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**BIME-015**

# B.Tech. MECHANICAL ENGINEERING

## Term-End Examination

## December, 2013

## BIME-015 : REFRIGERATION AND AIR CONDITIONING

01091

*Time : 3 hours* *Maximum Marks : 70*

***Note :*** *Attempt **any five** questions. use of non-programmable **scientific** calculater is permitted. **Use** of psychometric charts, steam tables, mollier diagrams, refrigeration and air conditioning tables and charts is **permitted**.*

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**1.** (a) What are the different methods of Refrigeration? Explain with neat diagram about Evaporative-Refrigeration. **7**

(b) A carnot refrigerator extracts 100 kcal of heat per minute from a cold room which is maintained at $-15°C$ and it is discharged to atmosphere which is at 30°C. Find an ideal Horse Power required to run the unit. **7**

**2.** A refrigerator working on Bell-Coleman cycle operates between pressure limits of 1.05 $kg/cm^2$ and 8.5$kg/cm^2$. Absolute air is drawn through the cold chamber at 10°C. Air coming out of compressor is cooled to 30°C before entering the expansion cylinder. Expansion and compression follow the law $pv^{1.35} = constant$. Determine theoretical C.O.P. of the system. (take $r = 1.4$ and $C_p = 0.24$ kcal/kg°C for air) **14**

3. (a) Explain about vapour - compression refrigeration cycle with a neat T-S diagram. 7

(b) In an ammonia vapour compression refrigerator, the temperature of evaporator is $-10°C$ and temperature of $NH_3$ coming out of compressor is 30°C. The vapour is condensed in the condenser at 30°C. Find the theoretical c.o.p. of the cycle when the vapour at the end of the compression is 0.9 dry. Take latent heat of $NH_3$ at $30°C = 272 kcal/kg$. and sp.heat of liquid $NH_3 = 1.12 kcal/kg$. 7

4. (a) Brief about the sequence of operations in domestic electrolux-refrigerator. 6

(b) In an absorption type refrigerator the heat is supplied to $NH_3$ generator by condensing steam at $2 kg/cm^2$-absolute and 90% dry. The temperature to be maintained in the refrigerator is $-5°C$. The temp. of the atmosphere is 30°C. 8

(i) Find the maximum c.o.p. possible of the refrigerator.

(ii) If the refrigerator load is 20 tons and actual c.o.p. is 70% of maximum c.o.p., find the weight of steam required per hour.

5. (a) Brief about different psychometric properties. 6

(b) An air-conditioner coil is used to bring the condition of outdoor air to the required condition of 22°C DBT and 60% Relative Humidity. Find the By pass factor of the coil when the following conditions are given: 8

(i) Out-door conditions:- 40°C DBT and 30% R.H.

(ii) The depth of coil: 4

(iii) The overall heat transfer co-efficient on the surface of cooling coil : 200 kcal/$m^2$. hr.°C

(iv) The volume of free air passing through coil : 50$m^3$/min.

(v) The surface area of coil provider per row : 1.2 $m^2$.

6. The following data were collected in connection with the design of air conditioning of a small theatre : 14

(a) Total seating capacity : 350 persons

(b) Atmospheric condition : 34°C DBT & 70% RH

(c) Comfort conditions required : 22°C DBT & 50% RH

(d) Sensible heat given per person : 80 kcal/Hr.

(e) Latent heat given per person : 25 kcal/Hr.

(f) Quantity of fresh air supplied : 0.4$m^3$/person/min.

(g) Desirable temp. rise in theatre : 8°C.

Assume the recirculated air is mixed with the fresh air after leaving the conditioner.

Using the above data, compute the following :

(i) The percentage of total air recirculated

(ii) Refrigeration capacity of the conditioner coil.

Assume the air leaves the conditioner coil with 100% R. H.

7. (a) What are the different air conditioning systems ? Explain any one of them with a neat diagram. 6

(b) 100 cu.m of air per minute at 15°C DBT and 80% R.H. is heated until its temperature becomes 22°C. 8

Find the following :

(i) Heat added to air per minute.

(ii) R.H. of heated air.

(iii) Wet Bulb temperature of heated air. Assume air pressure is 1.033 kg f/$cm^2$.