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MANIPAL INSTITUTE OF TECHNOLOGY
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VI SEM. B.E. ENGG. DEGREE EXAMINATIONS JUNE/JULY 2016

SUBJECT: REFRIGERATION AND AIR CONDITIONING (MME-380)
(OPEN ELECTIVE- II)
REVISED CREDIT SYSTEM

Time: 3 Hours. MAX.MARKS: 50

Instructions to Candidates:
- Answer **ANY FIVE FULL** questions.
- Missing data, if any, may be suitably assumed.
- Use of thermodynamics data hand book is permitted.

1A) With the help of Line diagram and T-S diagram, explain the working of reduced ambient air cooling system and obtain an expression for power required to take the cooling load and C.O.P **(05)**

1B) The cockpit of a jet plane is to be cooled by a simple air refrigeration system. The data available is as follows.

Cockpit cooling load = 10 Tonnes, Speed of the plane = 1200 KM/Hr, Ambient air pressure = 0.85 bar, Ambient air temperature = 30^0 C

Ram efficiency = 90%, Pressure ratio in the main compressor = 4

Pressure drop in the heat exchanger = 0.5 bar, Pressure drop between the cooling turbine and cock pit = 0.2 bar, Isentropic efficiencies of main compressor and cooling turbine = 80%, Temperature of air entering the cooling turbine = 60^0 C, Pressure of air leaving the cooling turbine= 1.06 bar, Pressure in the cockpit= 1 bar, If the cockpit is to be maintained at 25^0 C, find;

i) Stagnation temperature and pressure of air entering the main compressor

ii) C.O.P of the system **(05)**

2A) Describe with the help of schematic and P-h diagrams, the working of a vapor compression refrigeration system with superheating and sub-cooling. Obtain an expression for its COP **(05)**

2B) The following data refer to a 10 Tonne vapor compression refrigeration system using ammonia

Condenser pressure = 12 bar

Evaporator pressure = 2 bar

Find the power required to drive the system and COP if the refrigerant at inlet to the compressor is 10% wet. **(05)**

3A) With the help of schematic and T-S diagram, Obtain an expression for the COP of a Bell- Coleman refrigeration cycle when compression and expansion processes take place according to the law pv^n = Const **(05)**

3B) A refrigeration system working on Bell-Coleman cycle operates between pressures of 4 bar and 16 bar. The air temperature after heat rejection to sorroundings is 37^0 C and air temperature at exit of refrigerator is 7^0C. The isentropic efficiencies of turbine and compressor are 0.85 and 0.8 respectively. Determine;

i) Compressor and turbine work per tonne of refrigeration
ii) Power required per tonne of refrigeration
iii) COP **(05)**

4A) What are the advantages and disadvantages of Absorption refrigeration system. Obtain an expression for the ideal COP of an absorption system **(05)**

4B) A small Auditorium is required to be maintained at 22^0 C dry bulb temperature and 70% relative humidity. The ambient conditions are 30^0C dry bulb temperature and 75% relative humidity. The amount of free air circulated is 200 m^3/min. The required conditions are achieved by first cooling and dehumidifying through a cooling coil having ADP of

14^0C and then by heating. With the help of psychrometric chart, find;

i) The capacity of the cooling coil in tones of refrigeration and its bypass factor

ii) The amount of water vapour removed by the cooling coil in kg/hr

iii) The capacity of the heating coil in kW and its surface temperature assuming its bypass factor as 0.2 **(05)**

5A) Define the following psychrometric terms and explain their significance in psychrometric processes.

i) Dew point temperature

ii) Humid specific heat **(06)**

iii) By-pass factor of cooling coil

5B) 800 m^3/min of recirculated air at 22^0C DBT and 10^0C dew point temperature is to be mixed with 300 m^3/min of fresh air at 30^0C DBT and 50% RH. Determine the enthalpy, specific volume, humidity ratio, and dew point temperature of the mixture **(04)**

6A) Draw a neat diagram of air conditioning system required for summer season. Explain the working of different components in the circuit **(05)**

6B) A food storage locker requires a refrigeration capacity of 12 Tonnes and works between the evaporating temperature of -8^0 C and condensing temperature of 30^0C. The refrigerant R-12 is subcooled by 5^0C before entry to expansion valve and the vapour is super heated to -2^0C before leaving the evaporator coils.

Determine;

i) Mass flow of refrigerant in kg/min

ii) COP

iii) Theoretical power per tonne of refrigeration **(05)**