Code No: 07A60302 **R07** **Set No. 2**

III B.Tech II Semester Examinations,December 2010
REFRIGERATION AND AIR CONDITION
Mechanical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain, with the help of a neat sketch, the working of a steam jet refrigeration system.
   (b) What are the advantages of barometric condenser over surface condenser in steam jet refrigeration system? [10+6]
2. (a) Define the "human comfort" and explain the factors which affect human comfort.
   (b) Explain the mechanism of human body which controls the body temperature as per atmospheric conditions [6+10]
3. (a) Discuss the various types of duct systems and their applications.
   (b) What are the characteristics of good air distribution system? Discuss the location of supply and return grills in obtaining good air distribution. [8+8]
4. (a) Discuss the advantages of vapor absorption refrigeration system over vapour compression refrigeration system.
   (b) What modifications are necessary in a simple absorption refrigeration system in order to improve the performance of the system? [8+8]
5. Outside air at 33^0C and 48% relative humidity is to be conditioned so that the final temperature and relative humidity are 22^0C and 32%. If the flow process occurs under constant-pressure conditions, compute
   (a) The quantity of water removed per kilogram of dry air
   (b) The heat removed in the initial cooling process per kilogram of dry air and
   (c) The heat added after the initial dehumidification process per kilogram of dry air. Assume standard atmospheric pressure. [16]
6. (a) Why a throttle valve is used in vapour compression refrigerator rather than an expansion cylinder to reduce the pressure between the condenser and evaporator .
   (b) An ice production machine produces 21 tons of ice in 24 hours when water is supplied at 0^0C. The temperature range of the machine is -13^0C to 22^0C. The vapour leaves the compressor in dry and saturated conditions and there is no under cooling in the condenser. If the actual COP is 75% of theoretical, find indicated power of the compressor. The latent heat of ice is 330 KJ/Kg. [6+10]

7. (a) Explain how a reversed Brayton cycle can be modified to approach a reversed Carnot cycle by means of multistage compression with inter cooling and also multistage expansion. Sketch P-V and T-s diagrams for the modified cycle.

   (b) A Carnot engine working between reservoir temperatures at T_1 and T_2 drives a Carnot refrigerator working between reservoir temperatures at T_h and T_2 ($T_1 > T_h > T_2$). Prove that the heat rejected to the reservoir at T_h for heat H added at temperature T_1 is given by H $[(T_1 - T_2) / T_1]$ $[T_h / (T_h - T_2)]$.

[8+8]

8. (a) Explain why reciprocating compressor cannot be used as a vacuum pump for producing high vacuum.?

   (b) A reciprocating compressor operates on $1m^3$/min of gas at 2 bar and delivers it at 12 bar. The clearance is 6%. The adiabatic compression index is 1.3. Determine the change in work of compressor if the re-expansion index is 1.1 instead of 1.31.

[6+10]

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Code No: 07A60302 **R07** **Set No. 4**

III B.Tech II Semester Examinations,December 2010
REFRIGERATION AND AIR CONDITION
Mechanical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. Briefly explain the working of a constant volume variable temperature air conditioning system with the help of refrigeration control with a neat sketch. [16]

2. (a) Explain how does the body attempt to compensate for a cool environment which tends to lower the internal temperature?
   (b) Why ventilation is required? Explain why different ventilation standards for different purposes are recommended? [6+10]

3. (a) What is the situation under which the Steam Jet Refrigeration system is recommended? What are its limitations? Can it be used for obtaining sub-zero temperatures?
   (b) Explain the various components of Steam Jet Refrigeration system and clearly discuss the function of each component. [6+10]

4. (a) Explain the working of a simple air cycle cooling system used for air crafts.
   (b) 700 kg of air is circulated in an open cycle air refrigeration machine per hour. The air is drawn into compressor at 10^0C and compressed isentropically to 4.5 bar. It is further cooled to 25^0C at the same pressure and expanded isentropically to pressure of 1 bar and returned to cold chamber. Take $\gamma = 1.4$ and $C_p = 1.005\ kJ/kg^0$ C for air. Find
      i. Refrigeration load of cold storage in tons.
      ii. Actual COP of the machine,if indicated power of the compressor is 20 kW.

