Ref. No.: Ex/ME(M2)/PC/B/T/412/2024(S)

B.E MECHANICAL ENGINEERING FOURTH YEAR FIRST SEMESTER SUPPLEMENTARY EXAMINATION, 2024

REFRIGERATION AND AIR CONDITIONING

Time: Three hours **Full Marks-100**

Answer any five questions. Assume any unfurnished data suitably.

Use of Refrigerant Tables, Steam Table and Psychrometric Chart are permitted.

Q: 1(a) In an ammonia vapour compression system, the pressure in the evaporator is 2 bar. Ammonia at exit is 0.85 dry and at entry its dryness fraction is 0.19. During compression, the work done per kg of ammonia is 150 kJ. Calculate the C.O.P. and the volume of vapour entering the compressor per minute, if the rate of ammonia circulation is 4.5 kg/min. The latent heat and specific volume at 2 bar are 1325 kJ/kg and 0.58 m^3/kg respectively. **[10]**

(b) What is a heat pump? Prove that $(COP)_{HP}=(COP)_R+1$. What is the function of a condenser in a refrigeration cycle? **[5+5]**

Q: 2(a) What do you understand by primary and secondary refrigerants? Explain in brief. What is refrigerant. What are the desirable properties of a good refrigerant should have? **[5+5]**

(b) A refrigerator used R-12 as a working fluid and it operates on an ideal vapour compression cycle. The temperature of refrigerant in the evaporator is -20^0C and in the condenser is 40^0C. The refrigerant is circulated at the rate of 0.03 kg/s. Determine the coefficient of performance and capacity of refrigeration plant in TR. **[10]**

[Turn over

Q: 3(a) Write down the comparisons between vapour compression system with vapour absorption system. **[10]**

(b) Why multistage compression is used in refrigeration plant? What is actual vapour compression refrigeration cycle? How does it differ from the ideal cycle? **[3+7]**

Q: 4(a) Write down the advantages and disadvantages of vapour compression refrigeration system over air-refrigeration system. **[10]**

(b) Explain the Ammonia-water absorption refrigeration system with net sketch. **[10]**

Q: 5(a) When the dry-bulb and dew-point temperatures are identical? **[5]**

(b) A two stages, single acting air compressor compresses air to 20 bar. The air enters the L.P cylinder at 1bar and 27^0C and leaves it at 4.7 bar. The air enters the H.P. cylinder at 4.5bar and 27^0C. The size of the L.P cylinder is 400mm diameter and 500mm stroke. The clearance volume in both cylinders is 4% of the respective stroke volume. The compressor runs at 200rpm, taking index of compression and expansion in the two cylinders as 1.3, estimate 1. The indicated power required to run the compressor; and 2. The heat rejected in the intercooler per minute. **[15]**

Q: 6(a) The moist air at 1 atm has 32^0C DBT and 26^0C WBT. Calculate (a) Partial pressure of water vapour, (b) Specific humidity, (c) Dew point temperature, (d) Relative humidity, (e) Degree of saturation, (f) Enthalpy of mixture. **[10]**

(b) For the moist air at 30^0C DBT and 15^0C WBT, calculate (i) Specific humidity, (ii) Enthalpy, (iii) Relative humidity, (iv) Dew –point temperature. Use the Psychrometric chart. **[10]**

Q: 7(a) Describe the followings: **[10]**

i) Humidification and dehumidification, ii) Dehumidification with heating, iii) Humidification with heating.

(b) A sling psychrometer gives reading of 25^0C dry bulb temperature 15^0C wet bulb temperature. The barometer indicates 760 mm of Hg assuming partial pressure of the vapour as 10 mm of Hg. Determine 1. Specific humidity 2. Saturation ratio. **[10]**