Ex/PG/ME-AUE/T/127F/2024

M.E. MECHANICAL ENGINEERING FIRST YEAR SECOND SEMESTER EXAM. 2024

ADVANCED REFRIGERATION AND AIR CONDITIONING METHODS

Time : 3 Hours

FULL MARKS : 100

Answer any FOUR questions.

All questions carry equal marks.

Use of Steam Tables, Refrigerant Tables and Psychometric Charts are allowed. Psychometric Charts where any problem will be solved are to be attached with the answer script.

Q.1.

a) With a neat sketch of Lithium Bromide-Water Vapour absorption system and with relevant notations, derive the expressions of Heat Transfer rates in the Generator, Absorber and Condenser. Hence also derive the expression of COP for such a system. 15

b) Derive the expression of maximum C.O.P. obtainable from a Vapour Absorption Refrigeration System. 10

Q.2.

a) What are the reasons for limiting the use of a single refrigerant and a simple vapour compression cycle for the production of low temperatures? 10

b) Derive the optimum coupling temperature between the stages of a two Stage Cascade Refrigeration System. 15

Q.3.

a) A R-134a simple vapour compression system operates with a condenser temperature of 40 °C and an evaporator temperature of 0 °C developing 20 TR. Using tables of R-134a determine,

i. The discharge temperature from the compressor and the mass flow rate of refrigerant in circulation.
ii. The COP.
iii. The heat rejection rate in the condenser. 15

b) Explain the Liquid-Vapour Regenerative heat exchanger with a sketch of the Vapour Compression System and also with P-H and T-S diagrams. Discuss the advantages of such a system. 10

Q.4.

a) A 15 TR LiBr-H_2O vapour absorption plant, has the following details:

	At Generator Inlet	At Generator Exit
Lithium Bromide Concentration	0.4	0.5
Specific Enthalpy of Binary Mixture	-20 KJ/Kg	50 KJ/Kg

Refrigerant leaves:

i. Evaporator at 2 °C as dry saturated vapour.
ii. Condenser as saturated liquid at 30 °C.
iii. Generator as dry saturated vapour at 110 °C.

Determine:

i. Mass flow rates of strong solution and weak solution.
ii. Maximum COP of the system.
iii. Actual COP and relative COP of the system.
iv. Heat transfer rates in the Absorber, Generator and Condenser.
v. If the heat supply to the Generator is done by condensing dry saturated steam at 2 Bar to Saturated liquid, find the steam mass flow rate in the generator.

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b) Give a comparison between the Vapour Absorption and the Vapour Compression Systems of Refrigeration. 05

Q.5.

a) Explain the Multistage or Compound Vapour Compression refrigeration using

i. The Flash Gas Removal,

and, ii. The Flash Intercooling Technique 17

b) Explain the Ozone Depletion Potential and Global Warming Potential of CFC refrigerants.

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Q.6.

a) 39.6 m^3/min of a mixture of recirculated room air and outdoor air enters a cooling coil at 31 °C DB and 18 °C WB temperatures. The effective surface temperature of the cooling coil is 5 °C. The surface area of the coil is such as would give 13 KW of refrigeration with the given entering state of air. Determine the exit condition of air from the coil and the coil By Pass Factor.

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b) Explain the Summer Air Conditioning System by drawing the AC system on the Psychometric chart. What are the items to be determined for the System Design of AC in Summer

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