

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

Term-End Examination

00173

December, 2018

**BIME-015 : REFRIGERATION AND AIR
CONDITIONING**

Time : 3 hours

Maximum Marks : 70

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

1. (a) Define the COP of a refrigerator. Show that the COP of a heat pump is greater than the COP of refrigerator by unity.
- (b) A domestic food freezer maintains a temperature of -15°C . The ambient air temperature is 30°C . If heat leaks into the freezer at the continuous rate of 1.75 kJ/s , what is the least power necessary to pump this heat out continuously ?

5+5

2. (a) What do you understand by saturated air and unsaturated air ?
- (b) Describe vapour compression refrigeration system with the help of p-h diagram. 5+5
3. Atmospheric air at 1.0132 bar has a dbt of 32°C and a wbt of 26°C. Compute the
- (a) partial pressure of water vapour,
- (b) specific humidity,
- (c) dew point temperature,
- (d) relative humidity, and
- (e) degree of saturation. 10
4. A refrigeration cycle uses Freon-12 as the working fluid. The temperature of the refrigerant in the evaporator is -10°C. The condensing temperature is 40°C. The cooling load is 150 W and the volumetric efficiency of the compressor is 80%. The speed of the compressor is 720 rpm. Calculate the mass flow rate of the refrigerant and the displacement volume of the compressor. 10

Properties of Freon-12

Temperature (°C)	Saturation Pressure (MPa)	Enthalpy (kJ/kg)		Specific Volume (m ³ /kg) Saturated Vapour
		Liquid	Vapour	
- 10	0.22	26.8	183.0	0.08
40	0.96	74.5	203.1	0.02

5. (a) What do you understand by dry and wet compression ? Which is preferred and why ?
- (b) What are the effects of CFCs on the environment ? How do they affect the ozone layer ? 5+5
6. (a) What do you understand by cascade refrigeration system ? Explain it with the help of flow and T-s diagram.
- (b) Determine the ideal COP of an absorption refrigerating system in which the heating, cooling, and refrigeration take place at 197°C, 17°C and - 3°C respectively. 5+5
7. (a) The capacity of the refrigerator (working on reversed Carnot cycle) is 280 tonnes when operating between - 10°C and 25°C. Determine :
- (i) Quantity of ice produced within 24 hours when water is supplied at 20°C.
- (ii) Minimum power (in kW) required.

- (b) A house requires 2×10^5 kJ/h for heating in winter. Heat pump is used to absorb heat from cold air outside in winter and send heat to the house. Work required to operate the heat pump is 3×10^4 kJ/h.

Determine :

- (i) Heat abstracted from outside
 (ii) Coefficient of performance

5+5

8. A refrigerating plant works between temperature limits of -5°C and 25°C . The working fluid ammonia has a dryness fraction of 0.62 at entry to compressor. If the machine has a relative efficiency of 55%, calculate the amount of ice formed during a period of 24 hours. The ice is to be formed at 0°C from water at 15°C and 6.4 kg of ammonia is circulated per minute. Specific heat of water is 4.187 kJ/kg and latent heat of ice is 335 kJ/kg.

10

Properties of NH_3

Temp. ($^\circ\text{C}$)	Liquid heat kJ/kg	Latent heat kJ/kg	Entropy of liquid kJ/kg K
25	298.9	1167.1	1.124
-5	158.2	1280.8	0.630

9. (a) Derive an expression for COP for an air refrigeration system working on reversed Brayton cycle.
- (b) State merits and demerits of an air refrigeration system. 5+5
10. Write short notes on any *four* of the following : $4 \times 2 \frac{1}{2} = 10$
- (a) Cooling and Dehumidification
 - (b) Joule-Thomson Effect
 - (c) Transport Refrigeration
 - (d) Purification of Air in Air-Conditioning System
 - (e) Vortex Tube
 - (f) Electrolux Refrigerator
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