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

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Course: B.Tech
Sub_Code: PME6I102

6th Semester Back Examination: 2022-23
SUBJECT: Refrigeration and Air Conditioning
BRANCH(S): MECH
Time : 3 Hour
Max Marks : 100
Q.Code : M324

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 **Answer the following questions :** **(2 x 10)**

a) Enumerate important refrigeration applications.

b) State merits and demerits of an air-refrigeration system.

c) Define COP and TR.

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

e) What is purpose of condenser in vapour compression system?

f) Define the terms “volumetric efficiency” and “clearance volumetric efficiency”.

g) How are the refrigerants numbered?

h) Briefly explain secondary refrigerants with example.

i) Write down factors affecting human comfort.

j) Define ‘air conditioning system’.

Part-II

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

a) A refrigerating machine of 6 tonnes capacity working on Bell-Coleman cycle has an upper limit of pressure of 5.2 bar. The pressure and temperature at the start of compression are 1 bar and 16^0C respectively. The compressed air cooled at constant pressure enters the expansion cylinder at a temperature of 41^0C. Assuming both expansion and compression processes to be adiabatic with $\gamma = 1.4$, calculate:

i) COP and

ii) Quantity of air in circulation

For air take, $\gamma = 1.4$, Cp = 1.003 kJ/kg.K.

b) Explain briefly an air-refrigerator working on reversed Carnot cycle. Derive an expression for its Coefficient of performance.

c) What is the difference between 'Wet compression' and 'Dry compression'?

d) A two-stage vapour compression refrigeration system with a direct contact heat exchanger (flash chamber) operates with ammonia as refrigerant. The evaporator and condenser temperatures are -30^0C and 40^0C respectively. If the capacity of the plant is 25 tonnes of refrigeration, estimate the total work of compression and the COP.

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

f) 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.

g) Differentiate between 'Primary refrigerant' and 'Secondary refrigerant'.

h) When is dehumidification of air necessary and how it is achieved?

i) Explain the following:

(i) absolute humidity

(ii) dry bulb temperature

(iii) wet bulb temperature

j) What is the difference between "wet bulb temperature" and "thermodynamic wet bulb temperature"?

k) The humidity ratio of atmospheric air at 28^0C DBT and 760 mm of mercury is 0.016 kg/kg of dry air. Determine

1. Partial pressure of water vapor
2. Relative humidity
3. Dew point temperature
4. Specific enthalpy
5. Vapor density

l) Explain the difference between 'summer air-conditioning' and 'winter air conditioning'.

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

Q3 **a)** Draw and explain the actual vapour compression refrigeration diagram on T-s and p-h plots. **(8)**

b) Discuss the effect of the following on the performance of vapor compression system **(8)**

(i) Effect of suction pressure (ii) Effect of delivery pressure
(iii) Effect of superheating (iv) Effect of subcooling

Q4 **a)** Explain the working of Thermostatic Expansion valve with neat sketch. Write its advantages and disadvantages. **(8)**

b) In an aqua-ammonia absorption refrigeration system of 10 TR capacity, the vapors leaving the generator are 100% pure NH_3 saturated at 40^0C. The evaporator, absorber, condenser and generator temperatures are -20^0C, 30^0C, 40^0C and 70^0C respectively. At absorber exit (strong solution), the concentration of ammonia in solution is $x = 0.38$ and enthalpy $h = 22$ kJ/kg. At generator exit (weak solution) $x = 0.1$ and $h = 695$ kJ/kg. **(8)**

i) Determine mass flow rate of ammonia in the evaporator.
ii) Carry out overall mass conservation and mass conservation of ammonia in absorber to determine mass flow rates of weak and strong solutions;
iii) Determine the heat rejection in absorber and condenser; and
iv) sC.O.P

Q5 **a)** State the advantages and disadvantages of Electrolux refrigerator over conventional refrigerators. **(8)**

b) Draw a neat diagram of lithium bromide water absorption system and explain its working in major field of applications of this system. **(8)**

Q6 **a)** In an air conditioning system, the inside and outside conditions are dry bulb temperature 25°C, relative humidity 50% and dry bulb temperature 40°C, wet bulb temperature 27 °C respectively. The room sensible heat factor is 0.8. 50% of the room air is rejected to atmosphere and an equal quantity of fresh air added before air enters the air conditioning apparatus. If the fresh air added is 100 m^3/min, determine; **(8)**

i) Room sensible and latent heat load
ii) Sensible and latent heat load due to fresh air
iii) Apparatus dew point
iv) Humidity ratio and dry bulb temperature of air entering air conditioning apparatus

Assume by-pass factor as zero, density of air as 1.2 kg/m^3 at a total pressure of 1.01325 bar.

b) Explain the difference between comfort air-conditioning and industrial air-conditioning. **(8)**