BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of RAC Skills

Session: 2020-21 (Winter Semester)

B. Voc. 5th Semester

End-Sem. Examination

Course Code: HVA1501 **Time: 2 Hours**

Course Name: Heat Load Estimation **Max. Marks: 50**

Instruction: Attempt all questions

Calculator is allowed

SET-B

Section – A

10X01 = 10 Marks

1. _____ is the process of mechanically moving air through building through an air handler system to the rooms.

   a) Ventilation b) Purification c) Circulation d) None of the above

2. The approx. converted value of 354 watt is:.
   a) 1000 Btu
   b) 1112 Btu
   c) 1210 Btu
   d) 1120 Btu

3. Which of the following is not a part of building envelope –
   a) Floor
   b) Walls
   c) Electrical Boxes
   d) Roof

4. Which of the following is an envelope problem:
   a) Absorptance
   b) Conductance
   c) Efflorescence
   d) Reflectance

5. The rate of convection heat transfer depends on the:
   a) Temperature Difference
   b) Pressure Difference
   c) Flow rate
   d) None of the above

6. Poorly designed or installed systems can have leakage rates of
   a) 50%to60% b) 70%-80% c) 20%-40% d) 10% to 30%.

7. Temperature affiliated to solar exposed walls is called:
   a) Air temperature b) Irradiation temperature c) Equivalent temperature d) none of the above

8. Air leakage is caused by:
   a) Exfiltration
   b) Infiltration
   c) Pressure difference
   d) Improper envelope

9. Which of the following Law's determine intensity
   a) Planck's Law
   b) Charles Law
   c) Boyle's Law
   d) none of the above

10. CFM stands for:
    a) Cubic Feet per minute
    b) Cubic foot per minute

c) Cubic feet per metre
d) none of the above

Section – B

04X04 = 16 Marks

1. What are impacts of building envelope?
2. What are the few defects that can occur in a building?
3. What are the sources of internal heat gain?
4. What is view factor? Explain with diagram

Section – C

04X06 = 24 Marks

1. A shop owner is considering replacing the shop's present fluorescent fixtures (90 bulbs at 35 W each with magnetic ballast) with either new T-8 lamps (with electronic ballast) or 5000 W of incandescent bulbs to highlight the products. The shop is open from 8:00am until 9:00pm, seven days per week. Determine the sensible heat gain at 10:00 am, 3:00pm and 8:00pm for all three scenarios. Use this data to discuss briefly how each might affect the cooling load on the space, and make a recommendation to the owner from a thermal system design perspective.
2. What is wind and stack effects? Explain.
3. What is radiation and its properties?
4. What are Transmission gains?

Cooling Load Factors for Lights[1]

Lights On For	Number of Hours after Lights Turned On																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Zone Type A																								
8	0.85	0.92	0.95	0.96	0.97	0.97	0.97	0.98	0.13	0.06	0.04	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
10	0.85	0.93	0.95	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.14	0.07	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01
12	0.86	0.93	0.96	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.14	0.07	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
14	0.86	0.93	0.96	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.15	0.07	0.05	0.03	0.03	0.03	0.02	0.02	0.02	0.02
16	0.87	0.94	0.96	0.97	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.15	0.08	0.05	0.04	0.03	0.03	0.03	0.02
Zone Type B																								
8	0.75	0.85	0.90	0.93	0.94	0.95	0.95	0.96	0.23	0.12	0.08	0.05	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.01
10	0.75	0.86	0.91	0.93	0.94	0.95	0.95	0.96	0.96	0.97	0.24	0.13	0.08	0.06	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.02	0.02
12	0.76	0.86	0.91	0.93	0.95	0.95	0.96	0.96	0.97	0.97	0.97	0.97	0.24	0.14	0.09	0.07	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.03
14	0.76	0.87	0.92	0.94	0.95	0.96	0.96	0.97	0.97	0.97	0.97	0.98	0.98	0.98	0.25	0.14	0.09	0.07	0.06	0.05	0.05	0.04	0.04	0.03
16	0.77	0.88	0.92	0.95	0.96	0.96	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.99	0.25	0.15	0.10	0.07	0.06	0.05	0.05	0.04
Zone Type C																								
8	0.72	0.80	0.84	0.87	0.88	0.89	0.90	0.91	0.23	0.15	0.11	0.09	0.08	0.07	0.07	0.06	0.05	0.05	0.05	0.04	0.04	0.03	0.03	0.03
10	0.73	0.81	0.85	0.87	0.89	0.90	0.91	0.92	0.92	0.93	0.25	0.16	0.13	0.11	0.09	0.08	0.08	0.07	0.06	0.06	0.05	0.05	0.04	0.04
12	0.74	0.82	0.86	0.88	0.90	0.91	0.92	0.92	0.93	0.94	0.94	0.95	0.26	0.18	0.14	0.12	0.10	0.09	0.08	0.08	0.07	0.06	0.06	0.05
14	0.75	0.84	0.87	0.89	0.91	0.92	0.92	0.93	0.94	0.94	0.95	0.95	0.96	0.96	0.27	0.19	0.15	0.13	0.11	0.10	0.09	0.08	0.08	0.07
16	0.77	0.85	0.89	0.91	0.92	0.93	0.93	0.94	0.95	0.95	0.95	0.96	0.96	0.97	0.97	0.97	0.28	0.20	0.16	0.13	0.12	0.11	0.10	0.09
Zone Type D																								
8	0.66	0.72	0.76	0.79	0.81	0.83	0.85	0.86	0.25	0.20	0.17	0.15	0.13	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.06	0.05	0.04	0.04
10	0.68	0.74	0.77	0.80	0.82	0.84	0.86	0.87	0.88	0.90	0.28	0.23	0.19	0.17	0.15	0.14	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.06
12	0.70	0.75	0.79	0.81	0.83	0.85	0.87	0.88	0.89	0.90	0.91	0.92	0.30	0.25	0.21	0.19	0.17	0.15	0.13	0.12	0.11	0.10	0.09	0.08
14	0.72	0.77	0.81	0.83	0.85	0.86	0.88	0.89	0.90	0.91	0.92	0.93	0.94	0.94	0.32	0.26	0.23	0.20	0.18	0.16	0.14	0.13	0.12	0.10
16	0.75	0.80	0.83	0.85	0.87	0.88	0.89	0.90	0.91	0.92	0.93	0.94	0.94	0.95	0.96	0.96	0.34	0.28	0.24	0.21	0.19	0.17	0.15	0.14

Zone Types for Use With SCL and CLF Tables, Single-Story Building[2]

