

(3 Hours)

[Total Marks : 80

- N.B. :** (1) Solve any four questions.
 (2) Figures to the right indicate full marks.
 (3) Assume suitable data wherever necessary and mention it clearly.
 (4) Answers to the sub question of an individual question should be written together and one below other.
 (5) Use of Refrigerant Charts, Psychrometric Chart and Steam Tables is allowed.
 (6) All questions carry equal marks.

1. a) A vapour compression machine is used to maintain a temperature of -23°C in a Cold Store. The ambient temperature is 37°C . The compressor takes in dry saturated vapour of Ammonia. A minimum of 10°C temperature difference is required at the evaporator as well as condenser. There is no subcooling of liquid. If the refrigerant flow is 1 Kg/min , find
 i) Tonnage of refrigeration ii) Power requirement iii) Ratio of COP of this cycle to COP of Carnot cycle. 10
- b) Moist air enters a refrigeration coil at 35°C dry bulb temperature and 50 per cent relative humidity at the rate of $100\text{ m}^3/\text{min}$. The barometric pressure is 1.013 bar . The air leaves at 27°C . Calculate the Ton of Refrigeration required and the final relative humidity. If the surface temperature of the cooling coil is 10°C and by-pass factor is 0.1 , calculate the Ton of refrigeration required and the condensate flow. 10
2. a) With the help of a neat sketch, explain the working of a thermostatic expansion valve with an external equalizer. 10
- b) What are the various components of cooling load? Suggest ways to reduce load in an Office building. 10

3. An air conditioned hall is to be maintained at 27°C dry bulb temperature and 21°C wet bulb temperature. It has a sensible heat load of 46.5 kW and latent heat load of 17.5 kW . The air supplied from outside atmosphere is at 38°C dry bulb temperature and 27°C wet bulb temperature with a flow rate of $30\text{ m}^3/\text{min}$, directly into the room through ventilation and infiltration. Outside air to be conditioned is passed through the cooling coil whose apparatus dew point is 15°C . The quantity of recirculated air from the hall is 60% . This quantity is mixed with the conditioned air after the cooling coil. Determine : i) Condition of air after the coil and before the recirculated air mixes with it ii) Condition of air entering the hall i.e. after mixing with

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recirculated air iii) Mass of fresh air entering the coil iv) By-pass factor of the cooling coil; and v) Refrigerating load on the cooling coil

4. a) Explain with neat sketches different types of Cooling Towers. What is meant by Range and Approach. 10
- b) What are the industrial applications of Ammonia refrigeration systems? Also discuss the safety precautions to be taken while installing an Ammonia Plant. 5
- c) What are natural refrigerants? Give examples of applications of natural refrigerants. 5
5. a) What are types of Non Conventional HVAC systems? Explain any one of them in details. 10
- b) Discuss differences and features of a Window Type and Split Type of air conditioners. 10
6. a) Explain with a neat sketch double effect Lithium Bromide -Water Vapour Absorption Refrigeration System. 10
- b) Write short notes on any two. 10
 - i) Types of Condensers
 - ii) Controls in an Air Conditioning System
 - iii) Green Buildings
 - iv) Application of Solar Energy in Air Conditioning