Instructions –

1. All Questions are Compulsory.
2. Answer each next main Question on a new page.
3. Illustrate your answers with neat sketches wherever necessary.
4. Figures to the right indicate full marks.
5. Assume suitable data, if necessary.
6. Use of Non-programmable Electronic Pocket Calculator is permissible.
7. Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.
8. Use of psychrometric chart is permitted.

1. a) Attempt any THREE of the following: 12

   (i) Define:
       1) Refrigeration
       2) EER

   (ii) In a vapour compression cycle the refrigerant absorbs heat till it reaches in superheated state and it is undercooled in the condenser. Draw P-H and T-S diagrams for this cycle.

   (iii) Draw a neat labelled sketch of vortex tube refrigerator and explain its working in brief. State any one application of it.

   (iv) Describe any two situations or conditions when secondary refrigerants are used. State its any two applications.
b) Attempt any **ONE** of the following: 06

(i) Classify vapour compression cycle w.r.t. the state of refrigerant and plot it on P-H and T-S diagram (any three)

(ii) Compare air cooled condensers with water cooled condensers on the basis of following points with justification.
   1) Power consumption per TR capacity
   2) COP of refrigeration system
   3) Noise level
   4) Day-night and seasonal performance consistency.

2. Attempt any **TWO** of the following: 16

a) Show Bell Coleman air refrigeration cycle on P-V and T-S diagram showing directions of processes and name of equipment used for each process. Also state COP of this refrigerator in terms of temperatures.

b) Refrigerant R134a enters the compressor of a refrigerator as superheated vapour at 0.14 MPa and –12°C (at \( h = 398 \text{ kJ/kg} \)) at a rate of 0.076 kg/s and leaves at 1 MPa and 70°C (at \( h = 450 \text{ kJ/kg} \)). The refrigerant is undercooled in the condenser to 36°C and 1 MPa and is throttled to 0.15 MPa (at \( h = 255 \text{ kJ/kg} \)). Assuming compression as nearly isentropic.
   (i) Draw P-H and T-S diagram of cycle. Show all the given pressures and temperatures at appropriate points on the diagram.
   (ii) Calculate the coefficient of performance (COP) of cycle.

c) Draw a neat labelled schematic sketch of Electrolux refrigerator. Explain why expansion valve is not required in this system.
3. **Attempt any FOUR of the following:**

   a) Comment on what is desirable in following properties of refrigerant with justification.
      (i) Critical temperature
      (ii) Latent heat of vapourization

   b) State reasons for suitability of capillary tube as an expansion device for domestic refrigerator.

   c) Draw a neat schematic sketch of air washer. State the use of air washer in connection with psychrometric process.

   d) Show adiabatic mixing of air streams on skeleton psychrometric chart. State the location where this process takes place in air conditioning system.

   e) Define:
      (i) Air conditioning
      (ii) Dalton’s law of partial pressures.

4. **a) Attempt any THREE of the following:**

   (i) State major controlling factors affecting human comfort.

   (ii) State any four components of cooling load which are responsible for only sensible heat gain, for a large restaurant.

   (iii) Discuss the material for thermal insulation called polyurethane foam (PUF) in respect of type of insulation, temperature range application areas and thermal conductivity and vapour permeability.

   (iv) Explain in brief revolving wick type humidifier with neat schematic sketch.
b) Attempt any **ONE** of the following: 06

(i) Explain working of flooded type evaporator with neat sketch.

(ii) Describe the heat sources considered for estimating the cooling load of a cinema theatre. Suggest the suitable air conditioning system. (State name only). The max capacity of cinema theatre is 500 persons.

5. Attempt any **TWO** of the following: 16

a) Draw a neat sketch of screw type compressor used in refrigeration and state any four advantages of it.

b) Air at 27°C DBT and 65% RH is cooled and dehumidified to 17°C DBT and 40% RH by performing no. of operation on it. Plot the process on Psychrometry chart and find out all properties of conditioned air.

c) With a neat schematic labelled sketch describe the working of year round air conditioning system.

6. Attempt any **FOUR** of the following: 16

a) Draw a neat sketch of closed perimeter duct system. Where is it preferred?

b) Enlist any four types of insulating materials used in refrigerations and air-conditioning with one example of each type.

c) Explain the necessity of refrigeration in ice factory.

d) Classify the ducts used in air distribution system of air conditioning.

e) Draw a neat labelled schematic layout of car air conditioning system. State the name of device used to connect or disconnect engine with compressor of this system.