Zone Parameters[a]				Zone Type		
No. Walls	Floor Covering	Partition Type	Inside Shade	Glass Solar	People and Equipment	Lights
1 or 2	Carpet	Gypsum	b	A	B	B
1 or 2	Carpet	Concrete block	b	B	C	C
1 or 2	Vinyl	Gypsum	Full	B	C	C
1 or 2	Vinyl	Gypsum	Half to None	C	C	C
1 or 2	Vinyl	Concrete block	Full	C	D	D
1 or 2	Vinyl	Concrete block	Half to None	D	D	D
3	Carpet	Gypsum	b	A	B	B
3	Carpet	Concrete block	Full	A	B	B
3	Carpet	Concrete block	Half to None	B	B	B
3	Vinyl	Gypsum	Full	B	C	C
3	Vinyl	Gypsum	Half to None	C	C	C
3	Vinyl	Concrete block	Full	B	C	C
3	Vinyl	Concrete block	Half to None	C	C	C
4	Carpet	Gypsum	b	A	B	B
4	Vinyl	Gypsum	Full	B	C	C
4	Vinyl	Gypsum	Half to None	C	C	C

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of RAC Skills

Session: 2020-21 (Winter Semester)

B. Voc. 5th Semester

End-Sem. Examination

Answer key

Time: 2 Hours

Max. Marks: 50

Course Code: HVA1501

Course Name: Heat Load Estimation

Instruction: Attempt all questions

SET-B

Section – A

10X01 = 10 Marks

1. A
2. B
3. C
4. C
5. C
6. D
7. C
8. D
9. A
10. A

Section – B

04X04 = 16 Marks

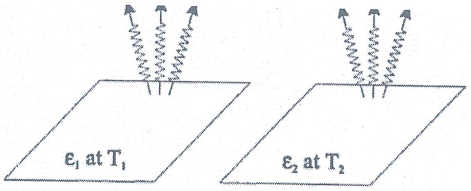
1. Barrier between conditioned inside air and unconditioned outside air

   - Significant impact on passive heat lost and gained by the building
   - Passive heat transfer increases the load on the HVAC system

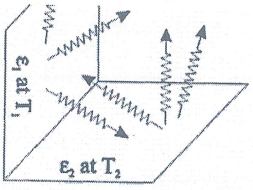
2. Spalling Cracking
   - Rain penetration
   - Moisture problems
   - Efflorescence
   - Deficient thermal resistance
   - High energy cost
   - Collapse

3. Sources of Internal heat Gain are:
   - People
   - Motors
   - Appliances
   - Lighting

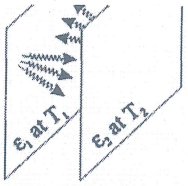
4. The effect of view angle between the energy source and receiver is shown.
   - As the angle between the hot surface and cold surface decreases, more of the available energy is transferred between the two plates. The maximum radiant heat transfer occurs when the two plates are parallel.
   - This geometry frequently occurs in buildings (double-pane glazings, hollow core walls, suspended ceilings and roofs, etc.).



No Radiant Transfer
(Surfaces are in same plane)



Some Radiant Transfer
(Surfaces intersect)



Maximum Radiant Transfer
(Surfaces are parallel)

Section – C

04X06 = 24 Marks

1. The indicated zone type is B. The total installed wattage is 90 (bulbs)·35W/ bulb)= 3150 W.

- The use factor is 1.0 (all lights are on) and the special allowance factor is 1.2.
- The CLF from Table for zone type B, for 10 am after being turned on is 0.95. The values at 3 pm and 8 pm are 0.96 and 0.12, respectively. Therefore the sensible heat gains will be 3150 *0.95*1.2*3.41
- 0.96 and 0.12 correction factor will also be used.

2. The prevailing wind causes a high pressure on one side of the structure and a slight negative pressure on the opposite side.

- These two different pressures combine to force air into any opening on the upwind side and to pull air out of the building on the downwind side
- . These openings can be very difficult to locate and control, but are often found where building materials change (for example, at the sole plate in a frame building and around doors and windows) and at service entrances (electric, water and telephone).
- The second driving force causing infiltration is natural draft, or the stack effect.
- Hot air rises through the building and escapes through cracks in the top ceiling. This causes cold outside air to be drawn in low (around the sole plate, basement windows or crawlspace access).
- While some outside air is necessary for fired equipment that is usually located in the basement (dryer, water heater, furnace, etc.), it is better to provide this air directly to the mechanical room.
- This helps to reduce drafts in the building caused by these devices. This stack effect becomes very pronounced in high-rise buildings, often causing noisy elevator and stair doors, where air is drawn into (or out of) these vertical shafts.

3. Thermal radiation emitted by any surface will have a range of wavelengths, depending upon the temperature of the emitting surface. The amount of thermal radiation absorbed, reflected, or emitted by any surface will depend on the wavelengths and direction in which the radiation is incident or emitted relative to the surface. Properties of interest include the following:

- Absorptance, ά the ratio of radiation absorbed by a surface to that incident on the surface.
- Emittance,ε , the ratio of radiation emitted by a surface to that emitted by an ideal "black" surface at the same temperature
- Reflectance, ρ, the ratio of radiation reflected by a surface to that incident on the surface
- Transmittance, τ, the ratio of radiation transmitted by a translucent surface to that incident on the surface

4. Transmission losses is the process of materials in the house having an effect on the heat gain and heat loss. The type of transmission losses are:

- Type of material
- Thickness and thermal conductivity
- Area of the material
- Temperature difference between indoors and outdoors
- Societies have developed charts for transmission losses through the type of material that may be found in homes and commercial buildings. A designer or technician will use these charts to understand the difference between similar products and how it can affect the heat load of a building. Once the HVAC designer has determine the type of material that will be used in the home, they will determine the square footage used and how thick material. The amount of material would transfer pre-determine amount of heat through it. By adding greater amount of insulation in an attic can reduce the heat transfer through the ceilings.

Registration No.: .....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Refrigeration & Air Conditioning Skills

Session: 2020-21 (Winter Semester)

B. Voc. Program, V Semester,

End-Sem. Examination

Course Code: HVA1502 Time: **2 Hours**

Course Name: Cold Chain & Cold Storage Max. Marks: 50

SET-B

Instruction:

All questions are compulsory.

Section A is objective type.

Section B is short answer type.

Section C is long answer type.

