Registration No : | | | | | | | | | | |

Total Number of Pages : 03 **B.Tech**

PME6I102

6th Semester Regular / Back Examination 2018-19

REFRIGERATION & AIR CONDITIONING

BRANCH : MECH

Max Marks : 100

Time : 3 Hours

Q.CODE : F221

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.

The figures in the right hand margin indicate marks.

Part- I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) What is the effect of sub cooling on the performance of a refrigerator?

b) Discuss the advantages of vapor absorption refrigeration system over the vapor compression refrigeration system.

c) What are the advantages of compound compression with intercooler over single stage compression?

d) What do you mean by thermodynamic wet bulb temperature?

e) Explain effect of variation of discharge pressure and suction pressure on performance of refrigeration system.

f) Draw the schematic diagram for a Electrolaux system.

g) Mention the essential characteristics of an ideal refrigerant.

h) Define COP and TR

i) Define Eutectic point.

j) What is adiabatic humidification?

Part- II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) A refrigerating system working on Bell-Coleman cycle receives air from cold chamber at -5^0C and compresses it from 1 bar to 4.5 bar. The compressed air is then coolded to a temperature of 37^0C before it is expanded in the expander. Calculate the C.O.P. of the system when compression and expansion are (i) isentropic; (ii) follow the law $pv^{1.25}$=constant.

b) The following data refer to a simple aircraft refrigeration system:
Ram air temperature and pressure : 30^0C and 1 atm.
Cabin air temperature and pressure : 27^0C and 1 atm
Pressure at the exit of main compressor : 4.5 bar.
ε =Heat exchanger effectiveness :0.8, $\eta_c = 0.84$, $\eta_e = 0.8$
Cooling load=31kW.
Determine (a) tonnage, (b) mass of the bled air from the main compressor for refrigeration, (c) heat rejection, (d) power, (e) COP and (f) power supplied to the blower.

c) What is sub-cooling and superheating? Explain with the help of diagram. Why is superheating considered to be good in certain cases

d) Make a comparative list between a vapor-absorption system and vapor-compression system.

e) A reversed Carnot cycle air conditioner of 1 *TR* capacity operates with cooling coil temperature $t_0=5^0C$. The surrounding air at 43^0C is used as a cooling medium rising to a temperature of 53^0C. The temperature of heat rejection is $t_k=55^0C$. The overall heat transfer coefficient of the heat exchanger between the working substance and the surrounding air is $U=250\ W.m^{-2}K^{-1}$. Determine the mass flow rate of the surrounding air entering the heat exchanger, area of heat exchanger, COP and power consumption of the air conditioner.

f) A Freon 12 vapour compression system operating at a condenser temperature of 40^0C and an evaporator temperature of 0^0C develops 15 tons of refrigeration. Using the p-h diagram for Freon 12, determine: (a) the discharge temperature and mass flow rate of refrigerant circulated, (b) the theoretical piston displacement of the compressor and piston displacement per ton of refrigeration, (c) the theoretical horsepower of the compressor and horsepower per ton of refrigeration (d) the heat rejected in the condenser and the Carnot COP.

g) What are azeotropic and non-azeotropic mixtures? Explain, in brief, their advantages giving examples

h) An ammonia refrigerating plant is working at an evaporating temperature of -30^0C and a condensing temperature of 37^0C. There is no subcooling of the liquid refrigerant, and the vapour is in the dry-saturated condition at the inlets to the compressors. The capacity is 150kW refrigeration. Estimate the power consumption.

(i) when one-stage is used ,
(ii) when two-stage compression with flash inter-cooling is used,
(iii) when two-stage compression with flash chamber and liquid subcooler is used. Assume suitable intermediate pressure.

i) The operating conditions for a water-lithium bromide chilled-water plant for air conditioning are as follows:

Generator temperature : 97^0C
Condenser temperature : 40^0C
Chilled-water temperature : 10^0C
Absorber temperature : 40^0C

Find the temperature of the solution entering generator assuming hot solution iscooled to the saturation temperature at absorber pressure. Determine for one ton refrigeration capacity, the following:

(i) The thermodynamic conditions at all points
(ii) Coefficients of performance.

j) Write short notes on :

(i) Secondary refrigerant
(ii) Thermodynamics of human body

k) The amount of air supplied to an air conditioned hall is $300m^3$/min. The atmospheric conditions are 35^0 C DBT and 55% RH. The required conditions are 20^0 C DBT and 60% RH. Find the sensible heat and latent heat removed from the air per minute. Also find sensible heat factor for the system.

l) Define the term effective temperature and explain its significance in the design of air conditioning systems.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 a) Explain the working principle of air refrigerator working on a Bell-Coleman cycle using *P-v* and *T-s* diagram. Derive the expression for COP. **(8)**

b) In a vapor compression refrigeration system using R-12, the evaporator pressure is 1.4 bar and the condenser pressure is 8 bar. The refrigerant leaves the condenser sub-cooled to 30^0C. The vapor leaving the evaporator is dry and saturated. The compression process is isentropic. The amount of heat rejected in the condenser is 13.42 MJ/min. Determine **(8)**

(i) refrigerating effect in kJ/kg;
(ii) refrigerating load in TR;
(iii) compressor input in kW; and (iv) C.O.P.

Q4 a) Describe a two stage ammonia vapor compression refrigeration system and calculate the savings of work over a single stage system in terms of enthalpies. **(10)**

b) A two-stage refrigeration system works between the pressure limits 9.634 and 1.828 bar (saturation temperatures 40^0C and -15^0C). Obtain the COP and capacity for a flow rate of 0.2 kg/s through the evaporator. The intermediate pressure is 4.238 bar. Compare the COP and capacity of the two stage system with a corresponding single stage operating between the above pressure limits. The refrigerant used is R-12. **(6)**

Q5 **a)** Explain the working principle of a simple three fluid absorption system with the help of a neat schematic diagram. Compare between three fluid and two fluid absorption system. **(8)**

b) Explain with neat sketch the working principle of Thermoelectric Refrigeration. Define figure of merit. **(8)**

Q6 **a)** Given for the air conditioning of a room : **(10)**
Room conditions: 26.5^0C DBT and 50% RH
Room sensible heat gain=26.3 kW
Room sensible heat factor=0.82
Find :
(i) The room latent heat gain.
(ii) The apparatus dew point.
(iii) The cmm of air if it is supplied to the room at the apparatus dew point.
The cmm and specific humidity of air if it is supplied to the room at 17^0C.

b) 39.6 cmm of a mixture of recirculated room air and outdoor air enter a cooling coil at 31^0C DB and 18.5^0C WB temperatures. The effective surface temperature of the coil is 4.4^0C. The surface area of the coil is such as would give 12.5kW of refrigeration with the given entering air state. Determine the dry and wet bulb temperatures of the air leaving the coil and the coil bypass factor. **(6)**