

- N.B. : (1) Question No 1 is Compulsory.  
(2) Attempt any three questions out of the remaining five.  
(3) All questions carry equal marks.  
(4) Assume suitable data, if required and state it clearly.  
(5) Use of Refrigerant tables, Friction charts, Psychometrics chart, and Steam table are permitted.

**Qu.1** Attempt any Five of the following **[20]**

- Define the i) Refrigeration ii) Ton of refrigeration iii) Air conditioning iv) Coefficient of performance
- Explain difference between vapour compression refrigeration system and vapour absorption refrigeration system
- Define the term 'by pass factor' Express it for heating and cooling coil.
- State the various applications of HVACR and explain any one application
- Classify of heat pump and its application in an industry
- Define the effective temperature. What are physiological hazards resulting from heat?
- Name the different types of air refrigeration system used for the cooling of the aircraft cabin. Draw bootstrap air refrigeration cycle with neat schematic

**Qu.2** a) Draw a schematic diagram of vapour compression system. Discuss the effect of change in evaporator and condenser pressure on the performance of standard VCR cycle with the help of P-H diagram. **[08]**

- b) An air refrigeration system used for food storage provides 25 tons of refrigeration. The temperature of air entering the compressor is 7°C and temperature at exit from the cooler is 27°C. The quantity of air circulated in the cooler is 3000 kg/hr. Both the compression and expansion follows the polytropic law  $PV^{1.3} = C$ . Calculate COP of the cycle and power required by the compressor per ton of refrigeration. **[12]**

**Qu.3** a) Explain the types of refrigerants, numbering system for halocarbon refrigerants with example. **[08]**

- b) A Simple NH<sub>3</sub> Vapor compression system has compressor with piston displacement of 3 m<sup>3</sup>/ min, a condenser pressure of 12 bar and evaporator pressure of 2.5 bar. The liquid is subcooled to 20°C by soldering the liquid line to suction line. The temperature of vapour leaving the compressor is 100°C heat rejected to compressor cooling water is 6000 KJ/hr and volumetric efficiency of compressor is 0.8. 1) Find capacity of the system 2) Indicated power 3) COP of the system. Draw P-H and T-S Diagram. Use PH Chart. **[12]**

- Qu.4** a) The pressure and temperature of mixture of dry air and water vapor in it are [08]  
736 mm of Hg and 21°C. Calculate 1) Relative Humidity 2) Specific Humidity 3) Enthalpy 4) Specific Volume. Calculate using Steam Table.  
b) Explain the various methods of duct design. [06]  
c) Discuss the Li-Bi vapour absorption system with neat sketch [06]

- Qu.5** a) Explain following Psychrometric Processes with neat sketch. [08]  
a) Heating & Humidification. b) Cooling & Dehumidification. c) Sensible Heating (d) Sensible Cooling  
b) An air-conditioned auditorium is to be maintained at 27°C dry bulb [12]  
temperature and 60% relative humidity. The ambient condition is 40°C dry bulb temperature and 30°C wet bulb temperature. The total sensible heat load is 100000 KJ/hr. and total latent heat load is 40000 KJ/hr. 60% of the return air is recirculated and mixed with 40% of make up air after the cooling coil. The condition of air leaving the cooling coil is at 18°C. Determine a) Room sensible heat factor  
b) The condition of air entering the auditorium c) The amount of makeup air  
d) Apparatus dew point e) By pass factor of the cooling coil.

- Qu.6** Write short note on (any Four) [20]  
a) Deep sea water air-conditioning  
b) Cooling towers performance and selection  
c) Explain working of commercial ice plant  
d) Working of thermostatic expansion valve  
e) Types of fans used air conditioning  
f) Type of insulation materials

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