Section – A

10X01 = 10 Marks

1. The horizontal line in psychrometric chart joining the change of state of air represents
   a. humidification
   b. sensible cooling or heating
   c. sensible cooling or heating with humidification
   d. sensible cooling or heating with dehumidification
2. Pork has a higher shelf life than beef.
   a. True
   b. False
   c. Not Comparable
   d. Services
3. It is possible to maintain conditions of temperature and pressure whereby the physical state of food substrate can be maintained at a critical point for the successful removal of water. This is called _____.
   a. Freeze dehydration
   b. Freeze rehydration
   c. Freezing
   d. None of the mentioned
4. Which of the following are Milk Processing Operations?
   a. Clarification
   b. Pasteurization
   c. Homogenization
   d. All of the mentioned
5. Which of the following nutrients are lost in all steps of food engineering (including packaging and freezing)?
   a. Minerals
   b. Vitamins
   c. Fats
   d. Proteins

6. Keeping in mind that texture changes take place after harvest, pulpy fruits become extremely hard after harvest.

   a. True
   b. False
   c. Mixed
   d. None of the above

7. After harvest, _____ of fruits and vegetables undergoes change.

   a. Texture, nutrients, minerals
   b. Color, minerals, nutrients
   c. Texture, minerals, nutrients
   d. None of the mentioned

8. Which of the following is true about fruits and vegetable processing?
   a. They get spoil very fast and hence need to be consumed soon
   b. They have high moisture content and should be kept in a cold, dark place
   c. They're tender and hence get spoiled easily
   d. All of the mentioned

9. Which of the following is not related to Post Harvest losses?
   a. Postharvest losses can be reduced by adding value to products
   b. Packaging, storage, transportation areas are where losses take place
   c. Farmers don't earn much after adding value to products
   d. Value can be added to products by converting raw form into a more processed/refined form

10. At 100% relative humidity, the wet bulb temperature is-
    a. lower than the dew point temperature
    b. higher than the dew point temperature
    c. equal to the dew point temperature
    d. none of the above

Section – B

04X04 = 16 Marks

1. Write down the different types of cold storages.
2. Write down the importance of food preservation.
3. Write a short note on raking system.
4. Explain the food preservation methods.

Section – C

04X06 = 24 Marks

1. Write down the advantages of forced draft cooling towers.
2. Explain Drive-in drive-through pallet racking
3. How multistage compressors are useful than single stage compressors?
4. What are the expansion devices? Explain the different types of it.

Registration No.: .....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Refrigeration & Air Conditioning Skills

Session: 2020-21 (Winter Semester)

B. Voc. Program, V Semester,

End-Sem. Examination

Course Code: HVA1502 Time: **2 Hours**

Course Name: Cold Chain & Cold Storage Max. Marks: 50

ANSWER KEY-B

Section – A

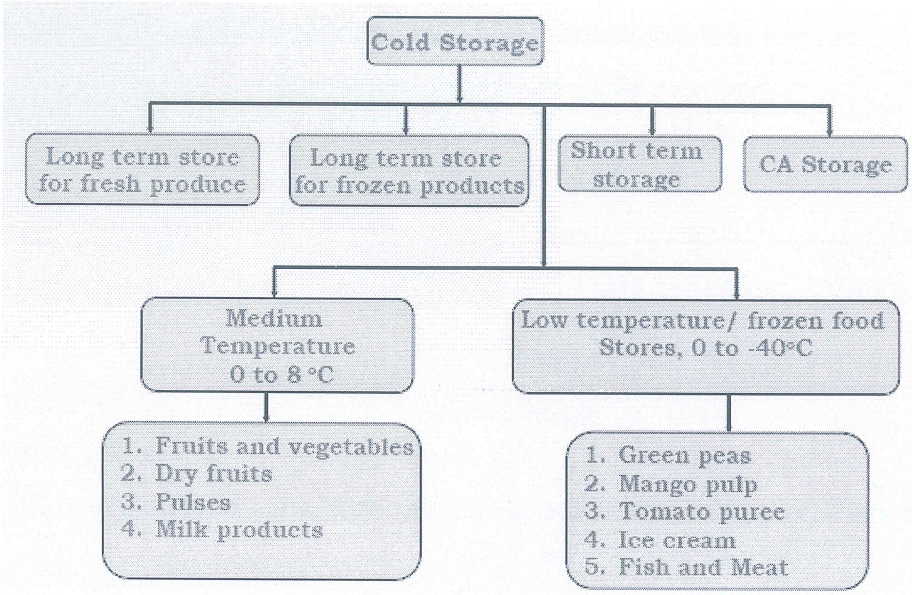
10X01 = 10 Marks

1. The horizontal line in psychrometric chart joining the change of state of air represents
   b. sensible cooling or heating
2. Pork has a higher shelf life than beef.
   b. False
3. It is possible to maintain conditions of temperature and pressure whereby the physical state of food substrate can be maintained at a critical point for the successful removal of water. This is called _____
   a. Freeze dehydration
4. Which of the following are Milk Processing Operations?
   d. All of the mentioned
5. Which of the following nutrients are lost in all steps of food engineering (including packaging and freezing)?
   b. Vitamins
6. Keeping in mind that texture changes take place after harvest, pulpy fruits become extremely hard after harvest.
   b. False
7. After harvest, _____ of fruits and vegetables undergoes change.
   a. Texture, nutrients, minerals
8. Which of the following is true about fruits and vegetable processing?
   d. All of the mentioned
9. Which of the following is not related to Post Harvest losses?
   c. Farmers don't earn much after adding value to products
10. At 100% relative humidity, the wet bulb temperature is-
    c. equal to the dew point temperature

Section – B

04X04 = 16 Marks

1. Write down the different types of cold storages.



2. Write down the importance of food preservation.

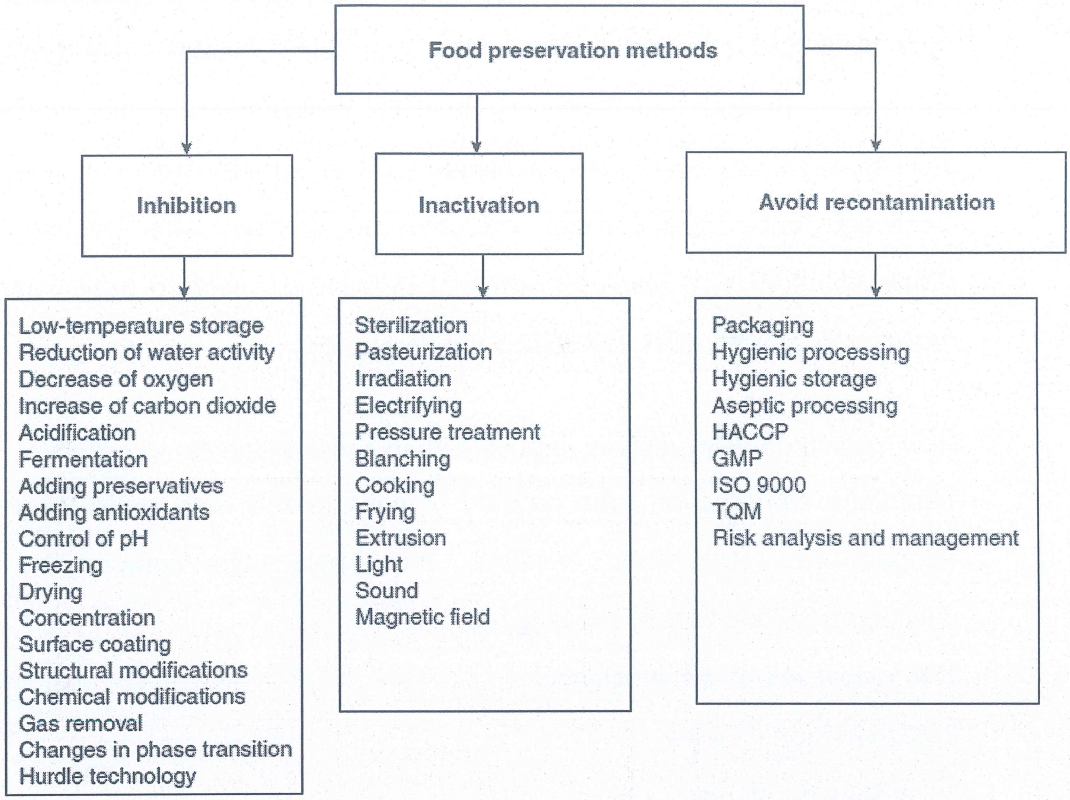
   Answer: The main reasons for food preservation are to overcome inappropriate planning in agriculture, produce value-added products, and provide variation in diet. The agricultural industry produces raw food materials in different sectors. Inadequate management or improper planning in agricultural production can be overcome by avoiding inappropriate areas, times, and amounts of raw food materials as well as by increasing storage life using simple methods of preservation. Value-added food products can give better-quality foods in terms of improved nutritional, functional, convenience, and sensory properties. Consumer demand for healthier and more convenient foods also affects the way food is preserved. Eating should be pleasurable to the consumer, and not boring. particularly in underdeveloped countries to reduce reliance on a specific type of grain (i.e., rice or wheat).

