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

III B.Tech II Semester Examinations,APRIL 2011
REFRIGERATION AND AIR CONDITIONING
Mechanical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain how does the body attempt to compensate for a warm environment approaching body temperature?
   (b) Draw and explain the comfort chart and zone of comfort for year-round air-conditioning. [6+10]

2. (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]

3. Draw a neat diagram of constant volume induction system of air conditioning and explain its working. List out its merits over other systems. [16]

4. (a) What is the difference between wet bulb temperature and thermodynamic wet bulb temperature?
   (b) Twelve grams of moisture per kg of dry air is removed from atmospheric air when it is passed through an air-conditioning system and its temperature becomes 27^0C. The atmospheric conditions are 44^0C DBT and 64 % R .H. Find the following:
      i. Relative humidity.
      ii. Wet-bulb temperature.
      iii. Dew-point temperature. Take air pressure as 1.03 bar. [6+10]

5. (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]

6. (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]

7. The motive steam to a flash water plant is supplied at 6.5 bar dry and saturated, make up water is at 28^0C and condenser pressure is 3.5 cm Hg absolute. The flash

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chamber water is at 8^0C. Assuming nozzle efficiency 84%, entrainment efficiency 64% and diffuser efficiency 79%, quality of steam and vapour mixture at inlet to diffuser as 0.88, Determine

(a) Steam required per hr. per ton of refrigeration.

(b) Steam required per kg of flashed vapour. [16]

8. The data refer to a reduced ambient refrigeration system are: ambient pressure = 0.8 bar, pressure of ram air = 1.1 bar, temperature of ram air = 20^0C, pressure at the end of main compression = 3.3 bar, efficiency of main compressor = 80%, heat exchanger effetctiveness = 80%, pressure at the exit of the auxiliary turbine = 0.8 bar, efficiency of auxiliary turbine = 85%, temperature of air leaving the cabin = 25^0C, pressure in the cabin = 1.013 bar, flow rate of air through cabin = 60 kg/min. Find

(a) The capacity of cooling system required.

(b) Power needed to operate the system.

(c) COP of the system. [16]

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III B.Tech II Semester Examinations,APRIL 2011
REFRIGERATION AND AIR CONDITIONING
Mechanical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (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]

2. (a) Why artificial cooling is required in aeroplanes?
   (b) A domestic electric refrigerator operates with an electrical energy input of 1.5 kW-hr per 24 hours. The interior temperature of the cabinet is maintained at 25^0C when the room air is maintained at 30^0C. Combined heat losses of motor and compressor are 35% of the electrical input. The heat transfer to the condenser is 2.6 times the electrical input to the motor. Determine the COP of the system based on the electrical input. [6+10]

3. (a) What are the specific problems concerned to factory air conditioning?
   (b) What methods are adopted for factory air conditioning? [8+8]

4. (a) For hot and dry weather conditions show the arrangement of summer air conditioning system and represent the processes on psychrometric chart.
   (b) Air at 42^0C and 32% relative humidity is passed through an adiabatic air washer at the rate of 30 m^3/min. Find the state of air leaving the air washer, if the effectiveness of the air washer is 82%. [8+8]

5. An ammonia refrigerator works between -18^0C and 28^0C. The vapour is dry at the end of isentropic compression. Assuming there is no undercooling, calculate
   (a) Theoretical COP
   (b) Power of the compressor to absorb 92000 kJ of heat per hour. Compare the COP obtained with that of an ideal reverse Carnot cycle working between the same temperature limits. Represent both the cycles on p-h chart. [16]

6. 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]

7. (a) Discuss the advantages of vapor absorption refrigeration system over vapour compression refrigeration system.

