Enrollment No......................................

Faculty of Engineering
End Sem (Even) Examination May-2019
ME3CO16 Refrigeration and Air Conditioning

Programme: B.Tech.   Branch/Specialisation: ME

Duration: 3 Hrs.   **Maximum Marks: 60**

Note: (a) All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.
(b) Refrigeration table and psychometric charts are permitted.

Q.1 i. The removing capacity of one tonne refrigerator is equal to   **1**
(a) 21 KJ/min   (b) 210 KJ/min
(c) 420 KJ/min   (d) 620 KJ/min

ii. A boot- Strap air cooling system has   **1**
(a) One heat exchanger   (b) Two heat exchangers
(c) Three heat exchangers   (d) Four heat exchangers

iii. The sub cooling is a process of cooling the refrigerant in vapour   **1** compression refrigeration system
(a) Before compression   (b) After compression
(c) Before throttling   (d) After throttling

iv. During a refrigeration cycle, heat is rejected by the refrigerant in a (a)   **1** Compressor   (b) Condenser
(c) Evaporator   (d) Expansion valve

v. An Electrolux refrigerator is called a   **1**
(a) Single-fluid absorption system
(b) Two-fluid absorption system
(c) Three-fluid absorption system
(d) None of these

vi. The COP of practical vapour compression system as compared to that   **1** COP of vapour absorption system is
(a) More   (b) Less   (c) Same   (d) None of these

vii. During sensible cooling of air, the specific humidity   **1**
(a) Increases   (b) Decreases
(c) Remains constant   (d) None of these

viii. During sensible cooling of air, the wet bulb temperature **1**
(a) Increases   (b) Decreases
(c) Remains constant   (d) None of these

ix. The ratio of sensible heat to total heat is known as **1**
(a) Specific humidity   (b) Relative humidity
(c) Apparatus dew point   (d) Sensible heat factor

x. When the outside air is introduced for ventilation purposes, there is a **1**
(a) Sensible heat gain
(b) Latent heat gain
(c) Sensible heat gains as well as latent heat gain
(d) None of these

Q.2   i. Define COP for Refrigerator and Heat pump. **2**

     ii. Write down chemical formula for refrigerants – R-11, R-22, R-134. **3**

     iii. Derive an expression for COP for an air refrigeration system working on reversed Brayton cycle. **5**

OR   iv. A simple air-cooled system is used for an aeroplane having a load of 9 tonnes. The atmospheric temperature and pressure are 0.9 bar and $10^{o}C$ respectively. During ramming pressure increases to 1.013 bar. In the heat exchanger, the temperature of air is reduced by $55^{o}C$. the pressure in the cabin is 1.01 bar and temperature of air leaving the cabin is $25^{o}C$. Determine: **5**
(a) Power required for the system
(b) COP of the system.
Assume that all expansions and compressions are isentropic. The pressure of compressed air is 4 bar.

Q.3   i. What is the effect of Sub-cooling and superheating on the performance of vapour compression system? **4**

     ii. In a 5 KW cooling capacity refrigeration system operating on simple vapour compression cycle, the refrigerant enters the evaporator with an enthalpy of 75 KJ/Kg and leaves with an enthalpy of 183 KJ/Kg. The enthalpy of refrigerant after compression is 210 KJ/Kg. Calculate Power input in KW and Rate of heat transfer at the condenser. **6**

OR   iii. The working temperature in evaporator and condenser are $-30^{o}C$ and $32^{o}C$ respectively. If the actual refrigerator has a COP of 0.75 times the maximum COP, find the power input for a refrigeration capacity of 5 KW. **6**

Q.4   i. Mention the function of each fluid in a three- fluid vapour absorption system. **3**

     ii. Explain practical ammonia water vapour absorption refrigeration system with neat diagram. **7**

OR   iii. A cascade refrigeration system of 100 TR capacity uses NH_3 and CO_2. The evaporating and condensing temperature of CO_2 are $-40^{o}C$ and $5^{o}C$ respectively. The evaporating temperature of NH_3 is $-7^{o}C$. Power supplied to NH_3 compressor is 96.5 KW. Both the cycles are simple V-C cycles, determine mass flow rate of CO_2 refrigerant and COP of refrigeration system. **7**