3. Write a short note on raking system.

   Answer: A racking system is one of several constituent parts of a warehouse system and can only be fully defined when all the other parameters of a warehousing operation are considered. It is totally dependent on what the user requires from the operational warehouse unit. At one end of the scale is a system that is 'all things to all men' and at the other end is a system dedicated to one customer with a fixed long-term requirement.

4. Explain the food preservation methods.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY



Section – C

04X06 = 24 Marks

1. Write down the advantages of forced draft cooling towers.

   Answer:

   1. Forced draft (FD) towers are more efficient than ID draft because some of the air velocity is converted into static pressure in the tower and recovered in the form of useful work.
   2. The vibration and noise are minimal because mechanical equipment is set on solid foundations.
   3. Because it handles dry air, problems of blade erosion are avoided.
   4. It is safer because it is located on the ground level.

2. Explain Drive-in drive-through pallet racking

   Answer: This system uses a form of racking which allows each pallet to be supported individually but gives a similar cube utilization to block stacking. Drive-in dictates that the loads stored will be last in, first out (LIFO). Drive-through enables a first in, first out (FIFO) operation to take place. The system generally uses racking uprights fitted with pallet support rails cantilevered from the side of the uprights (Figure 9.11). These rails run from front to rear and form the required storage levels. The uprights are fixed to the floor and tied above the top pallet level. The structure is also braced above the top pallet level. Lanes are therefore formed down which a truck can be driven to access each level of pallets. All levels in each lane have to be filled or emptied at the same time, which, in turn, means that each lane must contain the

same product. The difference between drive-in and drive-through is that with drive-in each block can only be accessed from one side, whereas drive-through can be accessed from both sides with no structural impediments in any of the lanes. As drive-through usually requires a higher level of strength to be derived from the steelwork above the top pallet, it is therefore less cost effective than drive-in. A simple solution is to place two drive-in installations back to back when access is required from both sides and FIFO is not important.

3. **How multistage compressors are useful than single stage compressors?**

   When the compression ratio required is considerably high, as in the case of low temperature refrigeration systems, the single-stage compression is highly uneconomical due to the following reasons.

   1. Very low volumetric efficiency
   2. High frictional losses
   3. Leakage problems
   4. High running cost

   In multistage compression, the compression of refrigerant from initial pressure to final pressure is carried out in more than one cylinder. A multistage compression with intermediate cooling is generally adopted for economical working.

4. **What are the expansion devices? Explain the different types of it.**

   An expansion device in a refrigeration system normally serves two purposes. One is the thermodynamic function of expanding the liquid refrigerant from the condenser pressure to the evaporator pressure. The other is the control function, which may involve supply of the liquid to the evaporator at the rate of which it is evaporated.

   The different devices that are used to perform these functions include the following:

   1. Capillary tube
   2. Pressure control or automatic expansion valve
   3. Thermostatic expansion valve
   4. High-side float valve
   5. Low-side float valve

9/8/21

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Refrigeration and Air-conditioning Skills

Session: 2020-21 (Winter Semester)

B. Voc. Program, 5th Semester,

End-Sem. Examination

SET- B

Course Code: HVA1503 **Time: 2 Hour**

Course Name: Chilled water supply system design **Max. Marks: 50**

Section – A

10*01 = 10 Marks

Note: Each question carries 01 mark.

Q. 1: The commonly used refrigerant in ice plant is

A. NH_3
B. CO_2
C. R-12
D. none of these

Q. 2: Efficiency of Electric-drive air-cooled scroll chiller is

A. 1.6
B. 1.9
C. 3.25
D. 5.8

Q. 3: Chillers operate efficiently in range of

A. 30% to 60% load
B. 40% to 80% load
C. 20% to 50% load
D. 10% to 70% load

Q. 4: Pipe schedule 40 is used for

A. Less than 18-inch pipe size
B. Less than 20-inch pipe size
C. Less than 10-inch pipe size
D. Less than 14-inch pipe size

Q. 5: The wall thickness of copper tubing is indicated by

A. Types K, L, and M
B. Types A, B, and C
C. Types J, K, and L
D. Types D, E, and F

Q. 6: The purge unit in a low-pressure chiller removes

A. overcharge of refrigerant.
B. excess oil.
C. condensable refrigerant.
D. non-condensable

Q. 7: The compressor used in low-pressure chillers is the

A. Centrifugal
B. Screw
C. Rotary
D. Reciprocating

Q. 8: When a chiller is used, the secondary refrigerant that circulates in the building is

A. Air
B. water
C. barine
D. glycol

Q. 9: A vapour absorption refrigeration system

A. gives noisy operation
B. gives quiet operation
C. requires more power consumption
D. have more wear and tear

Q. 10: In aqua-ammonia and Li-Br water absorption refrigeration system, the refrigerants are respectively

A. water and water
B. water and Li-Br
C. ammonia and Li-Br
D. ammonia and water

Section – B

04*04 = 16 Marks

Note: Each question carries 04 mark.

Q. 1: Classified the refrigerants with examples.

Q. 2: Explain line mounted and base mounted pumps.

Q. 3: Explain series and parallel chiller system with neat sketch.

Q. 4: Explain one-pump parallel chiller configuration.

Section – C

04*06 = 24 Marks

Note: Each question carries 06 mark.

