

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL (A constituent unit of MAHE, Manipal)

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

MAKE UP EXAMINATIONS, JUNE 2019

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 suitable assumed.
- ✤ Use of Thermodynamic data hand book is permitted
- 1A. Discuss with a sketch regenerative air cooling system used for aircrafts. 05 Derive the expression for COP of the system.
- **1B.** A boot strap cooling system of 10 TR capacity is used in an aero plane. Ambient air temperature and pressure are 20°C and 0.85 bar respectively. Pressure of air increases from 0.85 to 1 bar due to ramming. Pressure of air discharged from the main compressor is 3 bar. Discharge pressure from the auxiliary compressor is 4 bar. Isentropic efficiency of each of the compressor is 80% while that of the turbine is 85%. 50% of the enthalpy of the air discharged from the first compressor is removed in the first heat exchanger and 30% of the enthalpy of the air discharged from the auxiliary compressor is removed in the second heat exchanger using rammed air. Required cabin pressure is 0.9 bar and temperature 20°C,find
 - a. Power required to operate the system
 - b. COP of the system

05

05

- 2A. With proper P-h diagram explain the vapor compression refrigeration system with 3 evaporators operating at different temperatures with individual compressors and individual expansion valves. Derive an expression for the 05 COP of the system.
- 2B. A 15 TR ammonia plant compression is carried out in two stages with water and flash intercooling and water subcooling. Condenser pressure is 11.7 bar and evaporator pressure is 2.9 bar .Flash inter cooler pressure is 6.1 bar and limiting temperature for flash intercooling and water subcooling is 20°C. Calculate (a) power required for compressors (b) COP.

MME 4012

- **3A.** Explain the function of the following in an vapor absorption refrigeration system?
- (a) Absorber (b) rectifier (c) Analyser (d) Generator (e) Heat exchangers.
 3B. A refrigeration system using R-12 refrigerent consists of 3 evaporators of capacities 20 TR, 30 TR and 10 TR at temperatures -10°C, 5°C and 10 °C. Vapors leaving the evaporators are dry and saturated. System is provided with individual compressors and multiple expansion valves. Condenser temperature is 40°C and the liquid refrigerant leaving the condenser is subcooled to 30 °C. Assuming isentropic compression in each compressor find (a) mass flow of refrigerant in each evaporator (b) Power required (c) COP
- 4A. With the help of a neat sketch explain the principle of steam jet refrigeration 03 system.
- **4B.** Discuss the 4 important physical properties of a good refrigerant.
- **4C.** Explain the following terms of psychrometry.
 - (a) Wet bulb temperature (b) By-pass factor of a cooling coil (c) Sensible heat factor (d) Specific humidity (e) Relative humidity.
- **5A.** With a neat diagram explain summer air conditioning system. Explain the different components involved and also Show the processes involved in psychrometric chart.
- 5B. A conference room of 60 seating capacity is to be air conditioned for comfort conditions of 22°C DBT and 55% relative humidity. Outdoor conditions are 32°C DBT and 22°C WBT. Quantity of air supplied is 0.5 m³/min/person. Comfort conditions are achieved by chemical dehumidification and by cooling coil. Determine (a) DBT of air at the exit of dehumidifier and its capacity (b) Capacity and surface temperature of the cooling coil if the bypass factor is 0.3.

05

05

05

02

05

05