: **(8)**
Condenser pressure = 12 bar, Evaporator pressure = 3 bar, Flash intercooler pressure = 6 bar, limiting temperature for intercooling and sub-cooling = 20 °C. Draw the cycle on p-h chart and estimate: (i) the coefficient of performance of the plant, (ii) the power required for each compressor, and (iii) the swept volume for each compressor if the volumetric efficiency of both the compressors is 80 %.

Q5 **a)** Explain the working principle of a simple three fluid absorption system with the help of a neat schematic diagram. Compare between three fluid and two fluid absorption system. **(8)**

b) Explain with neat sketch the working principle of Thermoelectric Refrigeration. Define figure of merit. **(8)**

Q6 **a)** Describe in detail the various factors affecting human comfort in indoor environments. **(8)**

b) The readings from a sling psychrometer are as follows: Dry bulb temperature = 30 °C, Wet bulb temperature = 20 °C, Barometer reading = 740 mm of Hg. Using steam tables, determine: Dew point temperature, Relative humidity, Specific humidity, Degree of saturation, Vapour density, and Enthalpy of mixture per kg of dry air. **(8)**