Q. 1: Compare the vapour absorption refrigeration system over vapour compression refrigeration system.

Q. 2: Explain vapour absorption refrigeration cycle with neat sketch.

Q. 3: Write down the various piping materials used in chiller plant.

Q. 4: Explain thermal energy storage system with classification. Define the terms with respect to chiller:- off peak period, on peak period, charging and discharging.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Refrigeration and Air-conditioning Skills

Session: 2020-21 (Winter Semester)

B. Voc. Program, 5th Semester,

End-Sem. Examination

Answer key

Course Code: HVA1503 **Time: 2 Hour**

Course Name: Chilled water supply system design **Max. Marks: 50**

Section – A

10*01 = 10 Marks

10 objective type questions, each question carries 01 mark.

Q. 1: A

Q. 2: C

Q. 3: B

Q. 4: C

Q. 5: A

Q. 6: D

Q. 7: A

Q. 8: B

Q. 9: B

Q. 10: D

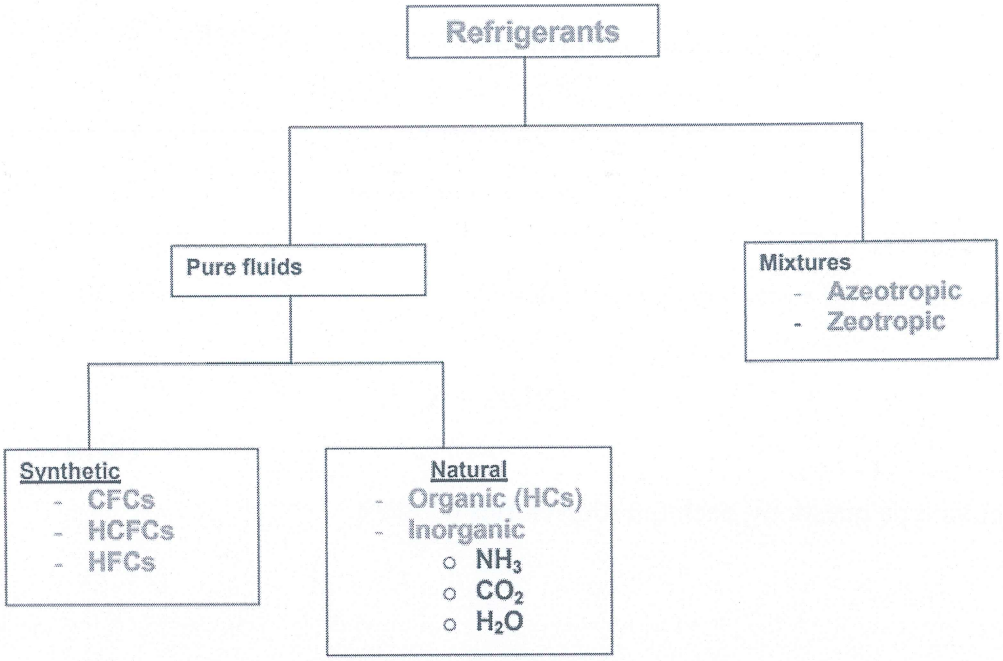
Section – B

4X4 = 16 Marks

4 short answer type questions, each question carries 04 marks.

Q. 1: Classified the refrigerants with examples.

Ans.



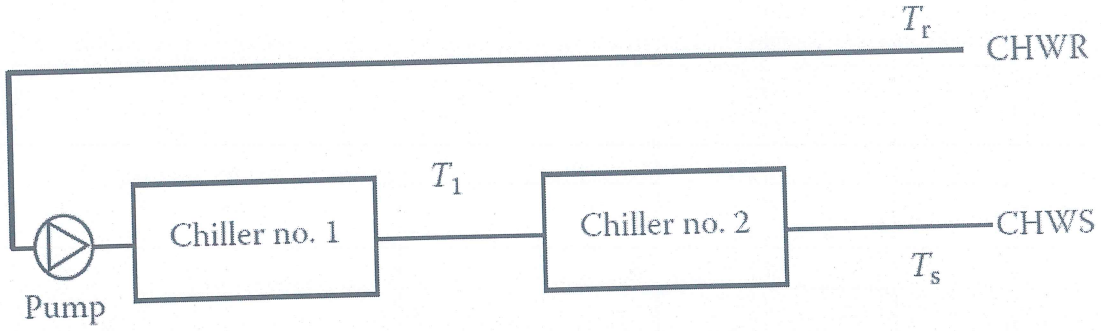
Q. 2: Explain line mounted and base mounted pumps.

Ans. Line-mounted pumps: These pumps can be installed directly in the piping since the suction and discharge connections are arranged 180° apart. The motor and pump shafts, typically, are mounted vertically. The pump may be supported by the piping and/or by additional hangers or a foot stand.

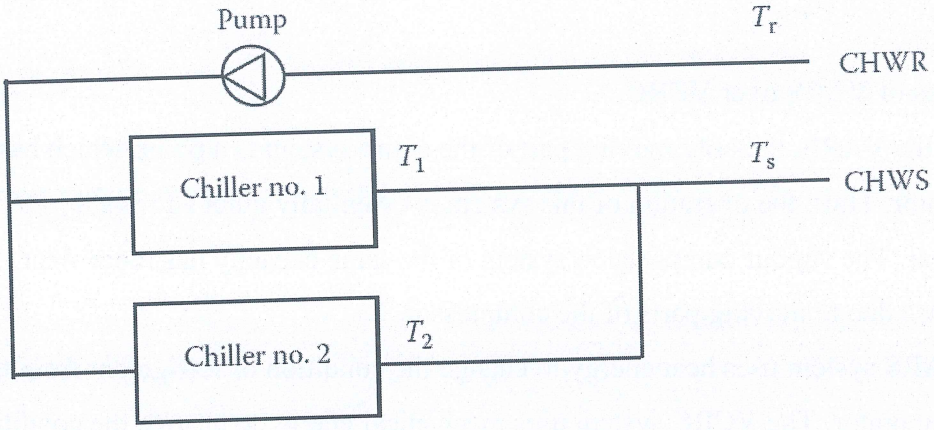
Base-mounted pumps: Base-mounted pumps have the motor and pump shafts mounted horizontally, with both the pump and the motor bolted to a common frame or base. These pumps are available in two configurations.

Q. 3: Explain series and parallel chiller system with neat sketch.

Ans. Series chiller system: In a series configuration with two chillers, each chiller is selected to produce half of the required cooling at the full system flow rate. Thus, half of the total design range is produced by each chiller. Series chiller systems are rarely utilized in present times because this configuration requires a constant chilled water flow rate at all times, resulting in high pumping costs. But, if a relatively large temperature difference is required or if there is a very steady base cooling load, the series configuration may offer some advantages.

