

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

P. Pages : 3

Time : Three Hours



GUG/W/24/14369

Max. Marks : 80

- Notes :
1. All questions carry equal marks.
 2. Due credit will be given to neatness.
 3. Assume suitable data wherever necessary.
 4. Illustrate your answers wherever necessary with the help of neat sketches.
 5. Use of Steam tables, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
 6. Attempt 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.

1. a) Comment in brief about the following for VCRS: 6
- i) Wet compression is not desirable.
 - ii) throttling device is used in place of expander.
- b) A single stage NH_3 refrigeration system has a cooling capacity of 500 kW. The evaporator and condenser temperature are -10°C and 30°C respectively. Assuming saturation cycle. Determine : (i) Mass flow rate of refrigerant kg/min (ii) Adiabatic discharge temperature (iii) Compressor work in kW (iv) Condenser heat rejection in kW; (v) C.O.P. (vi) Compressor swept volume in m^3/min , if volumetric efficiency is 75%. 10

OR

2. A simple ammonia compression system operates with a capacity of 150 TR. 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. 16
3. a) Discuss in brief about various Physical properties of refrigerants? 6
- b) Designate the refrigerant : (i) CH_3Cl (ii) $\text{C}_2\text{Cl}_2\text{F}_4$ 4
- c) Desirable properties of an ideal refrigerant. 6

OR

4. a) What is the function of expansion device in VCRS? With neat sketch discuss the operation of automatic (Constant Pressure) expansion valve in refrigeration system. 6

- b) What is the function of condenser in VCRS? With neat sketch describe the working of evaporative condensers? **6**
- c) Describe with neat sketch, a rotating blade type rotary compressor? **4**
- 5.** a) What is the function of following components in an absorption system: **8**
(i) Rectifier, (ii) Analyzer, (iii) Heat Exchanger
- b) With neat sketch describe the working of Li-Br VARS? **8**

OR

- 6.** a) Describe with neat sketch and T-s diagram Claude 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: **8**
i) Specific humidity,
ii) Absolute Humidity,
iii) Relative Humidity,
iv) Dry bulb temperature.
- b) A mixture of dry air and water vapor is at a temperature of 21°C under a total pressure of 736 mm Hg. The dew point temperature is 15°C. Using steam table Find : (i) Partial pressure of water vapor; (ii) Relative humidity; (iii) Specific humidity; (iv) Specific enthalpy of air per kg of dry air and (v) Volume of air per kg of dry air. **8**

OR

- 8.** a) Distinguish clearly between heat stroke, heat exhaustion and heat cramp? **6**
- b) Air at 10°C dry bulb temperature and 90% relative humidity is to be heated and humidified to 35°C dry bulb temperatures and 22.5°C wet bulb temperature. The air is preheated sensibly before passing to the air washer in which water is recirculated. The relative humidity of air coming out of air washer is 90%. This air is again reheated sensibly to obtain the final desired condition. Find: (i) Temperature to which air should be preheated, (ii) The total heating required; (iii) The makeup water required in air washer; (iv) Humidifying efficiency of the air washer. **10**
- 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) In an airconditioning system, the inside and outside conditions are dry bulb temperature 25°C, relative humidity 50% and dry bulb temperature 40°C, wet bulb temperature 27°C respectively. The room sensible heat factor is 0.8. 50% of the room air is rejected to **12**

atmosphere and an equal quantity of fresh air added before air enters the air conditioning apparatus. If the fresh air added is $100\text{m}^3/\text{min}$, determine:

- 1) Room sensible and latent heat load;
- 2) Sensible and latent heat load due to fresh air;
- 3) Apparatus dew point;
- 4) Humidity ratio and dry bulb temperature of air entering air conditioning apparatus.

Assume by-pass factor as zero, density of air as $1.2\text{kg}/\text{m}^3$ at a total pressure of 1.01325 bar.

OR

10. a) Explain with neat sketch the types of supply air outlets? **4**

b) The design data for an air-conditioning plant of a restaurant is given below: **12**

Outdoor design conditions	=	35°C DBT and 24°C WBT
Indoor design conditions	=	27°C DBT and 55% RH
Seating capacity of the restaurant	=	50
Latent heat gain per person	=	44 W
Latent heat gain from meals per person	=	6 W
Sensible heat gain per person	=	58 W
Sensible heat gain from meals per person	=	3.5 W
Number of service employees	=	5
Latent heat gain per employee	=	75 W
Sensible heat gain per employee	=	58 W
Sensible heat gain from outside	=	8.14 kW
Sensible heat gain from inside equipment	=	2.9 kW
Latent heat gain from inside equipment	=	0.7 kW
Rate of infiltrated air	=	$400\text{ m}^3/\text{h}$
Rate of fresh air supply	=	$1600\text{ m}^3/\text{h}$
Minimum temperature of air supplied to room = 17°C DBT		
The fan is situated before the conditioner and has a motor of 11 kW.		

Calculate : (a) Volume of air passing through the room in m^3/h ; (b) percentage of recirculated air; (c) apparatus dew point temperature and by-pass factor; and (d) cooling capacity in tonnes of refrigeration.

Draw the schematic diagram of the system and show the system on skeleton, psychrometric chart and insert the temperatures and enthalpy values at salient point.