   [6+10]

5. (a) Explain with the help of neat sketches the various components and their functions for a vapour absorption refrigeration system.
   (b) Discuss the function of rectifier and analyser in vapour absorption refrigeration systems. [8+8]

6. (a) What is sub-cooling and super heating? Explain with the help of diagram, why is super heating considered to be good in certain cases?
   (b) A F-12 refrigeration machine works between the pressures of 9.9 and 3.3 bars. The condition of the vapour leaving the compressor is 92% dry and there is under cooling in the condenser. Determine the theoretical COP of the machine. [6+10]

7. An air-conditioning system is to be designed for cinema-hall of 800 seating capacity when the following data is known. Out door conditions: 10^0C and 72% R.H., Indoor required conditions: 22^0C and 58% R.H., Amount of air supplied: 0.25 m^3/min/person. The required conditions are achieved first by heating, then by adiabatic humidifying and finally by heating. The condition of air coming out of the humidifier is 77

   (a) Heating capacity of the first heater in kW and condition of the air coming out of the first heating coil. Also find the surface temperature required if the by-pass factor is 0.28

   (b) Heating capacity of the second-heater in kW and by-pass factor if the surface temperature of the coil is maintained at 21^0C. [16]

8. (a) What is a refrigerant? Can water be used as refrigerant? Explain the limitations.

   (b) Name three refrigerants that are suitable for ice plants giving their relative merits and demerits.

   (c) What are azeotropes? [6+6+4]

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Code No: 07A60302 **R07** **Set No. 1**

III B.Tech II Semester Examinations,December 2010
REFRIGERATION AND AIR CONDITION
Mechanical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. The following data is given for the space to be air conditioned : Outside air conditions = 45^0C DBT and 28^0C WBT, inside design conditions = 23^0C DBT and 47% RH, room sensible heat load = 45 kW, room latent heat load = 15 kW, by-pass factor of the cooling coil = 0.21, the return air from the room is mixed with the outside air before entry to the cooling coil in the ratio of 3.5: 1 by mass. Determine
   (a) Supply air flow rate.
   (b) Outside air sensible heat.
   (c) Outside air latent heat
   (d) Grand toal heat.
   (e) Effective room sensible heat factor. [16]
2. (a) What is principle of a steam jet refrigeration system?
   (b) Draw the temperature-entropy and enthalpy-entropy diagram of a steam jet refrigeration system and write the expressions for the following efficiencies:
      i. Nozzle efficiency.
      ii. Entrainment efficiency.
      iii. Compression efficiency. [6+10]
3. (a) With the help of a schematic diagram, explain the functioning of thermostatic expansion valve.
   (b) Compare the performance of reciprocating and centrifugal compressors. [8+8]
4. Discuss the effect of chilled water flow control on cooling coil performance with respect to room RH for a room with varying sensible heat gain and relatively constant latent heat gain. [16]
5. (a) Mention the function of each fluid in a three-fluid vapour absorption system.
   (b) Explain how the function of compressor in vapor compression system is achieved in vapor absorption refrigeration system. [8+8]
6. (a) What is foreign material? Why is it objectionable in refrigeration system? What are the methods to prevent it?
   (b) A vapour compression refrigerator works between the pressures of 4.84 and 1.88 bars. The temperature of vapour leaving the compressor is 26^0C. The liquid is cooled to 8^0C before throttling. The vapour is 95% dry before compression. The specific heat at constant pressure for superheated vapour is 0.6

and for liquid $0.9kJ/kg^0$C. Find the COP of the refrigerator.Represent the cycle on p-h chart.

[6+10]

7. The following two indoor conditions give the same comfort when the out-door conditions are 38^0C and 62% R H.

   (a) 20^0C DBT and 60% R.H.

