B. E. MECHANICAL ENGINEERING (PART TIME) FOURTH YEAR SECOND SEMESTER (OLD)-2017

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

Answer any 5(Five) questions

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 script.

Q.1.a) What are the effects of superheating the refrigerant in the evaporator on the performance of a vapour compression refrigeration system. 10

b) The ambient air temperatures during summer and winter in a particular locality are 45^0C and 15^0C respectively. Find the values of reversed Carnot COP for a refrigerator used for cooling and a heat pump used for heating, corresponding to refrigeration temperatures of 5^0C for summer and heating temperature of 55^0C for winter. Assume a temperature difference of 5^0C for summer and 5^0C for winter in the heat exchangers that exchange heat with the surroundings. 10

Q.2.a) A Freon 12 vapour compression system operating at a condenser temperature of 40^0C and an evaporator temperature of 0^0C develops 25 TR of refrigeration. Using the refrigerant table for Freon-12 and assuming simple saturated cycle, determine.

i) the discharge temperature and mass flow rate of the refrigerant circulated,
ii) the heat rejected in the condenser, and
iii) the Carnot COP and actual COP of the cycle. 10

b) Explain the effect of sub- cooling of refrigerant in the condenser on the performance of a simple saturated vapour compression cycle. 10

Q.3.a) Derive the expression for maximum COP of a vapour absorption refrigeration system. 10

b) A vapour absorption refrigeration system works with 2^0C evaporator temperature and 30^0C condensing temperature. Heat is supplied in the generator by way of condensing steam at 2bar pressure from dry saturated vapour to saturated liquid condition. If the refrigeration capacity of the plant is 10TR, find,

i) the maximum COP of the system
ii) the mass flow rate of steam required for supplying the heat in the generator in Kg/sec. 10

Q.4.a) Explain why the COP in an air refrigeration system is always lower than that of a reversed Carnot refrigeration cycle. 05

b) Explain the difference between open-air and dense-air refrigeration system. 05

c) Derive the expression of COP for a reversed Brayton refrigeration cycle. 10

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Q.5.a) Moist air exists at a dry bulb temperature of 35^0C and a wet bulb temperature of 28^0C and 760mm Hg pressure. Using the psychrometric chart find the following for the moist air:

i) the relative humidity
ii) the specific humidity
iii) the partial pressure of water vapour
iv) The saturation pressure of water vapour at the DBT
vi) The dew point temperature of the moist air
vii) From the above, find out the percentage humidity of moist air using the relation between the relative humidity and the percentage humidity. 10

b) Define Relative Humidity, Specific Humidity and Dew Point Temperature of moist air. 10

Q.6.a) Moist air enters a chamber at 5^0C DBT and 2.5^0C WBT at a rate of 90 cubicmeter/minute. The barometric pressure is 1.01325 bar. While passing through the chamber, the air absorbs sensible heat at the rate 40.7 kW and picks up 40 kg/h of saturated steam at 110^0C. Determine the dry and wet bulb temperatures of the leaving air. 10

b) $30m^3$/min of a stream of moist air at 15^0C DBT and 13^0C WBT are mixed with $12m^3$/min of a second stream at 25^0C DBT and 18^0C WBT. Barometric pressure is one standard atmosphere. Determine the dry bulb and wet bulb temperatures of the resulting mixture. 10

Q.7.a) Moist air exists at 760 of Hg pressure, 35^0C Dry Bulb Temperature and 50% degree of saturation. Without using the psychrometric chart, determine for the moist air:

i) The relative humidity
ii) The specific humidity
iii) The Dew point temperature
iv) Specific volume 10

b) Explain the process of Cooling and Dehumidification with a sketch of the psychrometric chart. Explain the term "Bypass Factor". 10

Q.8.a) Compare between Vapour Absorption refrigeration system and Vapour Compression refrigeration system. 10

b) Explain the process of sensible heating and sensible cooling and also humidification and dehumidification with suitable sketches of the psychrometric chart. 10

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