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

IV B.Tech I Semester Regular Examinations, November 2007
REFRIGERATION AND AIR CONDITIONING
(Mechanical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. An air refrigeration system operating on an open air cycle is required to produce 25 ton refrigeration with a cooler pressure of 12 bar and the refrigerator pressure of 1 bar. The temperature of the air leaving the cooler is 25^0C and the air leaving the room is at 0^0C. Assume the cycle with isentropic compression and polytropic expansion with n=1.35, and with no compressor clearance. Determine:
   (a) Mass of the air circulated per minute
   (b) Compressor piston displacement required per minute
   (c) Expander displacement required/min
   (d) COP and
   (e) Power required per ton of refrigeration. [16]

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) Give the normal boiling points and designations of floro chloro derivatives of methane. [8]
   (b) Describe the chemical and physical requirements of a good refrigerant. [8]

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. (a) In an absorption type refrigerator, the heat is supplied to ammonia generator by Condensing steam at 2 bar and 90% dry. The temperature to be maintained in the refrigerator is -5^o C. The temperature of the atmosphere is 30^o C. Find the maximum COP possible of the refrigerator. If the refrigeration load is 20 Tons and actual COP is 70% of the maximum COP, find the weight of the steam required per hour. [12]
   (b) What are the disadvantages with water in absorption system? [4]

6. (a) What are the limitations of steam jet refrigeration system. [8]

(b) What are the merits of steam jet refrigeration system over other system? [8]

7. (a) Define "thermal shock" used to air-conditioning systems. Describe the methods of reducing the thermal shock. [8]

   (b) Why ventilation is required? Explain why different ventilation standards for different purposes are recommended. [8]

8. Hot water at 80^0C from the boiler is supplied to a building by a 25 metre long pipe of 6cm inside diameter. Assume the following data.

   Thickness of pipe materiel = 4mm

   K (pipe material) = 50 w/mk

   h_i (inside heat transfer coefficient) = 82 w/m^2 ^{0}C

   h_o (outside heat transfer coefficient) = 20 w/m^2 ^{0}C

   Ambient air temperature = 11^0C

   (a) Find the heat loss per hour from the pipe

   (b) Also find the percentage decrease in heat loss if the pipe is lagged with an insulation having k = 0.06 w/m k and thickness = 4cm. [16]

⋆ ⋆ ⋆ ⋆ ⋆

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

IV B.Tech I Semester Regular Examinations, November 2007
REFRIGERATION AND AIR CONDITIONING
(Mechanical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Prove that the COP of a Heat Pump is greater than 1. [6]
   (b) Determine the temperature ratio for a carnot refrigerator whose C.O.P is 4. What is the refrigeration capacity of the machine in tons of refrigeration if the power consumption is 7.5 kW. If the cycle is used as a heat pump, find its COP. [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) Explain the working of a automatic expansion valve with the help of a neat sketch. [8]
   (b) Describe the working of shell and tube type and shell and coil type evaporators. [8]

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. (a) Explain the principle of steam jet refrigeration. [6]
   (b) Explain thermo electric refrigeration system. [6]
   (c) Explain the term seebeck effect, Thomson effect. [4]

7. (a) The amount of air supplied to an air conditioned hall is 300 m^3 / min. The atmospheric conditions are 35^oc DBT and 55% RH. The required conditions are 20^oc DBT and 60% RH. Find the Sensible Heat and Latent Heat removed from air per minute. [8]
   (b) Define human comfort and explain the factors which affect the human comfort. [8]

8. (a) Differentiate between central and unitary air conditioning systems. [6]
   (b) Sketch a self contained air conditioning unit with air as the sink for the condenser and describe its working. [10]

