Code No: RR410305 **Set No. 1**

IV B.Tech I Semester Regular Examinations, November 2005
REFRIGERATION & AIR CONDITIONING
(Mechanical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. In a Bell Coleman refrigerating machine, the air is drawn from the cold chamber at a pressure of 1.03 bar and temperature of -10^{0}C and compressed isentropically to 6.18 bar. The same is cooled to 25^{0}C. It is then expanded in the expansion cylinder following the law $pV^{1.3}$ = C and discharged back to the cold chamber. Assume Cp = 1.004 kJ/kg ^{0}K and Cv = 0.717 kJ/kg ^{0}K for the air throughout the cycle. Determine,
   (a) work input to the cycle per kg of air
   (b) refrigeration produced in the cold chamber
   (c) COP of the cycle [16]

2. (a) What are the merits and demerits of vapour compression systems over vapour absorption systems? [6]
   (b) Explain the working of a simple vapour compression system with the help of a schematic diagram. [10]

3. (a) Explain the working of a rotary screw compressor. [10]
   (b) How the capacity control is achieved in refrigerant compressor? [6]

4. (a) What are the different types of evaporators used in a vapour compression refrigeration system? Explain the working of any one of them [10]
   (b) What are the advantages and disadvantages of capillary tube over other types of expansion devices? [6]

5. The following efficiencies must be assumed
   Isentropic efficiency of turbine = 90%
   Steam jet refrigeration nozzle efficiency = 90%
   Entrainment efficiency = 65%
   Thermo compressor efficiency = 65%
   The steam enters the thermo compressor at 0.01 bar and with dryness fraction of 0.94, make up water enters the flash chamber at 18^0C
   determine (using Mollier diagram)
   (a) State of steam at all salient points
   (b) Quantity of steam leaving the flash chamber
   (c) Quality of steam generated in the boiler

(d) COP of the steam jet refrigeration system based on the heat in put of the motive steam

Assume the same condenser for power turbine and steam jet refrigeration.[16]

6. In a Steam jet refrigeration system dry saturated steam at 7 bar abs. pressure is supplied. The flash chamber temperature is 5^oC, the condenser temperature is 40^oC, make up water is supplied at 20^oC. Assuming that quality of motive steam and flash vapour at the beginning of compression as 93% dry and efficiency of the nozzle, efficiency of entertainment and the efficiency of the thermo-compressor as $90\%, 65\% and 91\%$ respectively. Determine:

   (a) Weight of steam required per hour per ton of refrigeration.

   (b) The volume of vapour removed from the flash chamber per hour per ton of refrigeration. [16]

7. (a) An air-water vapor mixture enters a heater-humidifier unit at 5^oC, 100kpa, 50%RH. The flow rate of dry air is 0.1 kg/sec. Liquid water at 10^oC is sprayed in to the mixture at the rate of 0.002 kg/sec. The mixture leaves the unit at 30^oC, 100kpa. Calculate

      i. The R.H at the outlet

      ii. The rate of heat transfer to the unit. [10]

   (b) What is chemical dehumidification? What is an absorbent? [6]

8. (a) Illustrate with an example how heat pump can be used for dehumidification process. [10]

   (b) Write notes on electrically driven heat pump for heating and cooling. [6]

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Code No: RR410305 **Set No. 2**

IV B.Tech I Semester Regular Examinations, November 2005
REFRIGERATION & 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 refrigeration plant working on Bell - Coleman cycle maintains a refrigeration temperature of - 15^0C and compresses the air from 1 bar to 7 bar with an index of compression 1.3. Heat from the compressed air is then removed such that the air cooled to 30^0C before expansion. The index of expansion is 1.35 calculate:

   (a) The ideal COP

   (b) Quantity of air circulated per minute so as to manufacture the ice at the rate of 2 metric tons per day from water available at 30^0C.

   (c) What is the capacity of the plant then in tons of refrigeration?

   For air cp 1.05 kJ/kgK, $\gamma = 1.4$, latent heat of fusion of ice at 0^0C is 335 kJ/kg.Cp of water = 4.1868 kJ/kgK. [16]

2. (a) What is COP of a refrigeration system? [2]

   (b) A refrigerating machine using F-12 as working fluid works between temperatures 18^0C and 37^0 C. The enthalpy of liquid at 37^0C is 455 kJ/kg. The enthalpies of F-12 entering and leaving the compressor are 563.15 kJ/kg and 595.4 kJ/kg respectively the mass flow of refrigerant is 2 kg/min and the efficiency of compressor is 0.85. Determine

      i. The capacity of the plant

      ii. power required to run the plant

      iii. COP of the plant [14]

3. (a) Explain the working of a rotary screw compressor. [10]

   (b) How the capacity control is achieved in refrigerant compressor? [6]

4. (a) What are the advantages of evaporative condensers over water cooled condensers. [6]

   (b) Describe the working of any two types of water cooled condensers. [10]

5. (a) What are the conventional working pairs for absorption systems and explain with line diagram any one pair. [8]

   (b) What is the basic principle in three fluid refrigeration system and give the Constructional features of such system. [8]

6. In a Steam jet refrigeration system dry saturated steam at 7 bar abs. pressure is supplied. The flash chamber temperature is 5^oC, the condenser temperature is

40^oC, make up water is supplied at 20^oC. Assuming that quality of motive steam and flash vapour at the beginning of compression as 93% dry and efficiency of the nozzle, efficiency of entertainment and the efficiency of the thermo-compressor as $90\%, 65\% and 91\%$ respectively. Determine:

(a) Weight of steam required per hour per ton of refrigeration.

