

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°C and 1 bar and compressed to 11 bar. It is then cooled at this pressure, to the cooler temperature of 20°C and then expanded in expansion cylinder and returned to the cold room. The compression and expansion are isentropic and follows the law $p v^{1.4} = \text{constant}$. 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°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°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°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°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°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 m^3 of air per minute at a DBT of 21°C and 55% RH. The outside air is at DBT of 28°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°C and 37°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.