(Revised course)

(3 Hours) [Total Marks 80]

Note: 1) Question no. **1** is compulsory.

2) Attempt any **three** questions out of the remaining **five** questions.

3) Clearly mention the assumptions made if any.

4) Use of Refrigerant tables, P-h Chart, Friction charts, Psychrometric chart, and Steam tables are permitted.

Q 1 Answer any Four of the following: 20

a) Explain with a neat schematic diagram use of Liquid Suction heat exchanger in a Vapour Compression system.

b) What are eco-friendly refrigerants? Discuss with examples.

c) List down types of aircraft refrigeration systems. How are these systems compared on the basis of DART?

d) A reversed Carnot cycle air conditioner of 1 TR capacity operates with evaporator coil temperature $t_0 = 7\ ^0C$. The surrounding air at $43\ ^0C$ is used as a cooling medium rising to a temperature of $53\ ^0C$. The temperature of heat rejection is $t_k = 55\ ^0$. Determine COP, power consumption of the air conditioner and the mass flow rate of surrounding air entering the condenser. Take C_p for air as 1.005 kJ/Kg K.

e) Define RSHF, GSHF and ERSHF.

f) Discuss advantages of vapour absorption refrigeration system over vapour compression refrigeration system.

Q 2 a) In a laboratory test, a psychrometer recorded dry bulb temperature as $34\ ^0C$ and 8 wet bulb temperature of $26\ ^0C$. Without using Psychrometric chart, calculate:

i) Vapour pressure   ii) Relative humidity   iii) Specific humidity iv) Degree of saturation v) Dew point temperature   v) Enthalpy of mixture

Barometric pressure = 740 mm of Hg

b) What are different types of Cooling Towers ? Explain with a neat sketch an 6 Induced Draft type Cooling Tower.

c) What are the sources of cooling load? Explain how will you estimate cooling load 6 of your College Library.

Q 3 a) A regenerative air refrigeration system for an aeroplane is designed to take a load   **12**
of 25 TR. The temperature and pressure conditions of the atmosphere are 5 C and 0.85 bar.
The pressure of the air is increased from 0.85 bar to 1.2 bar due to ramming action. The
pressure of air leaving the main compressor is 4.8 bar. 60 % of the total heat of the air
leaving the main compressor is removed in the heat exchanger and then it is passed through
the cooling turbine. The temperature of the rammed air which is used for cooling purposes
in the heat exchanger is reduced to 50 C by mixing the air coming out from the cooling
turbine. The isentropic efficiencies of the compressor and turbine are 90 % and 80 %
respectively. The pressure and temperature required in the cabin are 1 bar and 25 C
respectively. Assuming isentropic ramming and mass of cooled air passing through the heat
exchanger equal to the mass of cooling air , find ; i. the ratio of by-passed air to ram air
used for cooling purposes ; and ii. the power required for maintaining the cabin at required
condition.

b) Discuss with a block diagram triple fluid Vapour Absorption refrigeration system.   **4**

c) Explain with the help of a neat sketch, the working of a refrigerating system   **4**
having three evaporators at different temperatures with individual compressors and
multiple expansion valves.

Q 4 a) A vapour compression system using NH_3 works between $-15\,^0C$ and $40\,^0C$ **10**
as evaporator and condenser temperature respectively. The vapour is superheated by $5\,^0C$
before entering compressor and liquid is subcooled by $5\,^0C$. Using P-h chart determine :
    i) COP
    ii) Mass flow of refrigerant per TR
    iii) Piston displacement per TR using volumetric efficiency = 80 %
    iv) Heat rejected in the condenser per TR; and
    v) Ideal COP

b) Draw front and side view of a Window Air Conditioner and explain the various   **6**
components inside the Unit.

c) What are the methods of duct design? Explain any one method in detail.   **4**

Q 5 a) The following data refer to an air conditioned space: **14**

Outdoor condition	$38\,^0C$, 50 % RH
Room condition	$24\,^0C$, 50 % RH
Sensible heat load	26 kW
Latent heat load	8 kW
By-pass factor of the cooling coil	0.16

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If the ventilation requirement is such that on mass flow rate basis, 20 % of fresh air is introduced and 80 % of supply is recirculated, determine:

      i) Supply air flow rate
      ii) Outside air sensible heat
      iii) Outside air latent heat
      iv) Grand total heat
      v) Effective room sensible heat factor

b) Discuss in details various controls used in a Central Plant Air Conditioning system,   6

Q 6 Write short notes on any **four** of the following: 20

a) Types of Condensers and Evaporators
b) Thermoelectric Refrigeration
c) Year round Air Conditioning System
d) Pressure and Temperature Controls
e) BEE Star Rating System
f) Bootstrap Cooling System

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