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

IV B.Tech I Semester Supplementary Examinations, Oct/Nov - 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) What is the necessity of Refrigeration? Write its applications. [3]

b) A regenerative air refrigeration system of an aircraft with flight speed of 1500 km/ hr has 30 ton cooling load while the ambient conditions are 0.1 bar and -63^{o}C. The ram efficiency is 90%. The pressure ratio of the main compressor is 5 with internal efficiency of 0.9. The air bled off the main compressor is cooled by ram air in a heat exchanger which is 60% effective. The air from the heat exchanger passes on to cooling air turbine whose internal efficiency is 0.8. Some portion of air from the cooling turbine is led to the regenerative heat exchanger reducing the temperature to 30^{o}C of the bled off compressed air. The cooling air gets heated to 92^{o}C before discharging to atmosphere. The cabin in pressurized to 0.8 bar and maintained at 25^{o}C. Determine: (i) The percentage of air extracted for regenerative cooling; (ii) Power required to maintain the cabin at required condition; (iii) COP. Assume the cooling turbine power to be used for ram air exhaust fan. [12]

2 a) How does increase in condenser temperature affect COP? Also explain the influence of evaporator temperature on COP. Which of these temperatures has more influence on COP.? [5]

b) A 4-cylinder single acting F_{-12} compressor works between – 10^{o}C and + 30^{o}C. The vapour leaves the evaporator dry and saturated. Assume the followings: Diameter of the compressor = 15 cm, Stroke of the compressor = 15 cm, R.P.M. of the compressor = 970, Volumetric efficiency of the compressor = 75%, Mechanical efficiency of the compressor = 95%, Motor efficiency = 98%. Find the following: i) Capacity of the plant in tons of refrigeration. ii) Power of the motor, and iii) Quantity of refrigerant flow per minute.
Properties of F_{-12} are given below:

Temp. ^{o}C	*h_f (kJ/kg)*	*h_{fg} (kJ/kg)*	*s_f (kJ/kg-K)*	*C_p (kJ/kg-K)*	*v_s (m^3/kg)*
30	107	588	4.75	0.672	---
-10	--	571.2	4.77	0.588	0.078

[10]

3 a) Compare the performance of reciprocating refrigerant compressors with that of centrifugal refrigerant compressors, with reference to variation in speed, variation in suction and condensing temperatures. [6]

b) Explain the working of following types of evaporators with neat sketches:
(i) Flooded evaporator (ii) Shell and tube evaporator (iii) Shell and coil evaporator. [9]

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4 a) Explain with the help of neat sketches the various components and their function for a vapour absorption refrigeration system. [6]

b) Data for an absorber of an ammonia absorption refrigeration system is given below: Evaporator pressure=2.5 bar; Temperature of ammonia leaving the evaporator and entering the absorber=-10^{0}C; Absorber pressure=2.5 bar; Weak aqua enters the absorber at 50^{0}C with mass concentration of 0.25; Strong aqua leaves the absorber at 35^{0}C with mass concentration of 0.33; Anhydrous ammonia circulated through system=8.5 kg/min; Neglect the water vapour returning from evaporator and assume specific heat of solution as 6.3 kJ/kg^{0}C and liquid heat at 0^{0}C as 418kJ/kg. Calculate the amount of heat to be removed per minute from the absorber in kJ/min. [9]

5 a) Explain the various components of steam jet refrigeration system and clearly discuss the function of each component; compare the system with vapour compression refrigeration system. [8]

b) List out the merits and demerits of thermo-electric refrigeration system over other refrigeration systems. What are the major fields of its applications? [7]

6 a) Prove that the partial pressure of water vapour in the atmospheric air remains constant as long as the specific humidity remains constant. [6]

b) 90m^3 of air per minute at 5^{0}C DBT and 2.5^{0}C WBT is passed through a heating coil which gives 40.7 kW energy to the air. Saturated steam at 110^{0}C and with a rate of 40 kg/hr is mixed with the air leaving the heater. Determine the DBT and WBT of the air after mixing the steam. h_s (enthalpy of saturated steam at 110^{0}C) = 2691kJ/kg. [9]

7 a) Define the ``human comfort`` and explain the factors which affect human comfort. [5]

b) A laboratory requires 24^{0}C DBT and 50%RH to be maintained when the outdoor conditions are 32^{0}C DBT and 23^{0}C WBT. The room sensible and latent heat gains are 125600kJ/hr and 68035kJ/hr respectively and the ventilation is 67.5cmm. Find (i) outdoor air load (ii) grand total heat (iii) effective sensible heat factor (iv) apparatus dew point temperature (v) reheat required (vi) supply air quantity (vii) entering and leaving conditions at the apparatus (viii) supply air conditions to the space. Assume by pass factor of 0.05. ADP should not be less than 8^{0}C. [10]

8 a) What is the function of a fan in an air conditioning system? Describe a centrifugal fan with the help of a neat sketch? [8]

b) Explain in detail about heat pump circuits? [7]