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**BIME-015**

# B. Tech. – VIEP – MECHANICAL ENGINEERING (BTMEVI)

## Term-End Examination

00332

## December, 2016

## BIME-015 : REFRIGERATION AND AIR CONDITIONING

*Time : 3 hours* *Maximum Marks : 70*

***Note :*** *Attempt any **five** questions. All questions carry equal marks. Use of Steam table, Refrigeration charts, Mollier diagram, Psychrometric chart and Scientific calculator is permitted.*

1. (a) State the basic principle of refrigeration. What is refrigerating effect ? Define ton of refrigeration.

   (b) A refrigeration system produces 20 kg/hr of ice from water at 20°C. Find the refrigerating effect and tonnage of the unit. If power consumption is 1·5 kW, calculate the COP. Take enthalpy of solidification of water as 335 kJ/kg; and specific heat of water as 4·19 kJ/kg °C. 7+7

2. (a) Explain the vapour compression refrigeration system with the help of T-s and p-h diagram.

(b) Using an engine of 30% thermal efficiency to drive a refrigerator having a COP of 5, what is the heat input into the engine for each MJ removed from the cold body by the refrigerator ? If this system is used as a heat pump, how many MJ of heat would be available for heating for each MJ of heat input to the engine ? 7+7

3. (a) What are the effects of CFCs on the environment ? How do they affect the ozone layer ?

(b) A refrigeration plant for a food store operates as a reversed Carnot heat engine cycle. The store is to be maintained at a temperature of $-5°C$ and the heat transfer from the store to the cycle is at the rate of 5 kW. If heat is transferred from the cycle to the atmosphere at a temperature of 25°C, calculate the power required to drive the plant. 7+7

4. (a) What are the parameters to be considered in the selection of a refrigerant ?

(b) Derive the expression for the maximum COP of a vapour absorption refrigeration system. 7+7

5. (a) Discuss the factors affecting the performance of simple air refrigeration cycle.

(b) Determine the ideal COP of a vapour absorption refrigeration system in which the heating, cooling and refrigeration take place at 197°C, 17°C and – 3°C respectively. 7+7

6. (a) An open cycle air refrigeration system working between 1 atm and 12 atm produces 25 tons of refrigeration. The temperature of air leaving the cooler is 298 K and the temperature leaving the expander is 273 K. Assuming the expansion and compression follow the law $pV^{1.35}$ = constant, determine the following :

(i) Mass of air circulated per minute

(ii) COP of the system

(b) A refrigerator working on Bell-Coleman cycle operates between pressure limits of 1·05 bar and 8·5 bar. Air is drawn from the cold chamber at 10°C compressed and then cooled to 30°C before entering the expansion cylinder. The expansion and compression follow the law

$$pV^{1.3} = \text{constant.}$$

Determine the theoretical COP of the system. 7+7

7. (a) A Freon-12 compression system, operating at a condenser temperature of 40°C and an evaporator temperature of − 5°C, develops 15 tons of refrigeration.

Determine :

(i) Mass flow rate of the refrigerant

(ii) Heat rejected in the condenser

(iii) Carnot COP and Actual COP of the cycle

(b) What are the three major types of air-conditioning systems ? Explain any one of them with a neat diagram. 7+7

8. Write short notes on any ***four*** of the following : $4 \times 3\frac{1}{2} = 14$

(a) Vortex tube and Thermoelectric system

(b) Psychrometry

(c) Dry bulb temperature and Wet bulb temperature

(d) Transport Refrigeration

(e) Purification of air in air-conditioning systems

(f) Alternate Eco-friendly Refrigerant