

Please check that this question paper contains 09 questions and 02 printed pages within first ten minutes.

[Total No. of Questions: 09]

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Uni. Roll No.

Program: B. Tech. (Batch 2018 onwards)

Semester: 6th

Name of Subject: Refrigeration and air conditioning

Subject Code: PCME-116

Paper ID: 17253

Time Allowed: 03 Hours

Max. Marks: 60

NOTE:

1. Parts A and B are compulsory.
2. Part-C has Two Questions Q8 and Q9. Both are compulsory, but with internal choice.
3. Any missing data may be assumed appropriately.
4. Use of Refrigeration Table and Psychometric Chart is allowed.

Part -A

[Marks: 02 each]

Q1.

- a) What is DART?
- b) Draw a line and p-h diagram for three stage compression with flash chambers vapor compression system.
- c) What is sensible heat factor?
- d) Write the chemical name and formula for R12 and R134a refrigerant.
- e) Discuss briefly the inverter system in VCERS.
- f) A cold storage is to be maintained at -5°C while the surroundings are at 35°C . the heat leakage from the surroundings into the cold storage is estimated to be 29kW. The actual COP of the refrigerator is one third to an ideal COP between same temperatures. Find the power required to drive the plant.

Part -B

[Marks: 04 each]

- Q2. A simple saturation cycle using R-12 is designed for taking a load of 10 tons. The refrigerator and ambient temperature are -0°C and 30°C respectively. A minimum temperature difference of 5°C is required in the evaporator and condenser for heat transfer. Find: 1. Mass flow rate through the system, 2. Power required in kW and 3. COP of system.
- Q3. Drive an expression for COP and power required for boot-strap air evaporative cooling system with detailed discussion. Also draw the line and T-s diagrams.
- Q4. A restaurant with 100 person capacity is to be air conditioned with the following data:
 Outside conditions = 30°C DBT and 70% RH
 Desired inside conditions = 23°C DBT and 55% RH
 Volume of air supplied = $0.5 \text{ m}^3/\text{min./person}$
 The desired conditions are achieved by cooling, dehumidifying and then heating. Determine: 1. Capacity of cooling coil in tons of refrigeration, 2. Capacity of heating coil, 3. Amount of water removed by dehumidifier.
- Q5. 200 m^3 of air per min. is passed through the adiabatic humidifier. The condition of air at inlet is 40°C dry bulb temperatures and 15% relative humidity and the outlet condition is

- 25°C dry bulb temperature and 20°C wet bulb temperature., Find the dew point temperature and the amount of water vapor added to the air per minute.
- Q6. What is effective temperature? Discuss the factors that affect the optimum effective temperature.
- Q7. 1.5kW per ton of refrigeration is required to maintain the temperature of -40°C in the refrigerator. If the refrigeration cycle works on Carnot cycle, determine the following: 1. COP of the cycle, 2. Temperature of the sink, 3. Heat rejected to the sink per ton of refrigeration, and 4. Heat supplied and EPR, if the cycle is used as a heat pump.

Part -C

[Marks: 12 each]

- Q8. A simple evaporative air refrigeration system is used for an aeroplane to take 20 tons of refrigeration load. The ambient air conditions are 20°C and 0.9 bar. The ambient air is rammed isentropically to a pressure of 1 bar. The air leaving the main compressor at pressure 3.5 bar is first cooled in the heat exchanger having effectiveness of 0.6 and then in the evaporator where its temperature is reduced by 5°C. The air from the evaporator is passed through the cooling turbine and then it is supplied to the cabin which is to be maintained at a temperature of 25°C and at a pressure of 1.05 bar. If the internal efficiency of the compressor is 80% and that of cooling turbine is 75%, determine: 1. Mass of air bled off the main compressor, 2. Power required for the refrigerating system, and 3. COP of the refrigerating system.

OR

Drive the relation for the COP and power required to drive the three stage compression with water intercooler refrigeration system. Also draw the T-s diagram and a neat sketch for the system.

- Q9. A conference room for seating 100 persons is to be maintained at 22°C dry bulb temperatures and 60% relative humidity. The outdoor conditions are 40°C dry bulb temperature and 27°C wet bulb temperature. The various loads in the auditorium are as follows:
Sensible and latent heat loads per person, 80W and 50W respectively, lights and fans, 15000W, sensible heat gain through glass, walls, ceiling etc., 15000W, The air infiltration is 20m³/min and fresh air supply is 100m³/min. Two-third of recirculated room air and one third of fresh air are mixed before entering the cooling coil. The by-pass factor of the coil is 0.1. Determine apparatus dew point temperature, the grand total heat load and effective room sensible heat factor.

OR

- (a) What are inorganic refrigerants? Discuss in detail the properties and application of each inorganic refrigerant.
- (b) One kg of air at 40°C dry bulb temperature and 50% relative humidity is mixed with 2kg of air at 20°C dry bulb temperature and 20°C dew point temperature. Calculate temperature and specific humidity of the mixture.
