B.E. (SEM.-VIII) (CBGS) (Mechanical Engg.)
Refrigeration & Air Conditioning

24th May. 2016
11.00 am to 2.00 pm
Q.P. Code : 731001

(3 Hours) **[Total Marks : 80**

(Revised course)

- Question No 1 is compulsory.
- Answer any three out of remaining five questions.
- Assumptions made should be clearly stated.
- Assume suitable data wherever required, but justify the same.
- Use of Refrigerant , Psychrometric tables and Psychrometric chart is permitted.

1 Answer any **Four** of the following : [20]

a) Define Energy Efficiency Ratio. Write a note on star rating of BEE.

b) What are the advantages of air refrigeration for cooling of aircraft?

c) Write a note on designation of refrigerants.

d) Explain in brief an adiabatic saturation process. Represent the same on a Psychrometric chart.

e) What is the function of a flash intercooler? Why it is not preferred for R-12 refrigerant.

f) Discuss the static regain method of duct design.

2 a) Derive an expression for COP of an ideal Bell Coleman cycle in terms of pressure ratio. [4]

b) An airplane using 20 TR bootstrap air refrigeration system has ambient conditions of 0.9 bar and 15°C. Ram air pressure after isentropic compression is 1.1 bar. Main compressor exit pressure is 3.5 bar, and exit pressure of secondary compressor is 4.5 bar. The cabin is required to be maintained at 1 bar and 25°C. Isentropic efficiency of each compressor is 85% and that of cooling turbine is 90%. The effectiveness of both heat exchangers is 60 %. Find : [12]

(i) Mass flow rate of air passing through the cabin (ii) Power required, (iii) COP of the system. Assume, C_p= 1.01 kJ/kg K.

c) Discuss the effect of evaporator and condenser pressures on the performance of a Vapour Compression Refrigeration System. [4]

3 a) Define bypass factor of a cooling coil. What are the factors affecting it? [4]

b) Explain with a block diagram the working of a practical Ammonia Water vapour absorption refrigeration system. [6]

c) A refrigeration machine using R-12 as refrigerant operates between the pressures 2.5 bar and 9 bar. The vapour entering the compressor is dry saturated and there is no subcooling in the condenser. If the capacity of the plant is 20 TR and the relative COP is 65 %. Determine: i) Actual COP, ii) Actual power input to the compressor.

Properties of the refrigerant are given below:

Pressure Bar	Sat Temp ° C	Sp. Enthalpy, kJ/kg		Sp. Entropy , kJ/kg K
		Liquid	Vapour	Vapour
9	36	456.4	585.3	4.74
2.5	-7	412.4	570.3	4.76

Take sp. heat of refrigerant vapour as 0.67 kJ/kg-k [10]

4 a) Explain with a neat sketch the function of a thermostatic expansion valve. [6]

b) A sample of moist air has a dry bulb temperature of 25° C and a relative humidity of 50 per cent. The barometric pressure is 740 mm of Hg. Without using Psychrometric chart, calculate: 1) partial pressure of water vapour and dry air; 2) Dew point temp.; 3) specific humidity of air; 4) Enthalpy of air per kg of dry air. [8]

c) Explain with schematic the working of a refrigeration system with a single evaporator and two stage compression system, with a water intercooler and flash intercooler interposed between the stages. Represent the cycle on a P-h diagram. [6]

5 a) Derive an expression for equivalent diameter of circular duct for rectangular duct for the same frictional loss per unit length when the quantity flowing through both the ducts is same. [6]

b) The following data are given for the space to be air conditioned:

Outside air conditions = 40°C DBT and 50 % RH, Inside design conditions = 26°C DBT and 50% RH, Apparatus Dew Point = 10^0 C ; By-pass factor of the cooling coil = 0.2

The return air from the room is mixed with the outside air before entry to the cooling coil in the ratio of 3: 1 by mass. If 20 m^3/min of fresh air is supplied find:

(i) Condition of air leaving the coil,
(ii) Capacity of cooling coil in TR,
(iii) Room sensible heat factor. [14]

6 Write short notes on any **four** of the following. [20]

a) Types of cooling tower.
b) Methods of defrosting.
c) Thermoacoustic refrigeration.
d) Variable refrigerant flow systems.
e) Liquefaction of Natural Gas (LNG).
f) Deep sea air conditioning.