

2 Answer any **two** **10**

- (1) Explain with sketch Ammonia water vapour absorption system.
- (b) Explain the effect of change in evaporator pressure on the performance of vapour compression system.
- (c) Compare actual and theoretical vapour compression system with p-V and T-s diagram.

3 Attempt any **three** : **30**

- (1) A bootstrap air refrigeration system is used to take 30 ton of refrigeration load. The ramming of air increases the pressure from 0.85 bar to 1.1 bar. The air required for refrigeration is taken from jet compressor at 3.5 bar and further compressed at 4.5 bar in secondary compressor run by cooling turbine. Ambient temperature is -10°C and cabin is maintained at 1 bar and 25°C .

Efficiency of ram compressor $\eta_r = 100\%$

Efficiency of compressors η_c and turbine $\eta_t = 85\%$

Effectiveness of heat exchangers $\epsilon_1 = \epsilon_2 = 1$.

Find COP of system.

- (2) The vapour compression system working on simple saturation cycle is operating between 40°C and 0°C condenser temperature and evaporator temperature respectively. Calculate work consumption, mass flow rate, heat rejected, volume flow rate and COP of the system. The cycle is using R-22 as refrigerant.

Use following properties of R-22 to calculate the questions :

T	h_f	h_g	s_g	Superheated by 50 K	
°C	kJ/kg	kJ/kg	kJ/kgK	hg	sg
0	200.0	405.4	1.752	441.4	1.873
40	249.7	416.6	1.699	460.4	1.830

Specific volume of R22 saturated vapour at 0°C is 0.0471 m³/kg.

- (3) A two stage vapour compression system with flash chamber operates with an ammonia refrigerant. The evaporator and condenser temperatures are –30°C and 40°C respectively. If the capacity of the plant is 25 TR, estimate the total work of compression and COP.
- (4) A refrigeration plant comprises three evaporators of capacities 10 tons at 10°C, 20 tons at 5°C and 30 tons at –10°C with individual expansion valves common compressor and condenser operating at 40°C and sub cooling the liquid to 30°C. Assuming isentropic compression in each compressor calculate :
- Mass flow rate in each evaporator
 - Compressor power required in each compressor
 - Heat rejected in condenser
 - COP.

4 (a) Attempt any **ten** from the following : **10**

- The relative humidity, during sensible heating.
(Increases, Decreases, remains constant)
- The wet bulb depression is zero, when relative humidity equal to (50%, zero, 100%).

- (3) Find enthalpy of mixture/kg of dry air if dry bulb temperature is 35°C , wet bulb temperature is 25°C and sp. humidity is 0.01586 kg/kg of dry air.
- (4) _____ signifies the absorption capacity of air.
(Enthalpy of moist air, Relative humidity, Sp. humidity)
- (5) How fog form during winter ?
- (6) Room Latent Heat (RLH) includes infiltration also.
(True, False).
- (7) _____ is a device that operates by changes in room temperature in case of Air Conditioners.
(Damper, Limit, Switch, Thermostate)
- (8) For finding relative humidity (ϕ) analytically, partial pressure of vapour (P_v) and _____ is required. (Wet bulb temperature, Dry bulb temperature, Sat. pressure at dry bulb temperature)
- (9) Transmission heat loss from walls, roof etc is just the outside and inside temperature difference.
(True, False)
- (10) Define Dew point temperature.
- (11) Write equation given by Dr. Carrier for determining partial pressure of water vapour in air.

5 Attempt any two.

10

- (a) Write short note on 'Methods of determination of duct size.'
- (b) Write short note on 'By pass Factor'.
- (c) With the help of neat sketch explain the main components of central air conditioning system.

- (a) The sling psychrometer in a laboratory test recorded the following readings :

Dry bulb temperature (DBT) = 35°C

Wet bulb temperature (WBT) = 25°C

Calculate the following :

- (i) Specific humidity
- (ii) Relative humidity
- (iii) Vapour density in air
- (iv) Dew point temperature
- (v) Enthalpy of mixture per kg of dry air. Assume atmospheric pressure = 1.0132 bar

Partial pressure of vapour is given by

$$P_v = (P_{vs})_{wb} - \left\{ \frac{[P_t - (P_{vs})_{wb}](t_{ab} - t_{wb})}{1527.4 - 1.3t_{wb}} \right\}$$

(Notations carry usual Meaning).

- (b) Saturated air at 19°C is passed through a drier so that its final relative humidity is 25%. The drier uses silica gel adsorbent. The air is then passed through a cooler until its final temperature is 19°C DBT without change in specific humidity. Determine the following.
- (i) Temperature of air at the end of the drying process.
 - (ii) Heat rejected during the cooling process.
 - (iii) Relative humidity at the end of cooling process.
 - (iv) Dew point temperature at the end of drying process.
 - (v) Moisture removed during the drying process.

- (c) A retail shop located in a city at $30^{\circ}N$ latitude has the following loads.

Room sensible = 58.15 kW

Room latent heat = 14.54 kW.

The summer outside and inside design conditions are:

Outside : $40^{\circ}C$ DBT, $27^{\circ}C$ WBT

Inside : $25^{\circ}C$ DBT, 50% R_H

$70m^3/min$ of ventilation air is used. Determine the following if the bypass factor of cooling coil is 0.15 :

- (i) Ventilation load
- (ii) Grand total heat
- (iii) Effective sensible heat factor
- (iv) Apparatus dew point
- (v) Dehumidified air quantity
- (vi) Condition of air entering and leaving apparatus.

Assume a bypass factor of 0.15 for the cooling coil.

- (d) The following data is available for designing an air-conditioning system for a new hotel 'Mysore'.

Inside design conditions $26^{\circ}C$ DBT, 55% R_H

Outdoor conditions $36^{\circ}C$ DBT, $27^{\circ}C$ WBT

Minimum temperature of air supplied to room .. $16^{\circ}C$ DBT

Total amount of fresh air supplied $1550m^3/h$

Total infiltration air $390m^3/h$

Seating chairs for dining 45

Employees serving the meals 5

Sensible heat gain per person 60W

Latent heat gain sitting person	45W
Latent heat gain per employee	75W
Sensible heat added from meals	0.16kW
Latent heat added from meals	0.28kW
Total heat flow through the walls, roof and floor ..	5.9kW
Solar heat gain per through glass	1.9kW
Equipment sensible heat gain	2.75kW
Equipment Latent heat gain	0.65kW
Motor power connected to fan	7.5kW

If the fan is installed before the conditioner determine :

- (i) Amount of air delivered to the room in m^3/h .
- (ii) Percentage of recirculated air.
- (iii) Refrigeration load on the coil in tonnes of refrigeration and
- (iv) Dew point temperature of the cooling coil and by pass factor.
