

E-207

B.E. VII Semester (Main & Re) Examination, Dec. 2015

Refrigeration and Air Conditioning

Branch : Mechanical Engg.

Time: Three Hours]

[Max. Marks : 75

[Min. Marks : 30

Note : Attempt **all** the questions of Section-A, **four** from Section-B and **three** questions from Section-C.

Section-A

(Objective Type Questions)

Note : This section will contain **ten** objective type questions. They may be Fill in the blanks, True/False or Multiple Choice Type. $1.5 \times 10 = 15$

1. (i) The function of a _____ is to direct the air from fan to the room.
- (ii) In _____ system each room is provided with a room unit which gets a supply of conditioned air from a central system.
- (iii) For air conditioning the cooling Load can be classified as _____ Load and _____ Load.
- (iv) Three types of air conditioning controls are _____, _____ and _____.
- (v) The difference between the dry bulb temperature and wet bulb temperature is called wet bulb depression.
- (vi) Air undergoes sensible _____ whenever it passes over a surface that is at a temperature less than the dry bulb temperature of the air but greater than dew point temperature.
- (vii) The highest temperature during the cycle, in a vapour compression refrigeration system, occurs after _____ process.

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- (viii) In a domestic vapour compression refrigerator, the refrigerant commonly used is NH_3 .
- (ix) For winter air conditioning, the relative humidity should not be more than 40 %.
- (x) The freezing point of R-12 is -15.6 °C.

Section-B

(Short Answer Type Questions)

Note : This section will contain six questions. Students will ask to attempt any **four** questions out of six questions. 6 × 4 = 24

1. Discuss the relative merits and fields of applications of vapour absorption and vapour compression refrigeration systems. 6
2. A refrigerating machine using F-12 as working fluid works between the temperatures - 18°C and 37°C. The enthalpy of liquid at 37°C is 78 kJ/kg. The enthalpies of F-12 entering and leaving the compressor are 200 kJ/kg and 238 kJ/kg respectively. The rate of circulation of refrigerant is 2 kg/min. and efficiency of compressor is 0.85. 6

Determine :

- (i) Capacity of the plant in T.R.
- (ii) Power required to run the plant
- (iii) C.O.P. of the plant.
3. Explain the applications of refrigeration for food preservation. Explain how the refrigeration controls the spoilage of foods. 6
4. What are the advantages & Disadvantages of using air as refrigerant compared to F-12 and NH_3 . 6
5. What are the different systems used for cooling the aeroplanes? Explain the advantages of one over others. When the regenerative cooling system is preferable over the others. 6

6. Define relative humidity, specific humidity, and dew point temperature and describe a theoretical method for determining their values. 6

Section-C

(Long Answer Type Questions)

Note : This section will contain five questions. Students will ask to attempt any three questions out of five questions. $12 \times 3 = 36$

1. Data for an absorber of an Ammonia absorption refrigeration system is given below, Evaporator pressure = 2.5 bar.

Temperature of Ammonia leaving the evaporator and entering the absorber = -10°C .

Absorber Pressure = 2.5 bar

Weak aqua enters the absorber at 50°C with mass concentration of 0.25.

Strong aqua leaves the absorber at 35°C with mass concentration of 0.33.

Anhydrous ammonia circulated through system = 8.5 kg/min.

Neglect the water vapour returning from evaporator and assume specific heat of solution as $6.3 \text{ kJ/kg}^{\circ}\text{C}$ and liquid heat at 0°C as 418 kJ/kg . Calculate the amount of Heat to be removed per minute from the absorber in kJ/min . 12

2. An air refrigerator used for food storage provides 50 tons of refrigeration. The temperature of air entering the compressor is 7°C and the temperature before entering in to expander is 27°C . Assuming 30% more power is required than theoretical. Find

(a) Actual C.O.P. of the cycle

(b) KW-capacity required to run the compressor.

