

(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 table, P-h chart, Friction chart, Psychrometric chart and Steam table is permitted.

Q.1 Answer any **Four** of the following:

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- a) Explain Standard VCR cycle with schematic, P-h & T-S diagrams.
- b) Explain the terms SHF, RSHF, GSHF and ERSHF.
- c) Define refrigerant and classify refrigerant giving examples of each.
- d) Define By-Pass Factor of a coil. Express it for heating & cooling coil. Also define efficiency of coil.
- e) Write short note on Thermal Comfort
- f) Define: Specific Humidity, Relative Humidity, DBT, WBT & DPT

Q.2 a) A boot strap cooling system of 10 TR Capacity is used in an aeroplane. The ambient air temperature and pressure are 20 °C & 0.85 bar respectively. The pressure of air increases from 0.85 bar to 1 bar due to ramming action of air. The pressure of air discharged from the main compressor is 3 bar. The discharge pressure of air from the auxiliary compressor is 4 bar. The isentropic efficiency of each compressor is 80%, while that of turbine is 85%. The heat exchanger effectiveness for both the heat exchanger is 60%. Assuming ramming action to be isentropic, the required cabin pressure of 0.9 bar and temperature of air leaving the cabin not more than 20 °C, Find: Power required to operate the system, COP of system.

12

b) Explain following Psychrometric Processes with neat sketch.

08

- (i) Heating & Humidification. (ii) Cooling & Dehumidification. (iii) Sensible Heating
(iv) Sensible Cooling

Q.3 a) A Vapour Compression Refrigeration System using R-12 works between -25°C and 40°C as evaporator & condenser temperature respectively. Using P-h chart, Determine;

1. COP.
2. Mass of Refrigerant per TR.
3. Piston Displacement per TR using Volumetric Efficiency = 83%.
4. Heat Rejected in the Condenser per TR.
5. Ideal COP.

12

b) Enlist the types of Air Cooling Systems. Explain Simple Air Cooling System with T-S diagram, processes involved in the cycle & application.

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Q.4 a) The readings from the Sling Psychrometer are as follows;
Dry Bulb Temperature = 30°C; Wet Bulb Temperature = 20°C; Barometric Reading = 740 mm of Hg;

Using Steam Table, Determine;

1. Dew Point Temperature.
2. Relative Humidity.
3. Specific Humidity.
4. Enthalpy of the mixture per kg of dry air.

10

b) Derive an expression for an equivalent diameter of a circular duct for rectangular duct for same frictional loss per unit length when quantity of air flowing through both ducts is same.

06

c) Write short note on Applications of Refrigeration & AC.

04

Q.5 a) The following data is given for Summer air conditioning of a building:

Outside design conditions = 43°C DBT, 27°C WBT

Inside design conditions = 25°C DBT, 50 %RH

Room Sensible Heat Gain = 84,000 kJ/hr

Room Latent Heat Gain = 21,000 kJ/hr

By-Pass Factor of cooling coil = 0.2

The return air from the room is mixed with the outside air before entering the cooling coil in the ratio

of 4:1 by mass. Determine;

1. Apparatus Dew Point of the cooling coil.
2. Inlet & Outlet conditions of air for cooling coil.
3. Fresh air mass flow rate.
4. Capacity of cooling coil in TR.

14

b) Classify cooling towers. Explain any one type in details. Define Tower Range, Tower Approach & Tower Efficiency.

06

Q.6) Write short note on any **Four** of the following:

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- a) Classification of Heat Pumps.
- b) ICE plant.
- c) Thermostatic Expansion Valve.
- d) ASHRAE Numbering system for Refrigerants.
- e) Effective Temperature.
- f) Duct design methods.