BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING) FOURTH YEAR FIRST SEMESTER-2019

REFRIGERATION AND AIR CONDITIONING Time -- Three hours Full Marks – 100

Answer any 5(Five) questions. All questions carry equal marks.

Use of Refrigerant tables, Steam tables and psychometric chart are permitted.

Attach the Psychometric chart used for solving problems on air-conditioning with the answer sheet.

Q.1.a) With a neat sketch on the P-h and T-s coordinate planes, explain the effects of superheating of the refrigerant in the evaporator , in comparison with the vapour compression simple saturated refrigeration cycle. 10

b) A refrigerator working in the Reversed Carnot cycle between two thermal reservoirs at 35^0C and 5^0C requires 3 KW work input. What will be the refrigerating effect in TR. If the same machine is now used as a heat pump working between the same two thermal reservoirs, determine the heat output by the heat pump in KW with an work input of 5 KW. What will be the COP of the refrigerator and also of the heat pump? 10

Q.2.a) A Freon 12 vapour compression system operating at a condenser temperature of 35^0C and an evaporator temperature of 5^0C develops 8 tons of refrigeration. Using the p-h diagram for Freon 12 and assuming simple saturated cycle, determine.

(a) the discharge temperature and mass flow rate of the 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
(e) the Carnot COP and actual COP of the cycle
(f) the refrigerating effect per Kg of refrigerant. 15

b) Discuss the advantages and disadvantages of using a liquid refrigerant-suction vapour regenerative heat exchanger in the vapour compression refrigeration system. 05

Q.3.a) Derive the COP of a Bell-Coleman cycle air-refrigeration system with proper notations and P-v and T-s diagrams. 10

b) Why the COP of the air-refrigeration cycle is quite less compared to the corresponding Reversed Carnot Cycle. 05

c) Explain the reason for not using the Bell-Coleman cycle for an air-refrigeration plant of large capacity. 05

Q.4.a) With a neat schematic diagram, explain the working principal of a vapour absorption refrigeration cycle. 10

b) Dry saturated steam at 3 bar is used for supplying heat in the generator of a vapour absorption refrigeration system. The evaporator of the refrigeration system is maintained at 2^0C. The circulating cooling water rejects heat at 30^0C in the condenser, Determine COP_{max} for the system. Also, if the steam leaves the generator as saturated liquid, determine the consumption of steam per hour for a 20TR refrigeration plant. Assume relative COP as 0.6. 10

Q.5.a) Define specific humidity, relative humidity and percentage humidity of moist air. Also derive the expression of specific humidity. 10

b) A sample of moist air has 32^0C Dry Bulb temperature and 28^0C Wet Bulb temperature at normal atmospheric pressure of 760mm Hg. Determine for this sample, the following using psychrometric chart:

i) Specific Humidity
ii) Relative Humidity
iii)Degree of Saturation
iv) Dew point temperature. 10

Q.6.a) Moist air, at 760 mm Hg or 101.3 Kpa, exists at 30^0C dbt and 50% Relative Humidity. Find the following (without using the psychrometric chart):

i) Degree of saturation
ii) Specific humidity
iii) Dew point temperature
iv) Specific volume of moist air. 12

b) With a neat sketch of the psychrometric chart explain the Sensible Cooling process and Sensible Heating process. Explain the term 'Bypass Factor'. 08

Q.7. Write short notes on (any two of the following):-

a. Reversed Brayton cycle.
b. Liquid refrigerant-suction vapour heat exchanger.
c. Cooling and Humidification process.
d. Comparison between Vapour Compression Refrigeration and Vapour Absorption Refrigeration.

10+10

x-x-x