Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institute of Manipal University, Manipal

VI SEMESTER B.TECH (MECHANICAL/IP ENGG.) END SEMESTER EXAMINATIONS, JUNE 2017

SUBJECT: REFRIGERATION AND AIR CONDITIONING SYSTEMS

[MME 4012]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. Sketch the flow diagram as well as T-s diagram for a boot strap air refrigeration system by considering all irreversibilities. **03**

1B. Explain the need for cabin pressurization in case of aircrafts when it is flying at higher altitudes. **02**

1C. A regenerative air cooling system is used for an aeroplane to take 20TR. The ambient air is at 0.8 bar and 10^0C. It is rammed isentropically till the pressure rises 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 heat exchanger is further cooled to 60^0C in the regenerative heat exchanger with the portion of 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 efficiency of the 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. **05**

2A. Explain with neat sketch and p-h diagram the working two stage cascade refrigeration system. List the advantages of the system over the simple vapor compression system when both are operating at same temperature limits. **05**

2B. A refrigeration system with R-12 as refrigerant has 3 evaporators and a single compressor with individual expansion valves. The evaporator capacity is 20TR, 15TR and 10 TR respectively. The temperature in the 3 evaporators is to be maintained at -10^0C, 5^0C and 10^0C respectively. The condenser pressure is 10bar. The liquid refrigerant leaving the condenser is sub-cooled to 30^0C. The vapor leaving the evaporators is dry and saturated. Assuming isentropic compression, find; (i) The mass of refrigerant flowing through each evaporator (ii) Power required to drive the system (iii) COP **05**

3A. Write the flow diagram and explain the working of an actual vapor absorption refrigeration system. Clearly mention the requirement of rectifier and analyzer in the system. **05**

3B. A 2 stage compression NH_3 refrigeration system operates between overall pressure limits of 16bar and 2 bar. The temperature of the de-superheated vapor and sub-cooled liquid refrigerant 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 3 bar. 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 20 TR. **05**

4A. Briefly explain the following: (i) Adiabatic saturation (ii) Psychrometric chart (iii) Apparatus dew point (iv) Room sensible heat factor (v) Comfort Chart **05**

4B. A conference room of 60 seating capacity is to be air conditioned for comfort condition of 22^0C dry bulb temperature and 55% RH. The outdoor conditions are 32^0C dry bulb temperature and 22^0C wet bulb temperature. The quantity of air supplied is $0.5m^3$/min/person. The comfort conditions are achieved by chemical dehumidification and by cooling coil. Determine: (i) DBT of air at exit of dehumidifier (ii) Capacity of dehumidifier (iii) Capacity and surface temperature of cooling coil if its by-pass factor is 0.3 **05**

5A. Explain with sketch working of Summer air conditioning system and show the processes on a psychrometric chart. **05**

5B. An air conditioned auditorium is to be maintained at 27^0C dry bulb temperature and 60% relative humidity. The ambient condition is 40^0C dry bulb temperature and 30^0C wet bulb temperature. The total sensible heat load is 100000kJ/h and the total latent heat load is 40,000kJ/h. 60% of the return air is recirculated and mixed with 40% of makeup air after the cooling coil. The condition of air leaving the cooling coil is 18^0C. Determine (i) Room sensible heat factor (ii) Condition of air leaving the auditorium (iii) amount of makeup air (iv) ADPT (v) Bypass of the cooling coil **05**