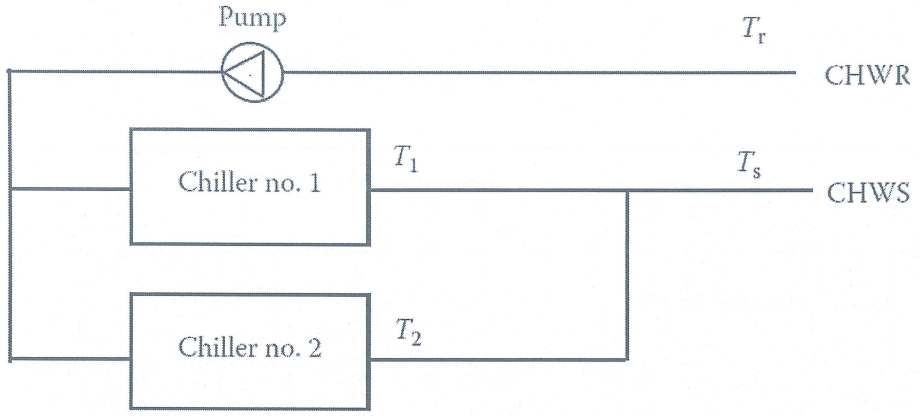


Parallel chiller system: The parallel chiller configuration is far more common. In a two-chiller configuration, each chiller is typically selected to operate with the same design range, but with only a half of the total system flow requirement. This again results in a 50/50 load split, but other load ratios may be selected if dictated by operational requirements. And, there is no real limitation on the number of parallel chillers that can be utilized in one system.



Q. 4: Explain one-pump parallel chiller configuration.

Ans. With this configuration, there is an inherent problem. If both machines were operated for the full-load range (15–100% of peak capacity), by the time the total system load drops to 30% of full load, each individual chiller would be operating very inefficiently. Thus, most designers utilize controls to shut off one chiller when the total system load, as evidenced by the return chilled water temperature, falls below 40% of full load. However, with this piping arrangement, if one chiller is not in operation, chilled water from the operating chiller will mix (blend) with the return water passing through the nonoperating chiller, effectively raising the system's chilled water supply temperature.



Section – C

04X06 = 24 Marks

04 essay type questions, each question carries 06 marks.

Q. 1: Compare the vapour absorption refrigeration system over vapour compression refrigeration system.

Ans.

Advantages of VARS over VCRC

1. In the VARS, the only moving part of the entire system is a pump which has a small motor. Thus, the operation of this system is essentially quiet and is subjected to little wear. The vapour compression system of the same capacity has more wear, tear and noise due to moving parts of the compressor.
2. VARS system uses heat energy to change the condition of refrigerant from the evaporator. The VCRC system uses mechanical energy to change the condition of refrigerant from the refrigerant.
3. The VARS system are usually designed to use steam, either at high pressure or low pressure. The exhaust heat from furnaces and solar energy may also be used. Thus, this system can be used where the electric power is difficult to obtain or is very expensive.
4. The space requirements and automatic control requirements favor the absorption system more and more as the desired evaporator pressure drops.
5. The VARS system can be built in capacities well above 1000 tons of refrigeration each, which is the largest size for single compressor units.
6. The load variations do not affect the performance of VARS system. The performance of a vapour compression system at partial loads is poor.

7. In the VARS system, the liquid refrigerant leaving the evaporator has no bad effect on the system except that of reducing the refrigerating effect. In the VCRC system, it is essential to superheat the vapour refrigerant leaving the evaporator so that no liquid may enter the compressor.

Disadvantage:

1. Less COP
2. More space required
3. More amount of refrigerant is circulated, which increase the running cost.

Q. 2: Explain vapour absorption refrigeration cycle with neat sketch.

Ans. In this system, the vapour refrigerant from the evaporator is drawn into an absorber where it is absorber by weak solution of the refrigerant forming a strong solution. This strong solution is pumped to the generator where it is heated by some external source (waste heat or solar energy). During the heating process, the vapour refrigerant is driven off by the solution and enters into the condenser where it is liquified. The liquid refrigerant then flows into the evaporator and thus the cycle is completed. The vapour absorption system uses heat energy, instead of mechanical energy as in VCRC. In VARS, the compressor is replaced by an absorber, a pump, a generator and a pressure reducing valve. These components in VARS perform the same function as that of a compressor in VCRC system.

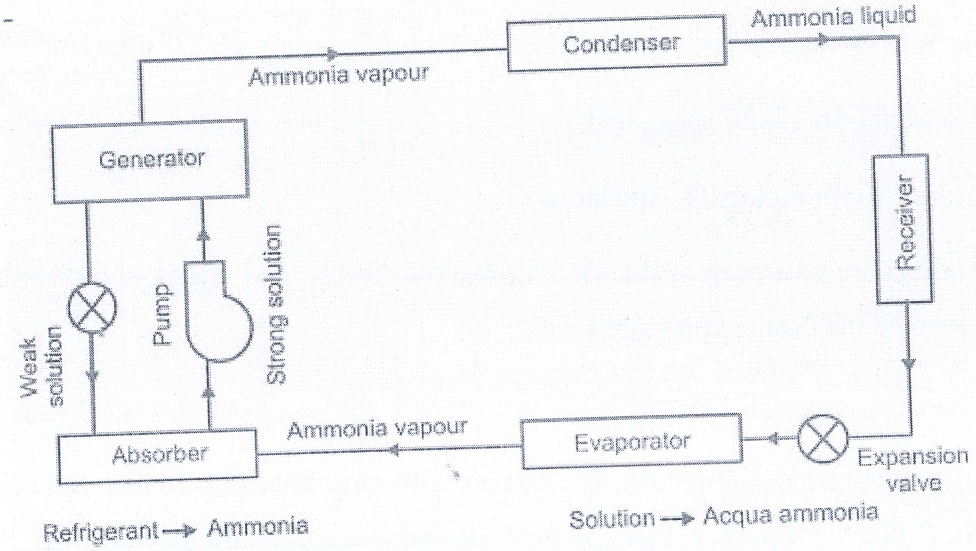


Fig. Vapour absorption refrigeration system

Q. 3: Write down the various piping materials used in chiller plant.

Ans. Chilled water distribution systems are assembled from commercially available piping materials, most commonly steel and copper.

Steel pipe: This is the most common above-ground piping type and is defined by its wall thickness, called schedule, and its finish. Up through 10″ pipe size, Schedule 40 piping is normally used for chilled water (and condenser) water applications.

Copper tubing: The cost of copper tubing is higher than that of a steel pipe, but the installation labor cost for smaller sizes, 2″ and smaller, is much less than that of steel. Therefore, most designers will allow copper tubing to be used in water systems for these smaller sizes at the contractor's option.