⋆ ⋆ ⋆ ⋆ ⋆

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

IV B.Tech I Semester Regular Examinations, November 2007
REFRIGERATION AND AIR CONDITIONING
(Mechanical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Derive an expression for COP of a Bell-Coleman cycle plotting the same on a P-V diagram. [6]
   (b) A Bell-coleman refrigeration cycle works between 1 bar and 6 bar. The adiabatic efficiency of compression is 90% and expansion is 95%. Find the COP of the system and its tonnage when the air flow rate is 2 kg/sec. The ambient temperature is 25^{o}C and refrigerator temperature is -5^{o}C. [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) Give the normal boiling points and designations of floro chloro derivatives of methane. [8]
   (b) Describe the chemical and physical requirements of a good refrigerant. [8]

4. (a) Differentiate between flooded type and dry expansion type evaporators. [6]
   (b) Explain the working of thermostatic expansion valve with the help of a neat sketch. [10]

5. (a) Why the boiling point difference of absorbent-refrigerant should be high. [4]
   (b) What is the effect of latent heat of absorbate on performance of the absorption systems. [6]
   (c) What are the desirable requirements of a Refrigent - Absorption pair. [6]

6. (a) Where is steam jet refrigeration system widely used. Explain how the refrigeration is produced with this system. [10]
   (b) What are the materials for the thermoelectric refrigeration? [6]

7. (a) Describe the following psychrometric processes [8]
      i. cooling with dehumidification
      ii. cooling with adiabatic humidification
   (b) 100 m^3 of air per minute at 15^{o}c DBT and 80% RH is heated until its temperature become 22^{o}c. Find the following

i. Heat added to the air per minute
ii. RH of heated air
iii. WBT of heated air

Assume air pressure is 1.033 bar [8]

8. (a) Write notes on Grills and Registers. [6]
   (b) Describe the following types of air filters for cleaning air with simple sketches.
   i. Viscous filter
   ii. Wet filter. [10]

⋆ ⋆ ⋆ ⋆ ⋆

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

IV B.Tech I Semester Regular Examinations, November 2007
REFRIGERATION AND AIR CONDITIONING
(Mechanical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) How is ideal reversed carnot cycle modified to result in Bell-Coleman cycle? Explain with sketches. [4]
   (b) The capacity of a refrigerator is 150 TR when working between -6^{0}C and 25^{0}C. Determine the mass of ice produced per day from water at 25^{0}C. Also find the power required to drive the unit. Assume that the cycle operates on reversed Carnot cycle. Latent heat of ice can be taken as 335 kJ/kg. [12]

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) Describe the important components of a centrifugal compressor with the help of a neat sketch. [8]
   (b) Name the two types of rotary compressors. Explain the working of anyone type of rotary compressor. [8]

4. (a) Differentiate between flooded type and dry expansion type evaporators. [6]
   (b) Explain the working of thermostatic expansion valve with the help of a neat sketch. [10]

5. (a) Explain with a simple sketch the working of Electrolux refrigeration system. [8]
   (b) Determine the HCOP of a vapour absorption refrigeration system when the temperature of generator is 120^{o}C, the temperature of the condenser is 30^{o}C and the temperature of the evaporator is -20^{o}C. What would be its COP if it were a Carnot. [8]

6. (a) With the help of a sketch of the processes on Mollier chart explain how the refrigeration is produced in steam jet refrigeration system. [10]
   (b) What difference does it make when the steam jet refrigeration system operates with a barometric condenser instead of a surface condenser? [6]

7. (a) Represent the following process in a skeleton psychrometric chart.
      i. Sensible cooling

ii. Cooling and humidification
iii. Adiabatic mixing of air streams [6]

(b) Ten 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 20^{o}C. The atmospheric conditions are 40^{o}C DBT and 60% RH. Find the following for the conditioned air

i. Relative humidity
ii. Wet-bulb temperature
iii. Dew point temperature
iv. Enthalpy change for the air [10]

Assume standard atmospheric pressure.

8. (a) With a simple sketch explain the principle of centrifugal dust collector. [6]

(b) List the different methods of odour removal from air and write short notes on any three methods. [10]

⋆ ⋆ ⋆ ⋆ ⋆