Q.P. Code: 16ME8806 **R16**

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SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR

(AUTONOMOUS)

M.Tech I Year I Semester (R16) Regular Examinations January 2017

REFRIGERATION & AIR CONDITIONING

(Thermal Engineering)

(For Students admitted in 2016 only)

Time: **3 hours** Max. Marks: **60**

(Answer all Five Units **5 X 12 =60** Marks)

UNIT-I

Q.1 a. Explain with a neat sketch, working of a refrigeration system having two evaporators at different temperatures with individual compressors and multiple expansion valves? 5M

b. A three stage ammonia refrigeration system with flash inter cooling operates between the overall pressure limits of 2 bar and 12 bar. The flash inter cooler pressures are 4 bar and 8 bar. If the load on the evaporator is 10 TR. Find the power required to run the system and compare COP of the system with that of simple saturation cycle working between the same temperature limits? 7M

OR

Q.2 a. What type of evaporator is used in domestic refrigerator? Explain it with a neat diagram? 5M

b. A single compressor using R-12 as a refrigerant consists of 3 evaporators of capacities 30 TR at -10^0 C, 20 TR at 5^0 C, 10 TR at 10^0 C. The vapors leaving the 3 evaporators are dry and saturated. The system is provided with multiple expansion valves and back pressure valves. The condenser temperature is 40^0C and the liquid refrigerant leaving the condenser is sub cooled to 30^0 C. Assuming isentropic compression and vapors leaving the evaporators are dry saturated. Find i) mass of refrigerant flowing through each evaporator ii) power required to drive the system iii) COP of the system. 7M

UNIT-II

Q.3 a. Represent actual vapor absorption cycle on H-C diagram? 5M

b. In an absorption refrigerator, the heat is supplied to ammonia generated by condensing steam at 2 bar and 90% dry. The temperature in the refrigerator is to be maintained at -5^0 C. Find the maximum possible COP. If the refrigeration load is 20 tonnes and actual COP is 70 % of the maximum COP; Find the mass of steam required per hour. Take atmosphere temperature as 30^0 C. 7M

OR

Q.4 a. Differentiate simple and actual vapor absorption refrigeration systems? 5M

b. With a neat sketch explain the working principle of Electrolux vapor absorption refrigeration system? What is the role of inert gas? 7M

UNIT-III

Q.5 a. With a neat sketch explain the working principle of a steam jet refrigeration system? 5M

b. A Bootstrap refrigeration system of 20 TR capacity is used for an aero plane flying at an altitude of 2000m. The ambient air pressure and temperature are 0.8 bar and 0^0 C. The ram air pressure and temperature are 1.05 bar and 17^0 C. The pressure of air after isentropic compression in the main compressor is 4 bar. The air is now cooled to 27^0 C in another auxiliary heat exchanger and then expanded isentropically up to the cabin pressure of 1.01 bar. If the air leaves the cabin at 25^0 C and the efficiencies for the main compressor, auxiliary compressor and the cooling turbine are 80%, 75% and 80% respectively. Find i) power required to operate the system ii) COP of the system 7M

OR

Q.6 a. Why air conditioning is necessary for aero planes? What are the advantages of air as a refrigerant in it? 5M

b. The reduced ambient air refrigeration system used for an air craft consists of two cooling turbines, one heat exchanger and one air cooling fan. The speed of air craft is 1500 km/hr. The ambient air conditions are 0.8 bar and 10^0 C. The ram efficiency is 90%. The rammed air used for cooling is expanded in the first cooling turbine and leaves it at a pressure of 0.8 bar. The air bled from the main compressor at 6 bar is cooled in the heat exchanger and leaves at 100^0 C. The cabin is to be maintained at 20^0 C and 1 bar. The pressure loss between the second cooling turbine and the cabin is 0.1 bar. If the isentropic efficiency of the main compressor and both of the cooling turbines are 85% and 805 respectively. Find: i) mass flow rate of air supplied to cabin to take a cabin load of 10 TR. ii) Quantity of air passing through the heat exchanger if the temperature rise of ram air is limited to 80 K. iii) power used to drive the cooling fan iv) COP of the system. 7M

UNIT-IV

Q.7 a. Discuss the factors which govern the optimum effective temperature for
comfort? Prove that mixing of two fluids is leading to adiabatic process? 5M

b. Air at 40^0 C and 30% relative humidity is passed through an adiabatic air washer at the rate of 28 m^3/min. Find the state of air leaving the air washer, if the effectiveness of the air washer is 80%. 7M

Q.8 a. Sketch comfort chart and show on it comfort zone? Represent Steam injection, water injection processes on psychrometric chart? 5M

b. The atmospheric air at 20^0 C and 60% relative humidity is heated and humidified in such a way that final DBT is 30^0C and relative humidity is 50%. Determine the heat and moisture added to the air per minute, if the volume of air entering is 100 m^3/min. 7M

UNIT-V

Q.9 a. Determine bypass factor of a cooling coil with the help of a neat diagram? Explain the difference between comfort and industrial air conditioning? 5M

b. A hall is to be maintained at 20^0 C DBT and 60% R.H. When ambient conditions are 40^0 C DBT and 26^0C WBT. The room sensible and latent heat gains are 70,000 KJ/hr and 22,000 KJ/hr respectively. The in filtered air is 30 m^3/min. 60% of the total air is recirculated and mixed with the conditioned air after the conditioner. Determine i) The condition of air leaving the conditioner and before entering the hall ii) Volume of fresh air passing through the air-conditioner iii)bypass factor iv) Refrigeration load on the conditioner coil in TR v) Area of the cooling coil required if the overall heat transfer coefficient is 50 W/m^2 -^{0}C. Take ADP of cooling coil as 5^0 C. 7M

OR

Q.10 a. Explain the working principle of a thermostat in an A/C plant? Discuss the conditions of comfort you would prescribe for an office in a city like puttur which was hot and dry climate? 5M

b. A library hall is to be maintained at 24^0 C DBT and 50% R.H. When ambient conditions are 38^0C DBT and 40% R.H. The room sensible and latent heat gains are 1,25,000 KJ/hr and 68,000 KJ/hr respectively. The ventilation is 65 m^3/min. Determine i) Grand total heat ii) ERSHF iii) ADP iv) Dehumidified air quantity. Take bypass factor of cooling coil as 0.1. 7M

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