The quantity of air circulated in the system is 100 Kg/min. The compression & Expansion follow the law $PV^{1.3} = \text{const}$. 12

3. Prove that the maximum value of the ratio of Bell-Coleman cycle to that of Carnot cycle is given by : 12

$$\frac{(\text{COP})_{\text{Bell Coleman}}}{(\text{COP})_{\text{Carnot}}} = \left(\frac{T_a - T_r}{T_r} \right)^2$$

where T_a - environmental temperature

T_r - refrigeration temperature when the rise in temperature of air passing through cooler is same in both cases and is constant.

4. In a vapour compression refrigerator, the working fluid is superheated at the end of compression and is under cooled in the condenser before throttling. Sketch a working cycle on temperature entropy diagram and show how theoretical coefficient of performance may be calculated from this diagram. 12
5. (a) Explain how the Psychrometric Chart is prepared. 4
- (b) Which type of air cleaner would be selected for removing very small particles of dirt and smoke from the air? Explain the working principle of this cleaner. 4
- (c) Draw a neat diagram of an ice factory mentioning the importance of each component. 4



E-336

B. E. VII Semester (Main & Re-Exam.) December – 2016

REFRIGERATION AND AIR CONDITION

Branch : Mech.

Time : Three Hours]

[Maximum Marks : 75

[Minimum Marks : 30

Note : Attempt all the questions of Section – A, four questions from Section – B and three questions from Section – C.

SECTION – A

[Marks : $1.5 \times 10 = 15$

(Objective Type Questions)

1. The quick freezing of food products is done by :

(a) Immersion Freezing

(b) Indirect Contact Freezing

(c) Air Blast Freezing

(d) All of the above

2. The freezing point of R-12 is :

(a) -86.6°C

(b) -95.2°C

(c) -107.7°C

(d) -157.5°C

3. Which of the following refrigerant has the lowest freezing point ?

(a) R-11

(b) R-12

(c) R-22

(d) Ammonia

P. T. O.

4. In aqua-ammonia absorption refrigeration system incomplete rectification leads to accumulation of water in :
(a) Condenser (b) Evaporator
(c) Absorber (d) None of the above
5. In a domestic vapour compression refrigeration, the refrigerant commonly used is :
(a) CO_2 (b) Ammonia
(c) Feron-12 (d) All of above
6. The water, alcohol and ammonia have refrigerating effect at different altitudes.
(a) Low (b) High
(c) Same (d) Different
7. During sensible heating of moist air, enthalpy :
(a) Increase (b) Decrease
(c) Remains Constant (d) None of the above
8. The relative humidity, during heating and humidification :
(a) Increase (b) Decrease
(c) May increase or decrease (d) Remains Constant
9. If the vapour is not superheated after compression, the operation is called
10. When the suction pressure decreases the refrigerating effect and cop are

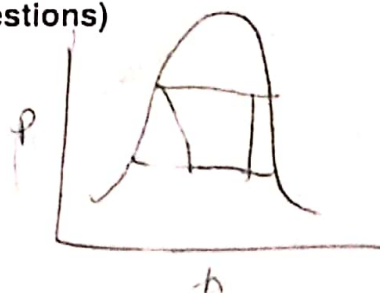
SECTION – B

[Marks : $6 \times 4 = 24$]

(Short Answer Type Questions)

1. Describe with a diagram :

- Boot strap cycle of air refrigeration system
- Reduced ambient air cooling system



2. Draw P-h and T-S diagram for vapour compression cycle when the vapour after compression is (a) dry saturated (b) wet.

3. Establish how an actual cycle differs from a theoretical vapour compression cycle.

4. What is the means of cryogenic ? Discuss the cascade refrigeration system.

5. A simple air cooled system is used for an airoplane having a load of 10 tonnes. The atmospheric pressure and temperature are 0.9 bar and 10°C respectively. The pressure increases to 1.013 bar due to ramming. The temperature of the air is reduced by 50°C in the heat Exchanges. The pressure in the cabin is 1.01 bar and the temperature of air leaving the cabin is 25°C . Determine :

- Power required to take the load of cooling in the cabin.
- Cop of the system

Assume that all the expansions & compressions are isentropic. The pressure of the compressed air is 3.5 bar.