The wall thickness of copper tubing is indicated by its *type*, defined as Types K, L, and M in decreasing order of wall thickness. Typically, Type K or L tubing can be used for chilled water piping, but Type M copper tubing is not rated as for pressure service and can be used only for drain lines or other atmospheric pressure applications.

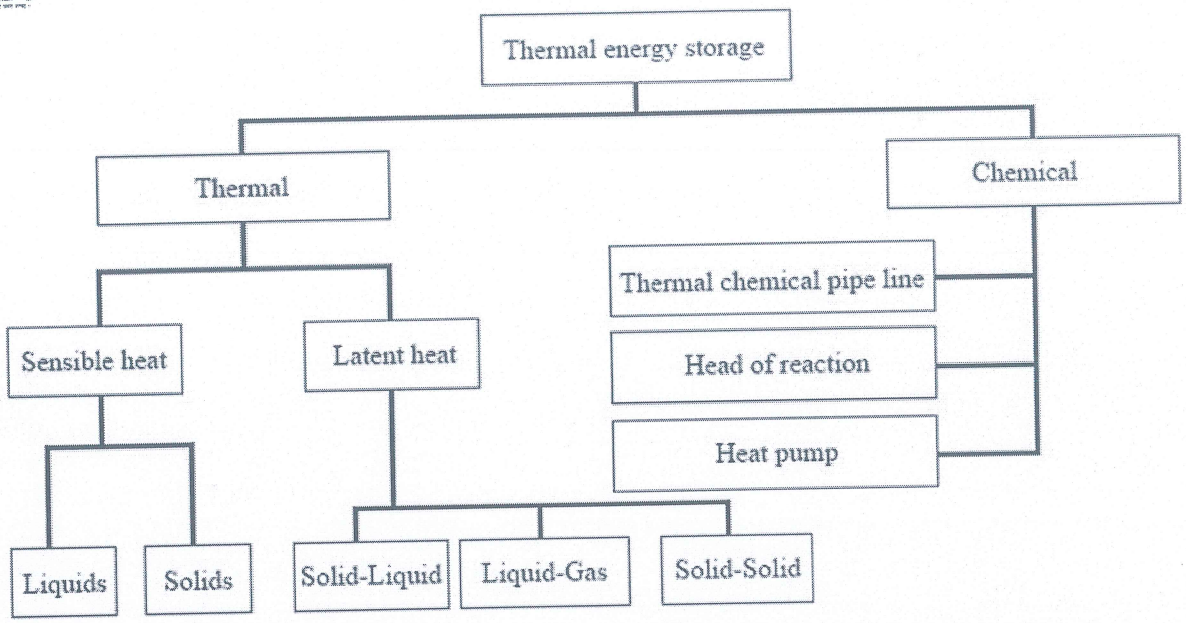
PVC or CPVC: As an alternative to iron piping for underground chilled water distribution, polyvinyl chloride (PVC) or chlorinated polyvinyl chloride (CPVC) piping can be used. PVC and CPVC piping wall thickness is defined in terms of schedules, much like steel pipe.

Cast or ductile iron

- For underground piping, cast iron piping or ductile iron piping is routinely used.
- Iron piping is rated for application in terms of "pressure class".
- for most chilled water systems, Class 350 is used up through 12″ pipe size,
- Class 250 for 14–20″ pipe, and
- Class 150 for piping 24″ and larger.
- Fittings are cast gray or ductile iron and the fittings and piping are assembled with gasketed mechanical pressure joints.

Q. 4: Explain thermal energy storage system with classification. Define the terms with respect to chiller:- off peak period, on peak period, charging and discharging.

Ans. Thermal energy storage (TES) allows the storage of heat and cold, which is used later. TES is also known as heat or cold storage. TES can aid in the efficient use and provision of thermal energy whenever there is a mismatch between energy generation and use. This mismatch can be in terms of time, temperature, power, or site. Cool thermal energy storage (CTES) has recently attracted increasing interest in industrial refrigeration applications, such as process cooling, food preservation, and building air-conditioning systems.



Off peak period represents when the system is not in use while on peak period represent when system is working. Charging represents the off-peak period production of cooling energy by the chiller that is stored, while discharging is the use of that stored energy during the on-peak period.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Refrigeration & Air conditioning Skills

Session: 2020-21 (Winter Semester)

B. Voc. Program, V-Semester,

End Sem. Examination

SET - B

Course Code: HVA1504 **Time: 2 Hour**

Course Name: AC system & Testing **Max. Marks: 50**

Instruction:

1.Read the question carefully.

2.Take given dimensions in Inches or convert them.

Section – A

10X01 = 10 Marks

Q1. Supply Air Duct-(SAD)_____

a) Carries the supply air from A.H.U to room.
b) Carries supply water from Ahu to Room.
c) Carries air return to A.H.U
d) Carries air in supply Line.

Q2. CFM determines the _____

a) Volume
b) Space
c) Duct height
d) Air velocity

Q3. Pipe is designed for _____

a) Pressure
b) Head pressure
c) To ensure Flow rate
d) Set back

Q4. Q4. Primary water loop connects _____

a) Chiller and ahu
b) F.C.U
c) Fain coil & Cooling tower
d) Condenser & A.H.U

Q5. LEED Is to regulate

a) Environment
b) Safety
c) Fire & hazard
d) Depression stresses

Q6. GPM determines_____?

a) Flow
b) Flow rate
c) Velocity

d) Space

Q7 Fire dampers are certified by.

a) Under writer's laboratory
b) Din
c) Space concern
d) Volume

Q8) Attic Space is the space _____?

a) Between BOFC & SSLB
b) SLAB & FFL
c) BOFC & FFL
d) SSLB & WINDOW

Q9. In equal friction method _____ is kept constant?

A9. a) Friction

b) Velocity drop /100 ft of W.C

c)Area

d) Discharge

Q10. Pipe work has _____& _____?

a) Flow & Velocity
b) Velocity
c) Kinetic energy
d) Stress

Section – B

04X04 = 16 Marks

Q11. Types of evaporators used in chillers with diagram.

Q12. Limitation and advantages of Scroll and reciprocating Compressor?

Q13. Using the continuity equation calculate the sizes of duct?

whose area is.

1)100 sq ft

2)156 sq inches

3) 64 sq ft

4) 225 sq inches

Q14. Using the continuity equation calculate the sizes of square duct?

whose area is.

1) 49 sq ft 2) 441 sq inches

3) 64 sq ft 4) 225 sq inches

Section – C 06X04 =24Marks

Q15. What are the basic differences between F.C.U & A.H.U?

