Reg.No.										

MANIPAL INSTITUTE OF TECHNOLOGY
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VII SEMESTER B.TECH (MECHANICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: **REFRIGERATION AND AIR CONDITIONING [MME 469]**

REVISED CREDIT SYSTEM

Time: 3 Hours. MAX.MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.
- Use of Thermodynamic data hand book is permitted
- Missing data may be suitable assumed.

1A. With schematic and T-s diagram, obtain an expression for COP of simple aircraft refrigeration cycle. What are its limitations? **05**

1B. A regenerative air cooling system is used for an aero-plane to take 20 TR. The ambient air is at 0.8bar and 10^0C. It is rammed isentropically till the pressure rises to 1.2bar. The air bled from the main compressor at 4.5bar is cooled by the ram air in the HE whose effectiveness is 60%. The air from the HE is further cooled to 60^0C 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 **05**

2A. Explain with sketch, working of auto cascade refrigeration system. What are its advantages? **05**

2B. A food storage chamber requires a refrigeration system of 12 tons capacity when evaporator temperature is -8^0C and condenser temperature is 30^0C. The system uses R12 as refrigerant. The refrigerant is sub-cooled by 5^0C before entering the throttle valve and the vapour is superheated by 6^0C before entering the compressor. Take C_p for liquid as 0.733 kJ/kg^{0}K and C_p for vapour as 1.235 kJ/kg K.Determine,
(i) Mass flow of refrigerant in kg/min (ii) Refrigerating effect (iii) COP **05**

3A. Obtain an expression for mass flow of refrigerant to the compressors and COP for a two stage vapor compression refrigeration system with flash gas removal with the help of schematic and P-h diagram **05**

3B. Compare the coefficient of performance of a refrigeration cycle which uses wet compression with that of one which uses dry compression. In both cases

use ammonia as the refrigerant, a condensing temperature of 30^0C, and an evaporating temperature of -20^0C; assume that the compressors are isentropic and that the liquid leaving the condenser is saturated. In the wet-compression cycle the refrigerant enters the compressor in such a condition that it is saturated vapor upon leaving the compressor. **05**

4A. Explain with neat sketch, working of vapour absorption refrigeration system using ammonia as refrigerant. Obtain an expression for heat transfer in absorber, generator and heat exchanger **05**

4B. The capacity of a refrigerator is 200 TR when working between – 6°C and 25^oC. Determine the mass of ice produced per day from water at 25°C. Also find the power required to drive the unit. Assume that the cycle operates on reversed Carnot cycle and latent heat of ice is 335 kJ/kg. **05**

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

5B. Air at 12^0C DBT & 90% RH is to be heated and humidified to 40^0C DBT and 24^0C WBT. The air is preheated sensibly before passing to the air washer in which water is recirculated. The RH of the air coming out of the air washer is 90%. This air is again reheated sensibly to obtain the desired condition. Find (i) The temperature to which the air should be preheated (ii) Total heating required (iii) Make-up water required in the air washer (iv) Humidifying efficiency of air washer. **05**

6A. Define the tem “adiabatic saturation temperature” of air. Explain with sketch how adiabatic saturator can be used to determine the thermodynamic wet bulb temperature of air. **05**

6B. The quantity of dry air supplied by an air handling unit is 3000 m^3/min which comprises by mass 30% fresh air at 38^0C DBT and 26^0C WBT and 70% recirculated air at 24^0C DBT and 50% RH. The air leaves the cooling coil at 14^0C saturated. Calculate the total cooling load and room heat gain. **05**