Paper / Subject Code: 89423 / Heating, Ventilation, Air Conditioning and Refrigeration

1T01436 - T.E.(Mechanical) Engineering)(SEM-VI)(Choice Base Credit Grading System) ((R-20-21) (C Scheme) / 89423 - Heating, Ventilation, Air Conditioning and Refrigeration

QP CODE: 10015040   DATE: 13/12/2022

(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: **20**

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 ℃ & 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 ℃, 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.   **08**

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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: **20**
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.

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