Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VI SEMESTER B. TECH (MECHANICAL/IP ENGG.) END SEMESTER EXAMINATIONS, APRIL 2018

SUBJECT: Refrigeration & Air-conditioning Systems [MME 4012]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data if any may be suitable assumed.
- Use of Thermodynamic data hand book is permitted

1A. With neat schematic flow diagram and T-s diagram obtain an expression for COP of simple aircraft refrigeration cycle. **5**

1B. A regenerative air cooling system is used for an aeroplane to take 20 TR. The ambient air is at 0.8 bar and 10^0C. It is rammed isentropically till the pressure raises to 1.2 bar. The air bled from the main compressor at 4.5 bar is cooled by the ram air in the HE whose effectiveness is 60%. The air from the HE is further cooled to 600C in the regenerative HE with a portion of the air bled after expansion in the cooling turbine. The temperature of air leaving the regenerative HE is 100^0 C. The cabin is to be maintained at 25^0C and 1 bar. If the isentropic efficiencies of compressor and turbine are 90% & 80% respectively. Find;
(i) Mass of air bled from cooling turbine to be used for regenerative cooling
(ii) Power required
(iii) COP **5**

2A. Discuss the following in vapor compression refrigeration system: (i) Condenser and evaporator pressure on COP (ii) Flash gas separation and compression at intermediate pressure on COP **5**

2B. A 2 stage compression NH_3 refrigeration system operates between overall pressure limits of 14 bar and 2 bar. The temperature of the de-superheated vapor from water intercooler and subcooled liquid refrigerant from condenser are maintained at 30^0C. The de-superheated vapor is mixed with vapor from flash chamber before going to HPC. The flash tank separates dry vapor at 5 bar and the liquid refrigerant then expands to 2 bar and leaves the evaporator as dry saturated. Estimate the COP of the machine and the power required to drive the compressor, if the mechanical efficiency of the drive is 80% and the load on the evaporator is 10 TR. **5**

3A. Explain the working of practical aqua Ammonia vapor absorption refrigeration system. How do we ensure pure ammonia enters the condenser? **5**

3B. The refrigeration system using R-12 as refrigerant consists of 3 evaporators of capacities 20 TR, 30TR and 10 TR with individual compressors and individual expansion valves. The temperatures in the 3 evaporators are to be maintained at 10^0C, 5^0C and 10^0C. The vapors leaving the evaporators are dry and saturated. The condenser temperature is 40^0C and the liquid leaving the condenser is subcooled to 30^0C. Assuming isentropic compression in each compressors, find; (i) Power required to drive the system (ii) COP **5**

4A. Represent the following items on temperature entropy diagram and explain briefly: (i) Dew point Temperature (ii) Adiabatic saturation (iii) Dry bulb temperature.
If the total atmospheric pressure remains constant at a location, prove that specific humidity is approximately a linear function of the partial pressure of the water vapor. **5**

4B. $300m^3$/min of outdoor air at 40^0C dry bulb temperature and 26^0C wet bulb temperature is supplied to the required room after conditioning. The air is dehumidified first by a cooling coil having a bypass factor of 0.32 and apparatus dew point temperature of 15^0C. It is then passed through a chemical dehumidifier. The air leaves the chemical dehumidifier at 30^0C dry bulb temperature. The air is then passed over a cooling coil whose surface temperature is 15^0C and bypass factor of 0.26. Calculate the capacity of the cooling coils and dehumidifier. **5**

5A. Explain with sketches the working of summer air conditioning system and show the processes on psychrometric chart. **5**

5B. Outdoor air at 38^0C dry bulb temperature and 50%RH is mixed with return air from the room which is at 27^0C dry bulb temperature and 40% relative humidity in the ratio of 1:2 on mass basis before being passed onto the cooling coil. The bypass factor of the cooling coil is 0.25 and the ADP is 10^0C. The total through the cooling coil is 10kg/s. Determine (i) Condition of the air at the inlet and outlet of the cooling coil (ii) Room sensible factor (iii) Tonnage of the plant (iv) Rate of condensation **5**