(b) The volume of vapour removed from the flash chamber per hour per ton of refrigeration. [16]

7. (a) Explain the following terms

   i. Wet bulb temperature

   ii. enthalpy of humid air

   iii. Specific volume of humid air

   iv. Density of humid air [4X2=8]

   (b) Define the term "by-pass factor" used for cooling or heating coil and derive an expression for the same [8]

8. (a) A heat pump uses water at 10C as the source of heat and the air supplied to the room is to be at 35^0C. If the actual EPR attained is 70% of the reversed carnot cycle operating between the same temperatures, determine

   i. The actual EPR of the heat pump system

   ii. The power required to run the compressor if required heat load is 60,000 KJ/hr.

   The power required to run the compressor if required heat load is 60,000 KJ/hr. [10]

   (b) What are the different constructional features used in heat pump to improve the overall EPR? [6]

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Code No: RR410305 **Set No. 3**

IV B.Tech I Semester Regular Examinations, November 2005
REFRIGERATION & 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) Give a brief description of an ideal cycle of air refrigeration. [6]
   (b) A carnot refrigerator and a heat pump are supplied with equal amount of work. The refrigerator operates between -27^{0}C and +27^{0}C and the heat pump operates between + 45^0 C and + 27^{0}C. The refrigerator absorbs 4000 kJ/ min at -27^{0}C. The heat pump absorbs all the heat rejected by the refrigerator and supplies at 45^{0}C. Compute

   (i) COP of refrigerator

   (ii) COP of heat pump

   (iii) heat available at + 45^{0}C and

   (iv) work input to each unit. [10]

2. A simple vapour compression cycle using F-12 is designed to take a load of 10 tons. The refrigerator and ambient temperatures are 0^{0}C and 30^{0}C respectively. A minimum temperature of -5^{0}C is required in evaporator and condenser for heat transfer. Find

   (a) Mass flow rate through the system

   (b) Power required in kW

   (c) Cylinder dimensions assuming L/D ratio as 1.2 for a single cylinder and single acting compressor running at 300 RPM with a volumetric efficiency of 0.9 [16]

3. (a) How are the refrigerants classified? [8]
   (b) Discuss the factors to be considered in the selection of a refrigerant. [8]

4. (a) Explain the working of an evaporative condenser. [10]
   (b) Give the comparison of flooded evaporators and dry evaporators. [6]

5. (a) What difference does it make when LiBr-H_2O system operates below 0^{o}C . [4]
   (b) Compare practical $NH_3 - H_2O$ system with theoretical NH_3 - H_2O system. [8]
   (c) "In absorption systems low grade energy may be used" explain. [4]

6. In a Steam jet refrigeration system dry saturated steam at 7 bar abs. pressure is supplied. The flash chamber temperature is 5^oC, the condenser temperature is 40^oC, make up water is supplied at 20^oC. Assuming that quality of motive steam and flash vapour at the beginning of compression as 93% dry and efficiency of the nozzle, efficiency of entertainment and the efficiency of the thermo-compressor as $90\%, 65\% and 91\%$ respectively. Determine:
   (a) Weight of steam required per hour per ton of refrigeration.
   (b) The volume of vapour removed from the flash chamber per hour per ton of refrigeration. [16]

7. (a) What do you understand the term psychrometry? [4]
   (b) The atmospheric conditions of air are 28^oC DBT and Specific humidity of 0.02 kg/per kg of dry air. Find
      i. partial pressure of vapour
      ii. relative humidity
      iii. DPT
      iv. WBT [12]

8. (a) Illustrate with an example how heat pump can be used for dehumidification process. [10]
   (b) Write notes on electrically driven heat pump for heating and cooling. [6]

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Code No: RR410305 **Set No. 4**

IV B.Tech I Semester Regular Examinations, November 2005
REFRIGERATION & 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) Give a brief description of an ideal cycle of air refrigeration. [6]
   (b) A carnot refrigerator and a heat pump are supplied with equal amount of work. The refrigerator operates between -27^{0}C and +27^{0}C and the heat pump operates between + 45^0 C and + 27^{0}C. The refrigerator absorbs 4000 kJ/ min at -27^{0}C. The heat pump absorbs all the heat rejected by the refrigerator and supplies at 45^{0}C. Compute
   (i) CO P of refrigerator
   (ii) COP of heat pump
   (iii) heat available at + 45^{0}C and
   (iv) work input to each unit. [10]

2. (a) Describe the use of liquid vapour regenerative heat exchanger in a vapour compression system [6]
   (b) A simple saturation ammonia compression system has a high pressure of 1.35 MN/m^2 and low pressure of 0.19 MN/m^2. Find per 400,000kJ/h of refrigerating capacity the power consumption of the compressor and COP of the cycle. [10]

3. (a) Explain the working of a rotary screw compressor. [10]
   (b) How the capacity control is achieved in refrigerant compressor? [6]

4. (a) What are the advantages of evaporative condensers over water cooled condensers. [6]
   (b) Describe the working of any two types of water cooled condensers. [10]

5. (a) What is the effect of inert gas in three fluid refrigeration system. [4]
   (b) What is absorption refrigeration system and how it differs from convention vapour compression system and explain its working. [8]
   (c) What is Carnot COP of absorption refrigeration system. How it is differ from actual COP. [4]

6. (a) What is thermo electric refrigerator. [4]
   (b) Explain the principle of steam jet refrigeration system. [6]
   (c) What is the function of a condenser in a steam Jet refrigeration system? Explain its working. [6]

7. (a) Enumerate the components of cooling load estimate. [10]
   (b) Explain the summer air conditioning system for hot and wet weather. [6]

8. (a) Name the chemicals that are used as absorbent and adsorbent in a dehumidification process. [4]
   (b) Explain with a circuit diagram, the Lithium Bromide absorption system for dehumidification of air. [8]
   (c) Write short notes on solar driven dehumidifier. [4]

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