Code No: 136DQ **R16**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, March - 2024

REFRIGERATION AND AIR CONDITIONING

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.
iv) R&AC Data books are permitted into the exam hall.

PART - A

(25 Marks)

1.a)	Write the Industrial applications of air conditions systems.	[2]
b)	Why the coefficient of performance may be greater than one sometimes? Justify.	[3]
c)	What is the role of capillary tube in vapour compression refrigeration system?	[2]
d)	How does the COP of VCRS being influence by the sub cooling? Explain.	[3]
e)	What are the desirable thermal properties of a good refrigerant?	[2]
f)	What do you understand by the term Ozone depletion? Explain.	[3]
g)	Why Maximum COP is estimated for vapour absorption refrigeration system?	[2]
h)	What is the function of ejector used in steam refrigeration system?	[3]
i)	Explain the significance of ESHF in estimating the cooling load.	[2]
j)	What is the need of ventilation? Explain.	[3]

PART - B

(50 Marks)

2.a) What are the advantages and limitations of reduced ambient refrigeration system used for aircraft refrigeration? Explain.

b) A bootstrap air refrigeration system of 15 TR capacity is used for an aero plane. The ambient temperature and pressure are 10^0C and 0.8 bar. The air is rammed isentropically to a pressure of 0.1 bar. The pressure of air bled off from the main compressor is 3.0 bar and this is further compressed in a secondary compressor to a pressure of 4.0 bar, the isentropic efficiency of both the compressors is 90% and that of cooling turbine is 85%. The effectiveness of the heat exchangers is 90%. If the cabin is to be maintained at 25^0C and the pressure in the cabin is 1 bar. Find: (i) Mass of air passing through the cabin, (ii) COP of the system. [5+5]

OR

3.a) Compare and contrast the Bell Coleman cycle with the Brayton cycle.

b) A dense air closed Bell-Coleman refrigeration system working between 4 bar and 16 bar extracts 125 MJ/h. The air enters the compressor at 5^0C and enters the expander at 23^0C. The compressor is double acting and its stroke = 30 cm; γ for air = 1.4; mechanical efficiency (compressor) = 82%; mechanical efficiency (expander) = 87%; C_p for air = 1.005kJ/kg K; R for air = 0.287 kJ/kg K. Assume the unit runs at 300 rpm, find: (i) Power required to runs the unit (ii) Bore of the compressor (iii) Refrigerating capacity in tones. Assume isentropic compression and expansion. [5+5]

4.a) Explain the modified vapour compression refrigeration system along with p-h diagram.

b) An ammonia refrigeration plant operates between a condenser temperature of 40^0C and an evaporator temperature of -10^0C. The vapour is dry at the end of end of compression. The specific heat of ammonia is 2.187 kJ/kg K. Calculate net refrigeration effect, work required and COP. [5+5]

OR

5.a) What are the effects of sub cooling and superheating on the net refrigerating effect, work required and COP of vapour compression refrigeration system? Explain along with p-h diagrams.

b) The vapour compression refrigeration ycle refers to a 20 TR ice plant using ammonia as refrigerant. The temperature of water entering and leaving the condenser are 20^0C and 27^0C respectively and temperature of brine in the evaporator is -15^0 C. Before entering the expansion valve, ammonia is cooled to 20^0 C and enters the compressor dry saturated. Calculate for 1 tone of refrigeration the power expended the amount of cooling water in the condenser and C.O.P of the plant. [5+5]

6.a) What are different commonly used refrigerant? Describe the nomenclature of the refrigerant representation.

b) A refrigerating plant is required to produce 2.5 tonnes of ice per day at -4^0C from water at 20^0C. If the temperature range in the compressor is between 25^0C and -6^0C, calculate power required to drive the compressor, the latent heat of ice = 335 kJ/kg and specific heat of ice = 2.1 kJ/kg K. [5+5]

OR

7.a) What are different types of evaporators used in vapour compression refrigeration system? Explain them with suitable diagrams.

b) Differentiate between evaporative condenser with the water cooled condenser and discuss their limitations. [5+5]

8.a) Draw the schematic diagram of three fluid refrigeration system and describe the constructional and operational features of the system.

b) In a vapour absorption system, the heat is supplied to the generator by condensing steam at 3 bar and 85% dry. The temperature in the evaporator is to be maintained at -10^0 C. If the cooling water rejects heat at 30^0 C in the condenser, find the maximum C.O.P of the system. [5+5]

OR

9.a) Describe the principle of operation of Li Br absorption refrigeration system.

b) The motive steam to a flash water plant is supplied at 6.5 bar dry and saturated, make up water is at 28^0C and condenser pressure is 3.5 cm Hg absolute. The flash chamber water is at 80C. Assuming nozzle efficiency 84%, entrainment efficiency 64% and diffuser efficiency 79%, quality of steam and vapour mixture at inlet to diffuser as 0.88, Determine (i) Steam required per hr. per ton of refrigeration, (ii) Steam required per kg of flashed vapour. [5+5]

10.a) How to estimate the absolute humidity and relative humidity if the dry bulb temperature and wet bulb temperatures are known? Explain.

b) The sensible heat factor of an air-conditioned room is 0.67. The condition of the air leaving the air-conditioned room is 27^0C DBT and 52% RH. The maximum permissible temperature difference between the inlet air and outlet air is 11^0C. If the quantity of air flow at the inlet of the room is 180 m^3/min, then find the sensible and latent heat load of air conditioned room. [5+5]

OR

11.a) The following data refer to an air conditioning system for industrial process for hot and wet summer conditions: outdoor conditions = 33^0C DBT and 78% RH, required conditions = 20^0C DBT and 73% RH, amount of out-door air supplied = 220 m^3/min, coil dew point temperature = 12^0C. If the required condition is achieved by first cooling and dehumidifying and then by heating, find: (i) The capacity of the cooling coil and its by-pass factor (ii) The capacity of the heating coil and surface temperature of heating coil if the by-pass factor is 0.18.

b) Describe the working principle of heat pump along with their practical applications. [5+5]

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