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SE-7469

B. E. IV (Sem. VII) (Mechanical) Examination

May / June – 2011

Advanced Refrigeration and Air-Conditioning

Time : **3** Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **B. E. - IV (Sem. VII) (Mechanical)**

Name of the Subject :

☛ **Advanced Refrigeration and Air-Conditioning**

☛Subject Code No. : **7 4 6 9** ☛Section No. (1, 2,.....) : **Nil**

Seat No. :

Student's Signature

(2) Answer all questions.

(3) Figure to the right indicate full marks.

(4) Assume suitable data, if necessary.

(5) Use of steam table, molier diagram, refrigeration charts are permitted.

1 (a) The montreal protocol was signed in 1987 to address _____ environmental problem **20**

(b) An electrolux refrigerator is called a
(i) Single fluid (ii) two fluid (iii) three fluid (iv) none of the above

(c) In a steam jet refrigeration system, the expansion of motive steam takes place in (i) convergent nozzle (ii) divergent nozzle (iii) convergent divergent nozzle

(d) In _____ refrigeration system sudden expansion and release of gas are employed to get the refrigerating effect.

(e) Those material which are weakly attracted by a magnet are called _____.

(f) In comfort chart the effective temperature is represented by _____ lines.

(g) _____ are employed for cleaning air.

(h) The primarily function of a _____ is to produce air movements through heating, ventilating and air conditioning apparatus.

(i) The capacity of a fan is _____ cube of the impeller diameter.

(j) _____ is an instrument used to measure humidity of air.

2 Attempt any four. **20**

(a) Describe main types of condensers in use with specific application of each.

(b) What do you understand by hermetic sealed compressor? Give its advantage.

(c) Why capillary is used as expansion device in small of domestic units.

(d) Discuss factors governing optimum effective temperature.

(e) Why ventilation is required ? Explain why different ventilation standards for different purpose are recommended ?

(f) Principal of thermoelectric refrigeration.

(g) Working of pulse tube refrigeration.

3 Attempt any two **30**

(a) The following data refer to a steam jet refrigeration system : Capacity of thermal power plant : 2000kW
Condition of steam supplied from the boiler : 25 bar, 350^0C.
Refrigeration load taken up by the steam jet refrigeration system : 110 tonne
Pressure at which steam is bled off the steam turbine: 4 bar
Vaccum maintained in the condenser : 730 mm of Hg
Pressure and condition at which steam enters in thermo-compressor : 0.01 bar, 0.92 dry
Temperature at which make-up water enters into flash chamber : 20^0C Isentropic efficiency of the steam turbine: 88%
Nozzle efficiency : 88%
Entrainment efficiency : 64%
Thermo-compressor efficiency : 64%

Determine following by using mollier diagram :

(1) Dryness fraction of steam leaving the flash chamber

(2) Mass of motive steam bled off from the steam turbine

(3) Mass of steam generated in the boiler

(4) Mass of additional steam to be generated by the boiler due to refrigeration load, and

(5) COP of the system

(b) The following data refer to a $LiBr+H_2O$ absorption system

Generator temperature : 80^0C

Temperature of condenser and absorber : 30^0C

Evaporator temperature : 10^0C

Condensate temperature : 25^0C

Steam enters the generator heating coil at 120^0C (dry-saturated state steam) and leaves it at 100^0C as condensate.

Concentration of liquid leaving generator is 0.65 and its enthalpy - 75 kJ/kg.

Concentration of liquid leaving absorber is 0.51 and its enthalpy - 170 kJ/kg.

Enthalpy of vapour leaving generator is 2620 kJ/kg. Flow rate through evaporator is 0.4 kg/s. Determine the following.

(i) Pressures in generator, condenser, evaporator and absorber

(ii) Tonnage

(iii) Heat rejection to condenser and absorber

(iv) Rate of mass leaving absorber

(v) COP

(c) In an acqua-ammonia absorption refrigeration system of 9 tonnes refrigeration capacity the vapours leaving the generator are 100% pure NH_3 saturated at 40^0C. The evaporator, absorber, condenser and generator temperatures are -20^0C, 30^0C, 40^0C and 170^0C respectively. At absorber exit the concentration of ammonia in solution is x = 0.35 and enthalpy is h=22 kJ/kg. At generator exit x = 0.1 and h = 695 kJ/kg.

(i) Determine the mass flow rate of ammonia in the evaporator

(ii) Carry out overall mass concentration and mass conservation of ammonia of absorber to determine mass flow rate of weak and strong solution

(iii) Determine the heat rejection in absorber and condenser, heat added in generator and COP.

4 Attempt any two **30**

(a) (i) Explain the meaning of throw, drop, spread, decay and induction.

(ii) What do you understand by equivalent length ? How this is used in design air duct systems.

(b) The following data relates to the office air conditioning plant having maximum seating capacity of 25 occupants
Outside condition : 34^0C DBT, 28^0C WBT
Inside condition : 24^0C DBT, 50 % RH
Solar heat gain : 9120 W
Latent heat gain per person : 105 W
Sensible heat gain per person : 90 W
Lightening load : 2300 W
Sensible heat load from other sources : 11630 W
Infiltration load : $14m^3$/min
Assuming 40 % fresh air and 60% of recirculated air passing through the evaporator coil and the by pass factor 0.15, find the dew point temperature of coil and capacity of the plant.

(c) A laboratory having an unusually large latent heat gain is required to be air conditioned. The design condition and loads are follows :
Summer Design conditions : 40^0C DBT, 27^0C WBT
Inside design conditions : 25^0C DBT, 50 % RH
Room sensible heat : 34.9 kW,
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 desing
(d) Supply air quantity
(e) Condition of air entering and leaving coil and supply air temperature
(f) Grand total heat

Take by pass factor 0.05