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(b) What are the different refrigerant - absorbent working pairs and what is the effect of evaporator temperature on performance of absorption systems? [8+8]

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,APRIL 2011
REFRIGERATION AND AIR CONDITIONING
Mechanical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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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. An aircraft cooling system consists of a compressor, cooler and expansion turbine. The compressor receives air at 1.2 bar and 60^0C from the engine supercharger. It is compressed isentropically with an efficiency of 75% to 1.6 bar and cooled to 55^0C. The air then expands isentropically through the turbine to 0.85 bar, the work developed is used to drive the compressor. The turbine exhaust air is then sent to the aircraft cabin for cooling. Determine
   (a) Temperature of air at turbine exhaust and turbine efficiency.
   (b) COP of the system. [16]

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. (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]

5. (a) Define a semiconductor and explain its properties from thermo-electric refrigeration point of view. Explain the difference between N-type and P-type semiconductors. Which are more useful for thermo electric refrigeration system?
   (b) Give the applications of thermo electric refrigeration. [8+8]

6. A laboratory has 27 kW sensible and 23 kW latent heat load. The inside design conditions of air are 20^0C DBT and 53% R.H. and outside design conditions of air are 38^0C DBT and 25^0C WBT. The ventilation air used is 76 m^3/min. A cooling coil with a bypass factor of 0.06 must be used. An apparatus DPT is 8^0C. Determine

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(a) Amount of reheat required.

(b) Supply air quantity.

(c) DBT and WBT of air entering and leaving the apparatus.

(d) Supply air temperature. [16]

7. (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]

8. The atmospheric air at 38^0C DBT and 55% R.H. and at pressure of 1.03 bar is passed, with a rate of 30 m^3 per minute through air conditioning system and cooled down to 13^0C DBT. This cooled air is further passed through a water heater and heated to 26^0C. Find the final R.H. and quantity of water vapour removed per hour. The temperature of water inlet and outlet through the water heating coil are 32^0C and 27^0C. Find the amount of water circulation in kg per minute through the heating coil. [16]

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

III B.Tech II Semester Examinations,APRIL 2011
REFRIGERATION AND AIR CONDITIONING
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) When do the DBT, WBT and DPT become equal?
   (b) Air at 37^0C, 44 percent relative humidity, is cooled to 23^0C by spraying water at 13^0C into it. The mixture pressure remains constant at 101.3 kPa. Assuming that all of the water evaporates and that the mixing occurs in an insulated duct, calculate the mass of water added per kilogram of air.
   (c) What are different latent heat loads that are to be considered in the design of air conditioners. [4+6+6]

3. (a) List out the advantages of vapour compression refrigeration system over air refrigeration system.
   (b) A refrigerating machine using NH_3 operates between the temperature limits of -15^0C and 30^0C. Find the COP of the system. Also find the corresponding value for a reversed Carnot cycle opearting between the same temperatures. Make the necessary assumptions. [6+10]

4. The following data refer to an air-conditioning system of a cinema hall for winter conditions: Outdoor conditions = 8^0C DBT, 57% RH, required comfort conditions = 20^0C DBT, 57% RH, seating capacity = 1800, amount of outdoor air supplied = 0.22 m3/min/person. The required condition is achieved by heating, humidifying and then again by heating. The air coming out of the humidifier is having 72% relative humidity. Find:
   (a) The heating capacity of the first heater in kW and the surface temperature of the coil if its by-pass factor is 0.27.
   (b) The capacity of the humidifier in kg/h.
   (c) The heating capacity of the second heater and its by-pass factor, if the surface temperature of the coil is 23^0C. [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]

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6. (a) Explain why the mineral oils are not used as lubricants for HFCs?
   (b) Explain the terms:
      i. Azeotrope
      ii. Hermetically sealed compressor.
   (c) Explain why refrigerant R22 cannot be used with Hermatically sealed compressors.

[6+5+5]

7. (a) With the help of a neat sketch explain the working of a regenerative air cooing system.
   (b) A dense air refrigerating machine operates between 3 bar and 12 bar. The air temperature entering the compressor and expansion cylinder are 1^0C and 30^0C respectively. If the expansion is isentropic and compression follows the law $PV^{1.32}$=C, determine power required for a capacity of 2000 kJ of heat extracted from cold room per minute and COP of the system. [8+8]

8. What are the various sources for heat pump? Discuss each one of them briefly. [16]

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