Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree Supplementary Examination June 2022 (2015 Scheme)

Course Code: ME405

Course Name: REFRIGERATION AND AIR CONDITIONING

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three full questions, each carries 10 marks. Marks

1 a) Define COP and prove that $COP_{Heat\ Pump} = COP_{Refrigerator} + 1$ (4)

b) A Bell-Coleman refrigerator operates between pressure limits of 1 bar and 8 bar. Air is drawn from the cold chamber at 9°C and compressed and then cooled to 29°C before entering into the expansion cylinder. The polytropic index for both compression and expansion each is 1.35. Calculate $COP_{theoretical}$, if $\gamma = 1.4$ and $C_p = 1.003 kJ/kgK$. (6)

2 a) Derive an expression for COP of Reversed Brayton cycle for air refrigeration system. (4)

b) The cabin load of an aircraft is 25 tonnes. The outside air temperature is 16°C. The atmospheric air is compressed to a pressure of 0.96 bar and temperature of 29°C due to ram action. This air is then further compressed in a compressor to 4.8 bar, cooled in a heat exchanger to 66°C, expanded in a turbine to 1 bar pressure and supplied to the cabin. The air leaves the cabin at a temperature of 26°C. The isentropic efficiencies of both compressor and turbine are 0.9. Calculate the COP of the system. (6)

3 a) Enlist any four methods to improve the COP of a simple vapour compression refrigeration cycle, with the help of necessary sketches. (4)

b) A vapour compression system with R12 as refrigerant includes a liquid to vapour heat exchanger in the system. The heat exchanger cools saturated liquid coming out of condenser from 32°C to 22°C with the help of vapour coming out of evaporator at - 12°C saturated. The compression is isentropic. (6)

Find:

(i) C.O.P. of the system,

(ii) Refrigeration capacity of the system if the compressor displacement is 1.2 m^3/min and

(iii) C.O.P. of the system without heat exchanger.

4 a) With the help of neat sketch explain the working of steam jet refrigeration system. (4)

b) With a neat sketch, explain the working of a modified ammonia water vapour absorption refrigeration system. Also explain the reason for the modification of the generator in the case of NH_3-H_2O system. (6)

PART B

Answer any three full questions, each carries 10 marks.

5 A compound refrigeration system is used to maintain +10°C and -10°C in two evaporators of 20TR and 10TR respectively connected in parallel. The refrigerant leaving the condenser is saturated liquid at 30°C. It then enters in to the corresponding expansion valves which are also connected in parallel. Find the power required to run the system and the COP if the compressors are connected in series. Also draw the line diagram of the arrangement and the P-H diagram of the cycle. (10)

6 Explain flash inter cooling with the help of a line diagram and P-H diagram. Write any two advantages of using flash chamber. (10)

7 a) Explain with a neat diagram working of domestic refrigerator. (5)

b) What is plate freezing? Write any two uses. (5)

8 a) With a neat sketch explain the working of a Flooded evaporator. (5)

b) With a neat sketch explain the working of a Hermetically sealed compressor. (5)

PART C

Answer any four full questions, each carries 10 marks.

9 20 m3 of air at 30°C and 60% R.H. is cooled to 22°C DBT maintaining its specific humidity constant. Find the heat removed from the air, RH of the cooled air, Wet-bulb temperature of the cooled air and the Dew point temperature of the air if the pressure is 1 bar. (10)

10 a) What is comfort chart? (3)

b) Write any four factors affecting human comfort. (4)

c) What is Effective temperature? (3)

11 a) Describe the three methods of designing ducts for air conditioning? (6)

b) With schematic diagram explain four arrangement of air distribution system in air conditioning. (4)

12 a) Explain Central air conditioning systems with a schematic diagram. (5)

b) Explain any five factors to be considered for the design of an air conditioning system for a hospital. (5)

13 An air-conditioned space is to be maintained at 27°C DBT and 55% RH. The outside condition is 39°C DBT and 28°C WBT. The total sensible heat load is 120000 kJ/h and the total latent heat load is 45000 kJ/h. 60 per cent of the return air is recirculated and mixed with 40 per cent of make-up air after the cooling coil. The condition of air leaving the coil is 17 °C. Determine, Room sensible heat factor, Condition of air entering the auditorium, Amount of make-up air, Apparatus dew point and By-pass factor of the cooling coil. (10)

14 With the help of schematic diagram explain winter and summer air conditioning systems. (10)

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