B. E. (Eighth Semester) EXAMINATION, June, 2011
(Common for AU & ME Engg. Branch)
REFRIGERATION AND AIR-CONDITIONING
Time : Three Hours Maximum Marks : 100Minimum Pass Marks : 35

Note : Attempt five questions in all, selecting one question from each Unit. Use of property tables and charts (refrigerants, steam, moist air) is permitted. Assume missing data if any.

Unit-I

1. (a) The ambient air temperature during summer in a particular locality is 4Q°C. Find the value of Carnot COP'for an air-conditioner for cooling corresponding to refrigeration temperature of 5°C. Take a temperature difference of 5°C in the heat exchanger that exchanges the heat with surrounding. Also find the power consumption per ton of refrigeration. 8

(b) An open air refrigeration system operating between pressures of 16 bar and 1 bar is required to produce 33-5 kW refrigeration. The temperature of air leaving the refrigerated room is -5°C and that leaving the air cooler is 30°C. Calculate for the theoretical cycle : 12

(i) COP
(ii) Wieght rate of air circulated per minute.
(iii) Net work.
(iv) Theoretical piston displacement of compressor.

Or

2. (a) A boot strap air refrigeration is used for an aeroplane to take 10 TR load. The ambient air conditions are 12°C and 0-8 bar. This air is rammed isentropically to a pressure of 1.1 bar. The pressure of air bled off the main compressor is 3-5 bar and this is further compressed in a secondary compressor to a pressure of 4-5 bar. The isentropic efficiency of both the compressors is 88% and that of cooling turbine is 90%. The effectiveness of both the heat exchangers is 0-6. If the cabin is to be maintained at 1 bar, 25°C, find : 16

(i) Mass of air passing through the cabin.
(ii) Power used for the refrigeration system.
(iii) COP of the system.

t °C	P bar	h_f kJ/kg	h_g kJ/kg	s_f kJ/(kg K)	s_g kJ/(kg K)	v_g m^3/kg
5	5·836	205·9	407·1	1·02115	1·7447	0·0404
40	15·331	249·53	416·4	1·16659	1·69953	—

Draw the schematic and temperature energy diagrams of the system.

(b) Enlist the various principles and processes involved in the production of low temperature. 4

Unit-II

3. (a) A simple saturation cycle using R 22 is designed for a load of 100 TR. The saturated suction and discharge temperatures are 5°C and 40°C respectively. Calculate :

(i) The mass flow rate of refrigerant.
(ii) COP.
(iii) The heat rejected in the condenser. Use the following data : Specific heat of R 22 vapour is 0-65 kJ/(kg K)

(b) Discuss the effect of change in evaporator pressure and liquid subcooling on refrigerating effect, compressor work and COP. Discuss with the help of p-h diagram. 8

Or

4. (a) Why a throttling device is used in vapour compression refrigeration system rather than an expansion cyclinder, to reduce the pressure of refrigerant from condenser pressure to evaporator pressure ? 4

(b) The following data refer to a two-stage vapour compression system : 16 .Condensing temperature = 40°C Flash intercooler temperature = 15°C Evaporating temperature = - 15°C Refrigerant used = R - 717(NH_3) Refrigerant flow through H. P. side = 0-4 kg/s Condensate is subcooled in condenser = by 5°C Compression efficiencies =? 80% each Draw the schematic arrangement and its corresponding P-h diagram. Determine the following with the help of P-h chart :

(I) Flow rate through evaporator.

(ii) Tonnes of refrigeration.

(iii) Total power input.

(iv) Coefficient of performance.

Unit-III

5.(a) Derive .an. expression for the maximum COP of the vapour absorption refrigeration system' in terms of generator temperature (Tg), evaporator temperature (Te) and atmospheric temperature (Ta), at which heat . is discharged from condenser and absorber. 10

(b) Explain with the help of neat sketch, the working of a steam jet refrigeration system.10

Or

6.(a) Explain, the working of NH3 - H20 vapour absorption refrigeration system with neat sketch. 10

(b) Write a short note on refrigerants, desirable properties and their' designation. Also write, the chemical composition of R - 11, R - 134 a and R-744. 10

Unit -IV

7.(a) A mixture of dry air and water vapour is at a temperature of 21°C under a total pressure of 736 mm Hg. The- dew point temperature is 15°G. Find using steam table only : 10

(i) Partial pressure of water vapour

(ii) Relative humidity

(iii) Specific humidity

(iv) Enthalpy of air per kg of dry air tt bulb temperature

(b) 30 mVrnin. of a stream of moist air at 15°C DBT and 13°C WBT is mixed with 12 mVmin. of a second stream at 25°C DBT and 18°C WBT. Barometric pressure is one standard atmosphere. Sketch the process on Psychrometric chart. Determine the DBT, DPT and specific humidity of the resulting mixture.10

Or

8.(a) What is an effective temperature. ? State and explain the factors which govern optimum effective-temperature. 10

(b) Room air. at 20°C DBT and 50% RH is mixed with outdoor air at 40° DBT and 30% RH in the mass ratio of 4 : 1. The mixture is passed through a cooling coil whose bypass factor is 0-2 and cooling coil is •maintained at a constant temperature of 10°C. Determine the following : 10

(i) Condition of air before entering the coil.

(ii) Condition of air leaving the coil.

(iii)Refrigeration load on the cooling coil when 250 mVmin. of air is supplied to the room.

Unit-V

9.The following data relate to a conference room for seating 100 persons : 20

Inside design conditions = 22°C DBT, 55% RH

Outside design conditions = 40°C DBT, 30°C WBT

Sensible heat load per person = 75 W

Latent heat load per person = 45 W
Lights and fans loads =15 kW Heat gain through glass, walls,ceiling etc. = 12 kW
Air infiltration = 20m3/min. Fresh air supply = i mVmin/pereon
By-pass factor of the coils =0*15 , If two-third of recirculated room air and one-third of fresh air are mixed before entering the cooling coils, determine :

(i) Apparatus dew point.
(ii) Grand total heat load.
(iii) Effective room sensible heat factor.

Or

10 An air-conditioned room is maintained at 24°C DBT and 50% RH, while the outside conditions are 3$°C DBT and 27°C WBT. The air-conditioned room has a sensible heat load of 12 kW and latent heat load of 7-5 kW. The cooling coil has a by-pass factor of 0-1 and apparatus dew point is 8°C. Return air from the room is mixed with the outside air before entering the cooling coil in the ratio of 4 : 1 and return air from the room is also mixed with the air after the cooling coil in the ratio 1': 4. The air may be reheated, if necessary,, before supplying to the conditioned room. Determine : 20

(i) Supply air condition to the room.
(ii) Refrigeration load. •
(iii) Quantity of fresh air supplied.