

**B. TECH.****THEORY EXAMINATION (SEM–VI) 2016-17  
REFRIGERATION & AIR CONDITIONING****Time : 3 Hours****Max. Marks : 100****Note : Be precise in your answer. In case of numerical problem assume data wherever not provided.****Use of steam tables, refrigerant's property tables and charts, and psychrometric charts, and Enthalpy-concentration diagram is allowed.****SECTION A****1. Attempt all parts of the following.****[2×10=20]**

- a) What do you mean by refrigeration effect and unit of refrigeration?
- b) Describe boot-strap cycle of air refrigeration system.
- c) Differentiate open and closed air refrigeration system.
- d) Explain Dry air rated temperature (DART)
- e) How does an actual vapour compression cycle differ from that of a theoretical cycle?
- f) Discuss the operation of a capillary tube in refrigeration system.
- g) Explain psychrometric process.
- h) Explain the modified comfort chart with neat sketches.
- i) Write the expression for calculating the heat gain through the ducts.
- j) What are the different factors considered in load estimation sheet for comfort application?

**SECTION B****2. Attempt any five of the following.****10×5=50]**

- a) In an open cycle air refrigeration machine, air is drawn from a cold chamber at  $-2^{\circ}\text{C}$  and 1 bar and compressed to 11 bar. It is then cooled at this pressure, to the cooler temperature of  $20^{\circ}\text{C}$  and then expanded in expansion cylinder and returned to the cold room. The compression and expansion are isentropic and follows the law  $pv^{1.4} = \text{constant}$ . Sketch the  $p-v$  and  $T-s$  diagrams of the cycle and for a refrigeration of 15 tonnes. Determine: 1) theoretical C.O.P., 2) rate of circulation of the air in kg/min, and 3) piston displacement per minute in the compressor and expander.
- b) In a vapour compression refrigeration system using R-12, the evaporator pressure is 1.4 bar and the condenser pressure is 8 bar. The refrigerant leaves the condenser sub-cooled to  $30^{\circ}\text{C}$ . The vapour leaving the evaporator is dry and saturated. The compression process is isentropic. The amount of heat rejected in the condenser is 13.42 MJ/min. Determine: 1) refrigerating effect in kJ/kg, 2) refrigerating load in TR, and 3) C.O.P.
- c) In a 100TR aqua ammonia absorption plant, saturated liquid ammonia at  $30^{\circ}\text{C}$  leaves the condenser and enters the expansion valve. The evaporator pressure is 1.9 bar and the vapour temperature at evaporator exit is  $-10^{\circ}\text{C}$ . The mass concentrations of ammonia in the weak and strong solutions are 0.25 and 0.325 respectively. Determine the mass flow rates in kg/min of the strong and weak solutions
- d) Atmospheric air at dry bulb temperature of  $16^{\circ}\text{C}$  and 25% relative humidity passes through a furnace and then through a humidifier, in such a way that the final dry bulb temperature is  $30^{\circ}\text{C}$  and 50% relative humidity. Find the heat and moisture added to the air. Also determine the sensible heat factor of the process.

- e) An air conditioning plant is required to supply  $60 \text{ m}^3$  of air per minute at a DBT of  $21^\circ\text{C}$  and 55% RH. The outside air is at DBT of  $28^\circ\text{C}$  and 60% RH. Determine the mass of water drained and capacity of the cooling coil. Assume the air condition plant first to dehumidify and then to cool the air.
- f) Draw a neat labelled sketch of a Practical Vapour Absorption refrigeration cycle and explain its working in brief.
- g) Define the terms:  
 (i) Dew point temperature  
 (ii) Specific humidity  
 (iii) Relative humidity  
 (iv) Degree of saturation
- h) Attempt the following:  
 (i) What are the desirable properties of an ideal refrigerant?  
 (ii) Discuss in detail, the secondary refrigerants.

### SECTION C

**Attempt any two of the following.**

**[15×2=30]**

3. What is multi-stage vapour compression refrigeration system? Compare it with cascade refrigeration system. Explain advantages and disadvantages over simple vapour compression system.
4. A Bell Coleman refrigerator operates between pressure limits of 1.1 bar and 5 bar. The temperatures at the suction to the compressor, and inlet to the expander are  $27^\circ\text{C}$  and  $37^\circ\text{C}$ , respectively. Isentropic efficiencies of the compressor and expander are 0.80 and 0.82, respectively. Determine the power input to the compressor, if the refrigerator produces cooling at the rate of 50 TR.
5. Answer the following:  
 a. Discuss the effect of variation of condenser and evaporator pressures and sub-cooling of condensate on COP of a vapour compression refrigeration system.  
 b. Discuss the applications of flash chamber with the help of P-h chart and schematic diagrams.