Q.5   i. Define: **4**
(a) Dry bulb temperature   (b) Wet bulb temperature
(c) Dew point temperature   (d) Relative humidity

     ii. Moist air at 1.013 bars and $30^{o}C$ contains 10 gram of water vapour per Kg of dry air. Assuming that air and water vapour mixture behaves as an ideal gas and saturation pressure at $30^{o}C$ is 3.167 K-Pa, determine relative humidity. **6**

OR   iii. Explain all Psychrometric processes with diagram. **6**

Q.6   Attempt any two:
     i. Define- **5**
(a) Bypass factor of coil   (b) Room sensible heat factor

     ii. Explain variables which are involved in the estimation of cooling load. **5**

     iii. Explain the methods of estimating heat gain due to infiltrated air. **5**

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Marking Scheme
ME3CO16 Refrigeration and Air Conditioning

Q.1 i.   The removing capacity of one tonne refrigerator is equal to   **1**
      (b) 210 KJ/min

   ii. A boot- Strap air cooling system has   **1**
      (b) Two heat exchangers

   iii. The sub cooling is a process of cooling the refrigerant in vapour   **1**
      compression refrigeration system
      (c) Before throttling

   iv. During a refrigeration cycle, heat is rejected by the refrigerant in a   **1**
      (b) Condenser

   v.   An Electrolux refrigerator is called a   **1**
      (c) Three-fluid absorption system

   vi. The COP of practical vapour compression system as compared to that   **1**
      COP of vapour absorption system is
      (a) More

   vii. During sensible cooling of air, the specific humidity   **1**
      (c) Remains constant

   viii. During sensible cooling of air, the wet bulb temperature   **1**
      (b) Decreases

   ix. The ratio of sensible heat to total heat is known as   **1**
      (d) Sensible heat factor

   x.   When the outside air is introduced for ventilation purposes, there is a   **1**
      (c) Sensible heat gains as well as latent heat gain

Q.2 i.   COP for Refrigerator and Heat pump.   **2**
      Definition   1 mark
      Diagram   1 mark

   ii. Chemical formula for refrigerants – R-11, R-22, R-134.   **3**
      1 mark for each   (1 mark * 3)

   iii. COP for an air refrigeration system working on reversed Brayton   **5**
      cycle.
      Property diagram   2 marks
      Derivation   3 marks

OR iv. Property Diagram   1 mark   **5**
      Power Input   2 marks
      COP   2 marks

Q.3 i.   Effect of Sub-cooling with diagram   2 marks   **4**
      Effect of superheating with diagram   2 marks

   ii. Property diagram   1 mark   **6**
      Power input   3 marks
      Rate of heat transfer   2 marks

OR iii. Maximum COP   3 marks   **6**
      Power Input   3 marks

Q.4 i.   Function of each fluid in a three- fluid vapour absorption system.   **3**
      1 mark for each   (1 mark * 3)

   ii. Practical ammonia water vapour absorption refrigeration system   **7**
      Block diagram   3 marks
      Special components   2 marks
      Other remaining components   2 marks

OR iii. Property diagram   1 mark   **7**
      Mass flow rate   3 marks
      COP   3 marks

Q.5 i.   Define: 1 mark for each   (1 mark * 4)   **4**

   ii. Determine relative humidity.   **6**
      Given   1 mark
      Calculation   5 marks

OR iii. All Psychrometric processes   **6**
      Any six with diagram 1 mark for each   (1 mark * 6)

Q.6   Attempt any two:

   i.   Define-   **5**
      (a) Bypass factor of coil with diagram   2.5 marks
      (b) Room sensible heat factor   2.5 marks

   ii. Variables which are involved in the estimation of cooling load.   **5**
      1 mark for each variable   (1 mark * 5)

   iii. Methods of estimating heat gain due to infiltrated air   **5**

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