Code No: **R41031** **R10** **Set No. 1**

IV B.Tech I Semester Supplementary Examinations, February/March - 2018
REFRIGERATION & AIR CONDITIONING
(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks
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1 a) The capacity of a refrigerator is 600 tons when working between -5°C and + 20°C. Find the mass of ice produced within 24 hours when water is supplied at 10°C. Also find the minimum kW required. Assume the cycle of operation is Carnot cycle. Latent heat of ice = 336 kJ/kg. [5]

b) A boot-strap air refrigeration system is used for an air-plane to take 20 ton of cooling load. The ambient conditions are 5°C and 0.85 bar. The air pressure increases to 1.1 bar due to ramming action which is considered ideal (isentropic). The pressure of air bled off the main compressor is 3.5 bar and this air is further compressed in the secondary compressor to 4.5 bar. The isentropic or internal efficiency of the main compressor as well as secondary compressor is 90% and that of the cooling turbine is 80%. Heat exchanger effectiveness of the primary heat exchanger is 0.6 and that of secondary heat exchanger is 0.6 assume C_p=1.0kJ/kg^{0}K. Determine: (i) Power required to take the cabin load (ii) C.O.P. of the system. The cabin may be maintained at 1 bar and 25^{0}C. The cooling turbine runs the secondary compressor and uses its surplus power to run fan for blowing in the ram air to waste. [10]

2 a) Distinguish between dry and wet compression. What are the advantages of one over the other? [5]

b) An ammonia refrigeration machine works between the temperatures of -10°C and 30°C. The vapour leaves the compressor in dry and saturated condition and temperature of the liquid refrigerant leaving the condenser is 30°C. Find the kilograms of ice produced per kW-hour assuming actual C.O.P. is 65% of theoretical. The quantity of heat carried per kg of ice is 370kJ/kg. The properties of ammonia are given below:

Temperature °C	*h_f (kJ/kg)*	*h_{fg} (kJ/kg)*	*s_f (kJ/kg-K)*	*s_g (kJ/kg-K)*
30	28.5	290.8	0.099	1.055
-10	-8.84	323	-0.033	1.191

[10]

3 a) ``The load on the condenser increases as the compression ratio is increased``, explain the statement. [6]

b) What points are considered in selecting a condenser for a refrigeration system? [4]

c) List the advantages and disadvantages of air-cooled condensers over water-cooled condensers. [5]

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4 20 tons refrigerating load on an evaporator is taken by an ammonia absorption refrigeration machine. The cooling is carried out at -30^{o}C. The refrigerant coming out of the condenser is at 20^{o}C and it leaves the evaporator at saturated condition. Assume the following data: Pressure in the generator = 11 bar; Temperature of strong aqua = 70^{o}C; Temperature of weak aqua = 100^{o}C; Heat of one kg of anhydrous NH_3 leaving the generator = 1930 kJ/kg; Concentration of the weak aqua = 0.28; Concentration of the strong aqua = 0.34; Mean specific heat of aqua solution = 4.7 kJ/kg-^{o}C; Take the heat of aqua per kg at 0^{o}C = 418 kJ/kg; Heat of absorption is given by $Q_a = 806 - 588\ x_w - 5960\ x_w^2$.Neglecting the heat loss to the surrounding from the generator, find the quantity of steam required per hour for heating the strong aqua solution in the generator if the steam is supplied at 5 bar and 0.9 dry and condensate comes out at 130^{0}C. Neglect the pressure losses in the system. [15]

5 a) Draw the temperature-entropy and enthalpy-entropy diagram of a steam jet refrigeration system and write the expressions for the following efficiencies: (i) Nozzle efficiency; (ii) Entrainment efficiency; and (iii) Compression efficiency. [8]

b) Explain the working principle of thermo-electric refrigeration system. Compare the working of different components of thermo-electric refrigeration system with the working of different components of vapour compression system. [7]

6 a) Derive an expression for specific humidity and show that it is function of vapour pressure and barometric pressure of air. [5]

b) Discuss briefly the factors which govern the optimum effective temperature for comfort. [5]

c) Explain clearly the different stages of human body defense against variations of weather conditions during summer and winter. [5]

7 a) Explain the difference between comfort air-conditioning and industrial air-conditioning. [5]

b) A cinema hall of seating capacity 1500 persons has been provided with an air conditioned plant with the following data: Outdoor conditions=40^{0}C DBT and 20^{0}C WBT; Required indoor conditions=20^{0}C DBT and 60% RH; Amount of outdoor air supplied=0.3 m^3/min/person. If the required condition is achieved first by adiabatic humidifying and then by cooling, find: (i) The capacity of cooling coil and surface temperature of the coil if by-pass factor is 0.25; and (ii) The capacity of the humidifier and its efficiency. [10]

8 a) Suggest the different constructional features used in heat pump to improve the overall EPR. [7]

b) Give the classification of fans and explain the working principles on which they work. [8]