B.Tech. MECHANICAL ENGINEERING

Term-End Examination

June, 2013

BIME-015 : REFRIGERATION AND AIR CONDITIONING

Time : 3 hours   *Maximum Marks : 70*

Note : *Attempt **any five** questions. Uses of non - programmable scientific calculator, psychrometric chart, steamtable, mollier diagram, refrigeration and air conditioning tables and charts are **permitted**.*

1. (a)   A carnot refrigerator requires 1.25 kW per   **6+8**
         ton of refrigeration to maintain the
         temperature of 243 K. Find :
         (i)   COP of carnot refrigerator.
         (ii)   Temperature at which heat is rejected.
         (iii) Heat rejected in kJ/ton of
                refrigeration.

    (b)   A Bell-Coleman refrigerator operates
         between pressure limits of 1 bar and 8 bar.
         Air is drawn from the cold chamber at 9°C,
         compressed and then it is cooled to 29°C
         before entering the expansion cylinder.
         Expansion and compression follow the law
         $pV^{1.35}$=constant. Calculate the theoretical
         C.O.P. of the system. For air, take γ=1.4,
         C_p = 1.003 kg/kg K.

2.   28 tonnes of ice at 0°C is produced per day in an   **14**
      ammonia refrigerator. The temperature range in
      compressor is from 25°C to −15°C. The vapour is
      dry and saturated at the end of compression. An
      expansion valve is used. Assuming a
      coefficient of performance of 62% of the
      theoretical, calculate the power required to drive
      the compressor. Take latent heat of ice = 335 kJ kg.

3.   A simple freon 12 heat pump for space heating   **14**
      operates between temperature limits of 15°C and
      50°C. The heat required to be pumped is
      100 MJ/hr.
      Determine :

      (a)   the dryness fraction of Freon 12 entering the
             evaporator,

      (b)   the mass flow rate of the refrigerant,

      (c)   the discharge temperature assuming the
             specific heat of vapour as 0.8 kJ/kg K,

      (d)   the theoretical piston displacement of the
             compressor,

      (e)   the theoretical horse power of compressor,
             and

      (f)   the COP.

4.   (a)   'A completely odourless refrigerant is not   **7+7**
             desirable', discuss the statement.

      (b)   Discuss why refrigerants are so selected that
             evaporator pressures and condenser
             pressures are greater than atmospheric
             pressure ?

5. It is required to design an airconditioning system for an industrial process for the following hot and wet summer conditions : **14**

Outdoor conditions : 32°C DBT and 65% RH

Required air inlet conditions : 25°C DBT and 60% RH

Amount of free air circulated : 250 m³/min coil dew temperature : 13°C

The required condition is achieved by first cooling and dehumidifying and then by heating.

Calculate the following :

(a) The cooling capacity of the cooling coil and its by passfactor,

(b) Heating capacity of the heating coil in kW and surface temperature of the heating coil if the by passfactor is 0.3.

(c) The mass of the water vapour removed per hour.

6. A computer lab having an usually large latent heat gain is required to be air conditioned . The design conditions and loads are as follows : **14**

Summer design conditions : 40°C DBT , 27°C WBT

Inside design conditions : 25°C DBT, 50% RH

Room sensible heat : 34.9kW

Room latent heat : 18.6 kW

The ventilation air requirement is 85 cmm.

Determine the following :

(a) Ventilation load ;

(b) Room and Effective sensible heat factors ;

(c) Apparatus Dew point and amount of reheat for economical design ;

(d) Supply air quantity

(e) Condition of air entering and leaving coil and supply air temperature ;

(f) Grand Total Heat

7. Write short notes on *any two* of the following :   7+7

(a) Effect of change in Evaporator Pressure on the performance of the vapour compression cycle.

(b) Vapour absorption system of refrigeration and its advantages over vapour compression system.

(c) Electrolux refrigerator and its applications.

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