6. What are azeotropic and non-azeotropic mixture ? Explain in brief, their advantages giving examples.

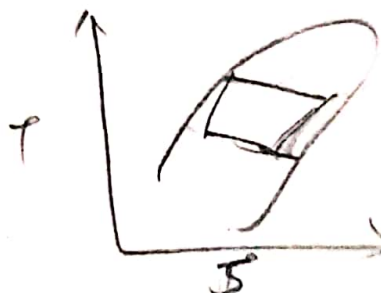
SECTION – C

[Marks : $12 \times 3 = 36$]

(Long Answer Type Questions)

1. A mixture of dry air and water vapour is at a temperature of 21°C under a total pressure of 736 mm of Hg. The dew point temperature is 15°C . Find :

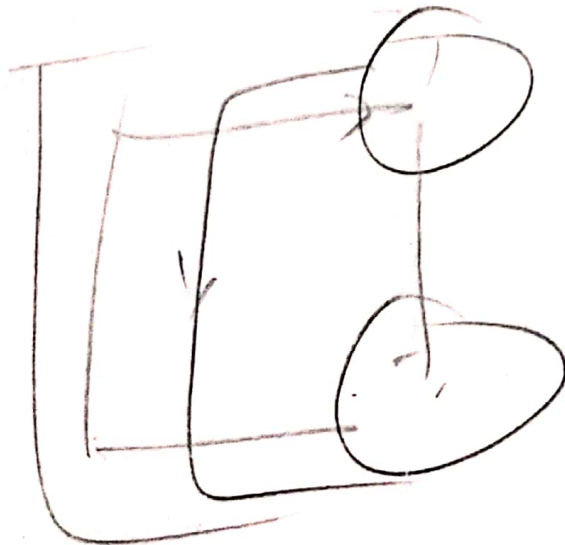
- Partial pressure of water vapour
- Relative humidity
- Specific humidity



(3)

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- (iv) Specific enthalpy of water vapour
 - (v) Enthalpy of air per kg of dry air
 - (vi) Specific volume of air per kg of dry air
2. Saturated steam at standard atmospheric pressure is injected in to a passing air stream in an amount sufficient to raise the absolute humidity from 0.0057 to 0.0143 kg w. v./kg d. a. If the air enters the humidifier at 21°C DBT, determine its leaving state.
 3. A simple NH_3 vapour compression system has compressor with piston displacement of $2\text{m}^3/\text{min}$, a condenser pressure of 2.5 bar. The liquid is sub cooled to 20°C by soldering the liquid line to suction line. The temperature of vapour leaving the compressor is 100°C, heat rejected to compressor cooling water is 5000 KJ/hour, and volumetric efficiency of compressor is 0.8.
Determine - capacity, indicated power, cop of the system.
 - 4/ Explain term cooling load. What are the different factors considered in load estimation sheet for comfort application.
 5. Compare the lithium bromide water vapour absorption system and ammonia water system. Explain briefly their working and applications also.



E-565

B. E. VII Semester Examination, December – 2017

REFRIGERATION AND AIR-CONDITION

Branch : Mechanical

(Main & RE Exam)

Time : Three Hours]

[Maximum Marks : 75

[Minimum Marks : 30

Note : Attempt *all* questions from *Section – A*, *four* questions from *Section – B* and *three* questions from *Section – C*.

SECTION – A

(Objective Type Questions)

1. During which component of vapour compression refrigeration system, the enthalpy remains constant :
 - (a) Evaporator
 - (b) Compressor
 - (c) Throttle valve
 - (d) None
2. Which one of the following is a CFC refrigerant ?
 - (a) R 744
 - (b) R 290
 - (c) R 502
 - (d) R 718
3. Which type of valve is used in a reciprocating refrigeration compressor ?
 - (a) rotary valve
 - (b) poppet valve
 - (c) ring plate
 - (d) glob valve

