Reg.No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTERB.TECH. (MECHANICAL ENGINEERING)

END SEMESTER MAKE UP EXAMINATIONS, DEC 2016/JAN 2017

SUBJECT:REFRIGERATION AND AIR CONDITIONING (MME- 469)

REVISED CREDIT SYSTEM
(30/12/2016)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Use of Thermodynamics data hand book is permitted.
- Missing data may be suitably assumed.

1A. With schematic and T-S diagram, obtain an expression for COP of air refrigerator working on reversed Carnot cycle. **(05)**

1B. A reversed Carnot cycle is used for refrigeration which rejects 1,000 kW of heat at 340 K while receiving heat at 250 K. Determine **(05)**

a) COP, power required and refrigerating effect.

b) If it is to have a COP of 4. What is the ratio of Tmax/Tmin?

c) If the work input is 6 kW, what will be the maximum refrigerating effect in kJ/min and tons for a COP of 4.

2A. With T-s and P-h diagrams, explain the working of compound or multi stage vapour compression cycle. **(05)**

2B. A cold storage plant is required to store 20 tons of fish. The fish is supplied at the temperature of 30°C. The specific heat of fish above freezing point is 2.93kJ/kgK. The specific heat of fish below freezing point is 1.26 kJ/kgK. The fish is stored in cold storage which is maintained at -8 °C. The freezing point of fish is -4 °C. The latent heat of fish is 235kJ/kg. If the plant requires 75kW to drive it, find **(05)**

i. The capacity of the plant

ii. Time taken to achieve cooling

Assume actual COP of the plant as 0.3 of the Carnot COP.

3A. Explain with a neat sketch the principle of working of steam jet ejector refrigeration system. **(04)**

3B. The cock pit of a jet plane flying at a speed of 1200 km/hr is to be cooled by a simple air cooling system. The cock pit is to be maintained at 25 °C and the pressure in the cock pit is 1 bar. The ambient air pressure and temperature are 0.85 bar and 30 °C. The other data available is as follows: **(06)**

Cock pit cooling load = 10TR

Main compressor pressure ratio = 4

Ram efficiency= 90%

Temperature of air leaving the heat exchanger and entering the cooling turbine =60 °C

Pressure drop in the heat exchanger= 0.5 bar

Pressure loss between the cooler turbine and cock pit=0.2 bar.

Assuming the isentropic efficiencies of main compressor and cooler turbine as 80%. Find the quantity of air passed through the cooling turbine and COP of the system. Take γ =1.4 and Cp=1 kJ/kgK.

4A. Derive the expression for the overall coefficient of performance of a simple vapour absorption system. **(05)**

4B. A hall is to be maintained at 25 °C DBT and 55% RH when outdoor conditions are 35°C DBT and 25 °C WBT. Sensible heat load in room 70000 kJ/min, Latent heat load in room 18000 kJ/min, infiltrated air 25 m^3/min, DPT of the cooling coil 6 °C. If 60% of the total air is recirculated from the hall and is mixed with the conditioned air after the conditioner (coil), find; (i) Conditions of air leaving the conditioner and just before entering the hall (ii) Mass of fresh air entering the room (iii) By-pass factor of the coil (iv) Load on the coil in tonnes. **(05)**

5A. Explain the factors affecting human comfort. **(05)**

5B. A small auditorium is required to be maintained at 22 °C DBT and 70% RH. The ambient conditions are 30 °C DBT and 75% RH. The amount of free air circulated is 200m^3/min. The required conditions are achieved by first cooling and dehumidifying through a cooling coil having apparatus DPT of 14 °C and then by heating. With the help of psychrometric chart, find: i) The capacity of the cooling coil in tonnes of refrigeration and its by-pass factor ii) The amount of water vapour removed by the cooling coil in kg/h iii) The capacity of the heating coil in kW and its surface temperature if its BF is 0.2.

6A. Explain with a neat sketch the various psychrometric processes that can be performed using air washer. Show these processes on a psychrometric chart. **(05)**

6B. 30 m^3/min of moist air at 15 °C dry bulb temperature and 13 °C wet bulb temperature is mixed with 12 m^3/min moist air at 25 °C dry bulb temperature and 50% RH. Determine the dry bulb temperature and wet bulb temperature of the resulting mixture. **(05)**