Reg. No.

MANIPAL INSTITUTE OF TECHNOLOGY

VI SEMESTER B.TECH (MECHANICAL/IP ENGG.) END SEMESTER

EXAMINATIONS, APRIL/MAY 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 Brayton cycle for air refrigeration system and write the corresponding state points on a T-s coordinates showing irreversibilities in different processes.
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- **1B.** Differentiate between a simple air refrigeration system and bootstrap air refrigeration system
- **1C.** A boot-strap air refrigeration system of 10TR capacity is used for an aeroplane to take up cabin load. The ambient air pressure and temperature are 0.9 bar and 15^oC. The ram air pressure is 1.1 bar. The pressure of air after isentropic compression in the main compressor is 3.5 bar and after isentropic compression in auxiliary compressor is 4.5 bar. Assuming the effectiveness of both heat exchangers as 0.6, find the power required for refrigeration system and COP, if the cabin is to be maintained at 25^oC and 1 bar.
- **2A.** Write the flow diagram and h-s diagram for a two evaporator with different temperatures vapor compression refrigeration system having individual compressors and multiple expansion valves.
- **2B.** Why is multistage refrigeration employed when the difference between the upper and lower temperature limits is large?
- **2C.** A two-stage ammonia refrigeration plant is operating between the temperature limits of -40°C and 40°C. The intermediate pressure is 3.413bar at which flash gas separation as well as flash intercooling is done. The mass flow rate of refrigerant through the evaporator is 30kg/min. Obtain the tonnage of refrigeration and COP. Assume that the refrigerant leaves the evaporator as dry saturated and leaves the condenser as saturated liquid. Compare the above results with the system working on simple VCRS without flash gas removal, without flash intercooling and with single stage compression only.

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- **3A.** What are the advantages of vapor absorption refrigeration system over vapor compression system?
- **3B.** Explain the basic principle of working of steam jet refrigeration system.
- **3C.** A simple vapor compression refrigeration system with 8TR capacity has its evaporator temperature -10^oC and a condenser temperature of 30^oC. The refrigerant is subcooled by 5^oC before entering into the expansion valve and the vapor is superheated by 6^oC before leaving the evaporator. The suction pressure drop is 0.183bar in the suction valve and discharge pressure drop is 0.2bar in the discharge valve. If the refrigerant used is R22, find (i) COP (ii) compressor rating if the mechanical efficiency of the compressor is 80% (iii) Piston displacement in m³/min if the volumetric efficiency is 80%.
- **4A.** Define: (i) Specific humidity (ii) Relative humidity (iii) Wet bulb temperature (iv) Dry bulb temperature (v) Dew point temperature (vi) Bypass factor.
- 4B. Explain briefly the human body reactions to changes in temperature of environment.02
- **4C.** A small auditorium is required to be maintained at 22[°] C dry bulb temperature and 70% RH. The ambient conditions are 30[°]C dry bulb temperature and 75% RH. The amount of free air circulated is 200cmm. The required conditions are achieved by first cooling and dehumidifying through a cooling coil having apparatus dew point temperature of 14[°]C and then by heating. With the help of psychrometric chart, find: (i) The capacity of the cooling coil in tones of refrigeration and its by-pass factor (ii) The amount of water vapor removed by the cooling coil in kg/h (iii) The capacity of the heating coil in kW and its surface temperature if its contact factor is 0.8.
- **5A.** Explain with sketch working of a winter air conditioning system and show the processes on a psychrometric chart.
- **5B.** An air conditioning plant is to be designed for a small office for winter conditions: Out-door conditions: 10^oC dry bulb temperature and 8^oC wet bulb temperature, Required indoor conditions: 20^oC dry bulb temperature and 60% RH, Amount of air circulation: 0.3 m³/min/person, Seating capacity of the office: 50 persons, the required condition is achieved first by heating and then by adiabatic humidifying. Find; (i) Heating capacity of the coil in kW and its surface temperature, if the by-pass factor of the coil is 0.32, (ii) Capacity of the humidifier (iii) Humidifier efficiency.

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