P. T. O.

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4. In psychrometric chart, specific humidity lines are :
- (a) Vertical
 - (b) Horizontal
 - (c) Inclined
 - (d) Curved lines
5. Accumulator is provided for :
- (a) Storing of liquid refrigerant
 - (b) Exchange of heat
 - (c) Storing of unvaporized liquid
 - (d) Condensing gas
6. Oil separator is fitted in between :
- (a) Condenser and evaporator
 - (b) On the suction line
 - (c) Compressor and condenser
 - (d) At the receiver outlet
7. Sensible heat factor is :
- (a) Sensible heat/Latent heat
 - (b) Total heat/Sensible heat
 - (c) Latent heat/Sensible heat
 - (d) Sensible heat/Total heat
8. Process of changing solid into vapour state without passing through liquid state is :
- (a) Super heating
 - (b) Sublimation
 - (c) Subcooling
 - (d) Triple point
9. Subcooling is a process of cooling the refrigerant in vapour compression refrigeration system before :
- (a) Evaporation
 - (b) Throttling
 - (c) Condensation
 - (d) Compression
10. The process in winter air-conditioning is :
- (a) Dehumidification
 - (b) Heating and humidification
 - (c) Humidification
 - (d) Cooling and dehumidification

SECTION – B**(Short Answer Type Questions)**

1. What is refrigeration ? Explain different methods of refrigeration that can be used for the production of cooling.
2. Describe with neat sketch vane type air refrigeration system. Also write its advantages and disadvantages.
3. Show the actual vapor compression cycle on a p-h diagram and explain the various irreversibility with the help of T-s diagram.
4. Explain with neat sketch steam jet refrigeration. Write its advantages and limitations.
5. Compare between vapour absorption system and compression system.
6. Write short notes on the following :
 - (a) Unitary air conditioner
 - (b) Central air conditioning
 - (c) Dehumidifier

SECTION – C**(Long Answer Type Questions)**

1. Sketch the boot strap regenerative system and obtain an expression for COP and power requirement for an ideal system in terms of main and auxiliary compression ratios and expansion ratios.

2. A cascade refrigeration system is to be designed to attain a temperature of 213 K in an, environment of 313 K. The refrigerant for the high temperature side is R-12 and that for the low side R-13. The cascade temperature is the geometric mean of the upper and the lower temperature limits. The condensing temperature for the low temperature side is 5 K above the evaporation temperature in the cascade. Compute using table and charts COP, pressure ratios and volume flow rate per ton.
 3. What is the year round air conditioner ? How does it work during winter ? Describe the heat pump working on the vapor absorption system with a neat sketch.
 4. Explain with neat sketches different type of Evaporators used in the refrigeration industry.
 5. For an air conditioned room the sensible and latent heat loads are 105 kJ/h and 40000 kJ/h, respectively. The make-up of air is 40% of the total air supplied to the room. Ambient condition is $T_{ab} = 40^{\circ}\text{C}$, $T_{wb} = 30^{\circ}\text{C}$ and inside room condition $T_{ab} = 27^{\circ}\text{C}$ and $\phi = 60\%$. The conditioned air leaves the cooling coil at 18°C . The return air is mixed after the cooling coil. Determine :
 - (a) RSHF line
 - (b) State of air entering the room
 - (c) Amount of total air and make up air
 - (d) ADP and by-pass factor
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E-880

B.E. VII Semester Examination, Dec. 2018

Refrigeration and Air-Conditioning

Branch : Mechanical

(Main & Re-Exam)

Time : Three Hours]

[Maximum Marks : 75

[Minimum Marks : 30

Note : Attempt **all** questions from Section-A, **four** questions from Section-B and **three** questions from Section-C.

