

B.E. Mechanical Engineering (Model Curriculum) Semester-VIII
PCC-ME-404 - Refrigeration and Air Conditioning

P. Pages : 3



Time : Three Hours

GUG/S/25/14369

Max. Marks : 80

- Notes :
1. All questions carry equal marks.
 2. Assume suitable data wherever necessary.
 3. Illustrate your answers wherever necessary with the help of neat sketches.
 4. Use of Steam tables, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
 5. Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6, Q. 7 or Q. 8, Q. 9 or Q. 10.
 6. Non programmable Electronic calculator is allowed.

1. a) Comment in brief about the following for VCRS:- 4
- i) Wet compression is not desirable
 - ii) Throttling device is used in place of expander
- b) A single stage NH_3 refrigeration system has cooling capacity of 500 kW. the evaporator and condenser temperature are -10°C and 30°C respectively. Assuming saturation cycle, determine: 1 mass flow rate refrigerant: 2 adiabatic discharge temperature: 3 compressor work in kW: 4, condenser heat rejection : 5. C.O.P.; and 6 compressor swept volume in m^3/min , if volumetric efficiency is 70%. 12

Use p-h chart

OR

2. A simple ammonia compression system operates with a capacity of 150 tonnes. 16
The condensation temperature in the condenser is 35°C . The evaporation temperature in the brine cooler is -25°C . Ammonia leaves the evaporator and enters the compressor at -8°C . Ammonia enters the expansion valve at 30°C .
Wire drawing through the compressor valves:
Suction = 0.118 bar; discharge = 0.23 bar; compression index = 1.2 ; volumetric efficiency = 0.8.
Calculate:-
 - i) Power
 - ii) Heat transferred to cylinder water jacket
 - iii) Piston displacement
 - iv) Heat transfer in condenser
 - v) Coefficient of performance
3. a) Discuss in brief about various thermodynamic properties of refrigerants? 8
- b) Write a note on:- 8
i) Substitutes for CFC refrigerants. ii) Secondary refrigerants.

OR

4. a) What is the function of expansion device in VCRS? With neat sketch discuss the operation of capillary tube in refrigeration system. 8

- b) What is the function of condenser in VCRS? With neat sketch describe the working of shell and coil condenser? 8
- 5.** a) With neat sketch describe the working of practical vapour absorption refrigeration system? 8
- b) With neat sketch describe the working of Electrolux refrigerator? 8

OR

- 6.** a) Describe with neat sketch and T-s diagram Linde- Hampson air liquefaction method? 8
- b) Explain vortex tube refrigeration system with neat schematic? Also discuss the applications and advantages. 8
- 7.** a) Define the following psychrometric terms:-
 i) Specific humidity.
 ii) Relative Humidity.
 iii) Degree of saturation.
 iv) Dew point temperature. 8
- b) The pressure and temperature of a mixture of dry air and water vapour are 736 mm of Hg and 21°C. The dew point temperature of the mixture is 15°C. Determine the following using steam tables:
 1) Partial pressure of water vapour
 2) Relative humidity
 3) Specific humidity
 4) Enthalpy of mixture per kg of dry air
 {Use steam table}

OR

- 8.** a) Distinguish clearly between heat stroke, heat exhaustion and heat cramp? 8
- b) $30 \text{ m}^3/\text{min}$ of moist air at 15°C dry bulb temperature and 13°C wet bulb temperature is mixed with $12 \text{ m}^3/\text{min}$ at 25°C dry bulb temperature and 50% relative humidity. Determine the dry bulb temperature and wet bulb temperature of the resulting mixture. 8
- 9.** a) Show on a psychrometric chart GSHF, RSHF and ERSHF lines when a mixture of outdoor and indoor air passes over a cooling coil? 4
- b) The following data refer for a space to be air conditioned :
 Inside design conditions = 25°C DBT, 50% RH
 Outdoor air conditions = 43°C DBT, 27.5°C WBT
 Room sensible heat gain = 20 kW
 Room latent heat gain = 5 kW
 By-pass factor of the cooling coil = 0.1
 The return air -from the space is mixed with the outside air before entering cooling coil in the ratio of 4 : 1 by mass. Determine (a) apparatus dew point (b) condition' of air entering and leaving the cooling coil ; (c) dehumidified air quantity (d) fresh air mass flow and volume flow rate; and (e) total refrigeration load on the air-conditioning plant 12

OR

10. The following data is available for the design of air conditioning of a small theatre: **16**

Outdoor design conditions	= 34°C DBT and 70% RH
Comfort conditions required	= 22°C DBT and 50% RH
Total seating capacity	= 350 persons
Sensible heat gain per person	= 90 W
Latent heat gain per person	= 30 W
Sensible heat due to solar gain and infiltrated air	= 46.6 kW
Latent heat gain due to infiltrated air	= 23.3 kW
Fresh air supplied	= 0.4 m ³ / min/ person
Desirable temperature rise in the theatre	= 8°C

Assume that the recirculated air is mixed with the fresh air after leaving the conditioner.
Find : (a) Room sensible heat factor ; (b) The percentage of total air circulated ;
(c) The refrigeration capacity of the conditioner coil.
Assume that the air leaves the conditioner coil with 100% RH.