   (b) 24^0C DBT and 50

   The required conditions are achieved first by cooling and dehumidifying and then by heating. The dew-point temperature of the cooling coil is 8^0C. If the supply of free air to the air-conditioning system is 450 m^3/min., then find the cost of the plant for 24-hours working for both comfort conditions. Also find the by-pass factors of the cooling coils in both cases if the Cost of cooling = 50 Paise per ton of refrigeration and the Cost of heating = 15 Paise per kWh. [16]

8. The data refer to a reduced ambient air refrigeration system used for an aircraft are: speed of air craft = 1500 km/hr, ambient pressure = 0.8 bar, ambient temperature = 5^o C, ram efficiency = 100%, pressure of cooled air leaving the first cooling turbine = 0.8 bar, temperature of cooled air leaving the heat exchanger = 100^0C, pressure ratio of the main compressor = 3, pressure loss between the outlet of second cooling turbine and the cabin = 0.1 bar, pressure in the cabin = 1 bar, temperature in the cabin = 22^0C, load in the cabin = 10 TR, isentropic efficiency of compressor = 85%, isentropic efficiency of both cooling turbines = 80%. Find

   (a) Mass flow of the air passing through the second cooling turbine.

   (b) Quantity of ram air passing through the heat exchanger, if the rise in temperature is limited to 80 K.

   (c) COP of the system. [16]

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Code No: 07A60302 **R07** **Set No. 3**

III B.Tech II Semester Examinations,December 2010
REFRIGERATION AND AIR CONDITION
Mechanical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is fog? Show on the psychrometric chart when two air streams yield fogged state of air.
   (b) The air at 45^0C DBT and 38% R.H. is passed through adiabatic humidifier and it comes out with 28^0C DBT and fully saturated. Find the quantity of water vapour added per kg of dry air. Assume air pressure = 1.03 bar. Use psychrometric formulae. [8+8]

2. (a) What is the effect of latent heat of absorbant on performance of the absorption systems.
   (b) What are the desirable requirements of a Refrigerant - Absorbent pair.
   (c) Derive the expression for maximum C.O.P of the vapor absorption system. [4+6+6]

3. (a) Draw the refrigeration cycle on T-s diagram when the refrigerant is dry and saturated at the end of compression and find an expression for the COP in terms of
      i. Temperature and entropies.
      ii. Enthalpies.
   (b) A CO_2 refrigerating plant works between the pressure limt of 56 bar and 21 bar. The vapour leaves the compressor at 34^0C and there is no undercooling in the condenser. Find theoretical COP of the system. Assume total heat per kg of vapour after leaving the compressor is 230 kJ/kg. [8+8]

4. Explain the working principle of thermoelectric refrigeration system and compare the working of different components of this system with that of vapour compression system. [16]

5. (a) What are the advantages of air-conditioned system over all water air-conditioned system?
   (b) What are the different methods of controlling the temperature? Discuss their relative merits. [8+8]

6. (a) When the regenerative cooling system is more preferable over the others?
   (b) For an air craft cabin cooling system, a turbine is to exhaust air at 0.7 bar and 5^0C at a rate of 2 kg/sec. The turbine drives a compressor which takes in air at 0.7 bar and 50^0C. The air discharged from the compressor is mixed

with air at the same statebled from the main engine compressor. It is then cooled to 60^0C before entering the cooling turbine. Assuming compression and expansion are isentropic, determine the pressure and the flow rate of air to be bled from the main engine compressor. [6+10]

7. The following data refer to summer air conditioning of a restaurant : Inside design conditions = 25^0C DBT and 19^0C WBT, outside design conditions = 36^0C DBT and 25^0C WBT, sensible heat load = 1,30,000 kJ/h, latent heat load = 50 000 kJ/h, the outside air is supplied at the rate of 23 m^3/min directly into the room through ventilators and by infiltration. The outside air to be conditioned is passed through a cooling coil which has an apparatus dew point of 10^0C and 58% of the total air is recirculated from the conditioned space and mixed with conditioned air after the cooling coil. Find:
   (a) Condition of air after the cooling coil before mixing with recirculated air
   (b) Condition of air entering the restaurant.
   (c) Mass of fresh air entering the cooling coil.
   (d) By-pass factor of the cooling coil.
   (e) Total refrigeration load of the cooling coil. [16]

8. (a) With the help of a schematic diagram, explain the functioning of thermostatic expansion valve.
   (b) Explain the functioning of scroll compressor for refrigeration applications. [8+8]

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