Section-A

1.5 × 10 = 15

(Objective Type Questions)

1. In vapour compression Refrigeration system, condition of refrigerant is saturated liquid.
 - (a) after passing through condensor
 - (b) before passing through condensor
 - (b) After passing through expansion through the valve
 - (c) Before entering compressor.
2. In S.I. Unit, one ton of refrigeration is equal to
 - (a) 210 KJ/min
 - (b) 420 KJ/min
 - (c) 210 KJ/hr
 - (d) 105 KJ/min
3. The moisture in refrigerant is removed by
 - (a) Evaporator
 - (b) Safety relief valve
 - (c) Drier
 - (d) Dehumidifier

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4. The vapour Absorption system uses following refrigerents-
- (a) Freon-11 (b) Freon-22
(c) SO_2 (d) Ammonia
5. A refrigeration cycle operates between condensor temperature of $+27^\circ\text{C}$ & evaporator temperature of -23°C . The Carnot COP of cycle will be :
- (a) 0.2 (b) 1.2
(c) 5 (d) 10
6. Freon group of refrigerants are :
- (a) inflammable (b) toxic
(c) non toxic & non inflammable (d) inflammable & non toxic
7. Superheating is refrigeration cycle
- (a) increases COP (b) decreases COP
(c) COP remains unchanged (d) None of these
8. In sensible cooling process relative humidity
- (a) decreases (b) increases
(c) remains constant (d) None of the above
9. Sling psychrometer is used to measure
- (a) Only Dry bulb temperature
(b) Only wet Bulb Temperature
(c) Dry Bulb temperature & wet Bulb temperature
(d) Relative Humidity
10. Sensible heat factor is :
- (a) Sensible heat /latent heat (b) Total heat/Sensible heat
(c) Latent heat/Sensible heat (d) Sensible heat/Total heat

Section-B

6×4=24

(Short Answer Type Questions)

1. Explain in brief the necessity of refrigeration & define refrigeration effect. Write difference between Air conditioning & refrigeration.
2. Explain Lithium-Bromide water vapour Absorption system with help of neat sketch
3. State the effect of Suction Pressure & discharge pressure on performance of vapour compression system.
4. Explain the concept of green house effect & elaborate preventive measures taken on ozone depletion. Enlist desirable properties of ideal refrigerant.
5. Enumerate various psychrometric process. Explain the concept of sensible heat factor & by pass factor with suitable sketches.
6. A refrigerating system operates on the reversed carnot cycle. The higher temperature of the refrigerant in the system is 35°C & the lower temperature is 15°C . The capacity is to be 12 tonnes. Neglect all losses. Determine :
 - (i) Co-efficient of performance.
 - (ii) Heat rejected from the system per hour
 - (iii) Power required

Section-C

12×3=36

(Long Answer Type Questions)

1. Derive an expression for co-efficient of performance of an ideal Bell-Coleman cycle in terms of pressure ratio. Explain the necessity of air refrigeration in cooling of air craft.
2. (a) Describe vapour compression Refrigeration System with help of diagram.
(b) An Ammonia refrigerator works between -6.7°C & 26°C . The vapour is dry-saturated at the end of compression. Calculate

- (i) Theoretical COP
- (ii) Power required to drive the compressor, if cooling capacity of refrigerator is 5 tons. Use of following properties of NH_3

| Temp. ($^{\circ}\text{C}$) | sp. Enthalpy KJ/kg | | | Sp Entropy (KJ/Kg-k) |
|---------------------------------|--------------------|----------------------------|------------------|----------------------------|
| | Liquid (h_f) | Saturated vapour (h_g) | Liquid (s_f) | Saturated vapour (s_g) |
| -6.7 | -29.26 | 1262.36 | 0.1087 | 4.7401 |
| 26.7 | 124.56 | 1291.62 | 0.4264 | 4.3263 |

3. The Sling-psychrometer reads 40°C D B T & 28°C WBT. Calculate the following :
 - (i) Specific humidity
 - (ii) Relative humidity
 - (iii) Vapour density is air
 - (iv) Dew point temp.
 - (v) Enthalpy of mixture per kg of dry air Assume atmospheric pressure to be 1.013 bar. Also find the above quantities if pressure at height of 1000 meters is 0.95 bar.
4. Describe the following air-conditioning system :
 - (a) Central Station air-conditioning system.
 - (b) Unitary air conditioning system.
5. Explain the term cooling load & heating load. What do you understand by selection of inside & outside design condition & what are the different factors considered in load estimation for comfort air conditioning.