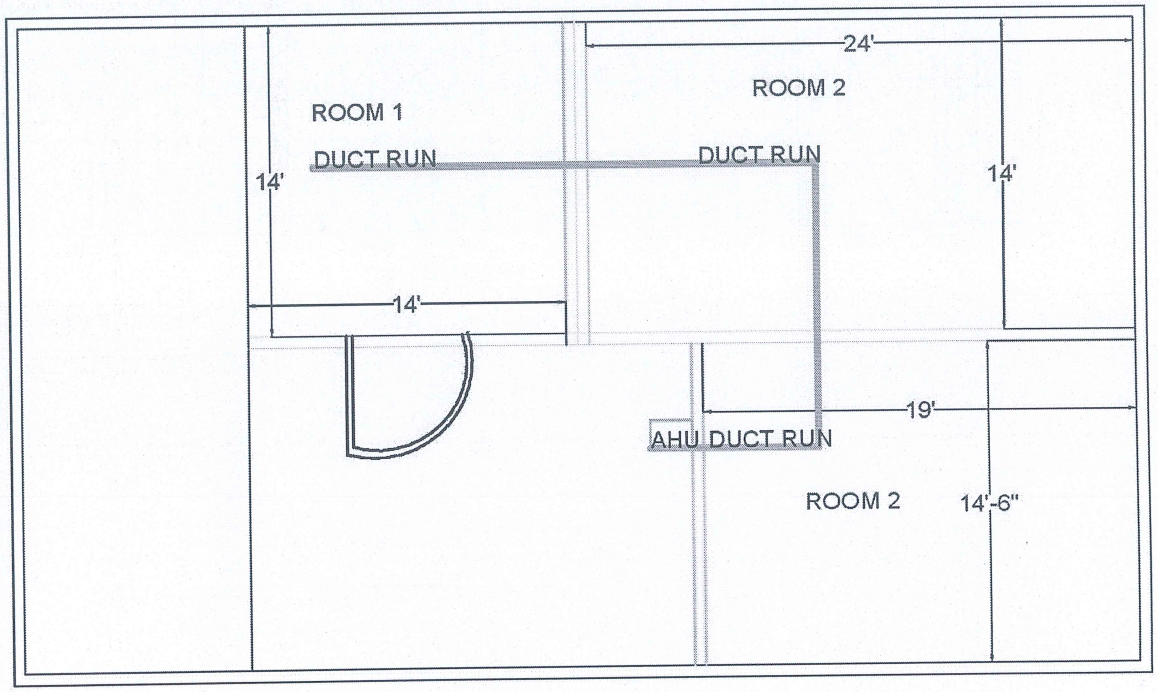
Q16. Calculate the required CFM and design the Duct for given building? Height to take 10.'

1) CFM of air required

2) Line diagram for duct design using EFM

3) Line diagram for duct design using EFM.

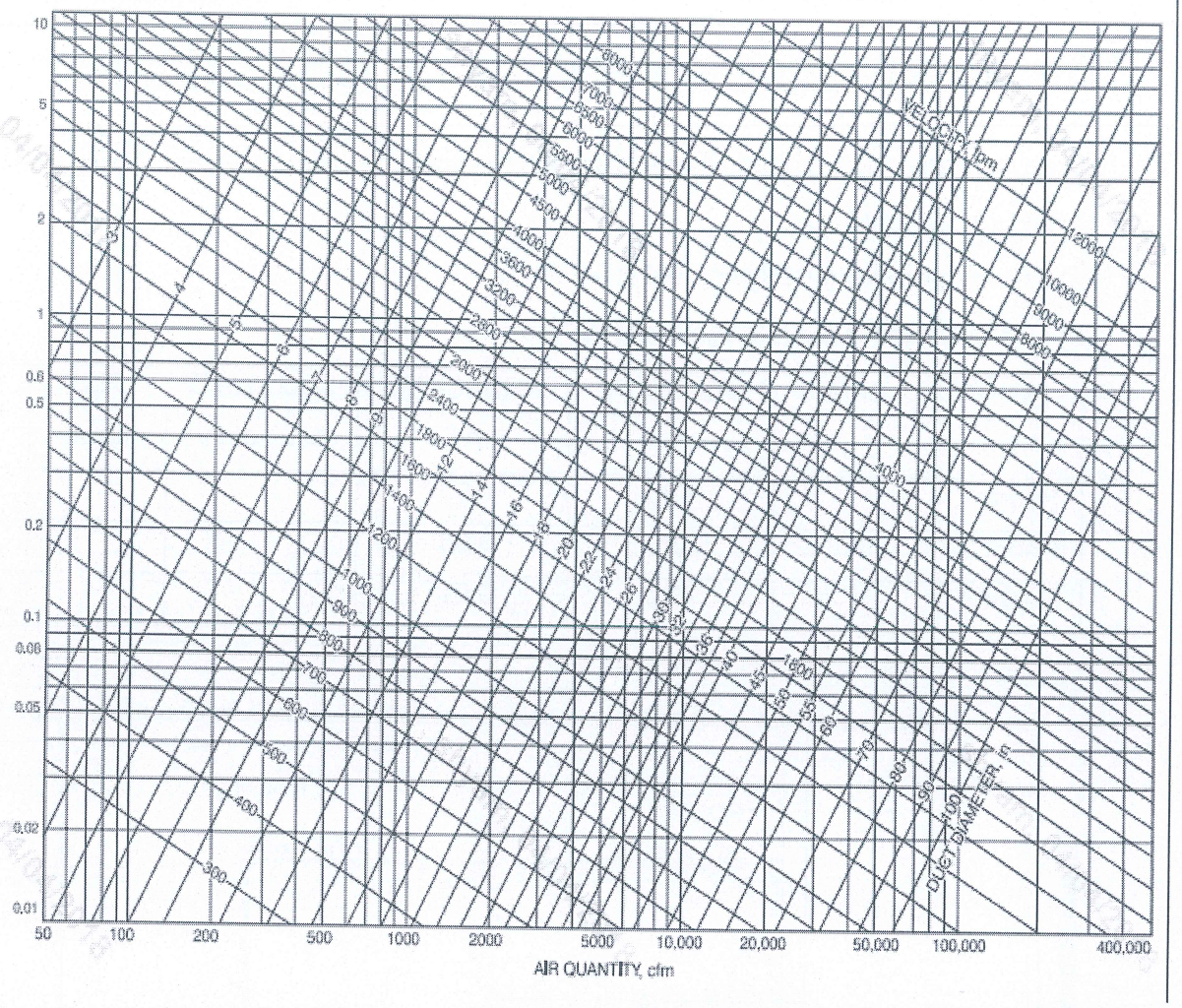
DUCT	CFM	VELOCITY	PRESSURE AT	Duct size D equivalent	Pipe sizes	GPM
Room 1		400	0.05"			800
Room 2		450	0.05"			500
Room 3		420	0.05"			300



1.CALCULATE CFM FOR ROOM 1,2 AND 3
2.WRITE DUCT DIMENSIONS
3.Make a table and fill in values for blanks

Q17. What are the types of Air Ventilation Explain with the help of A neat sketch?

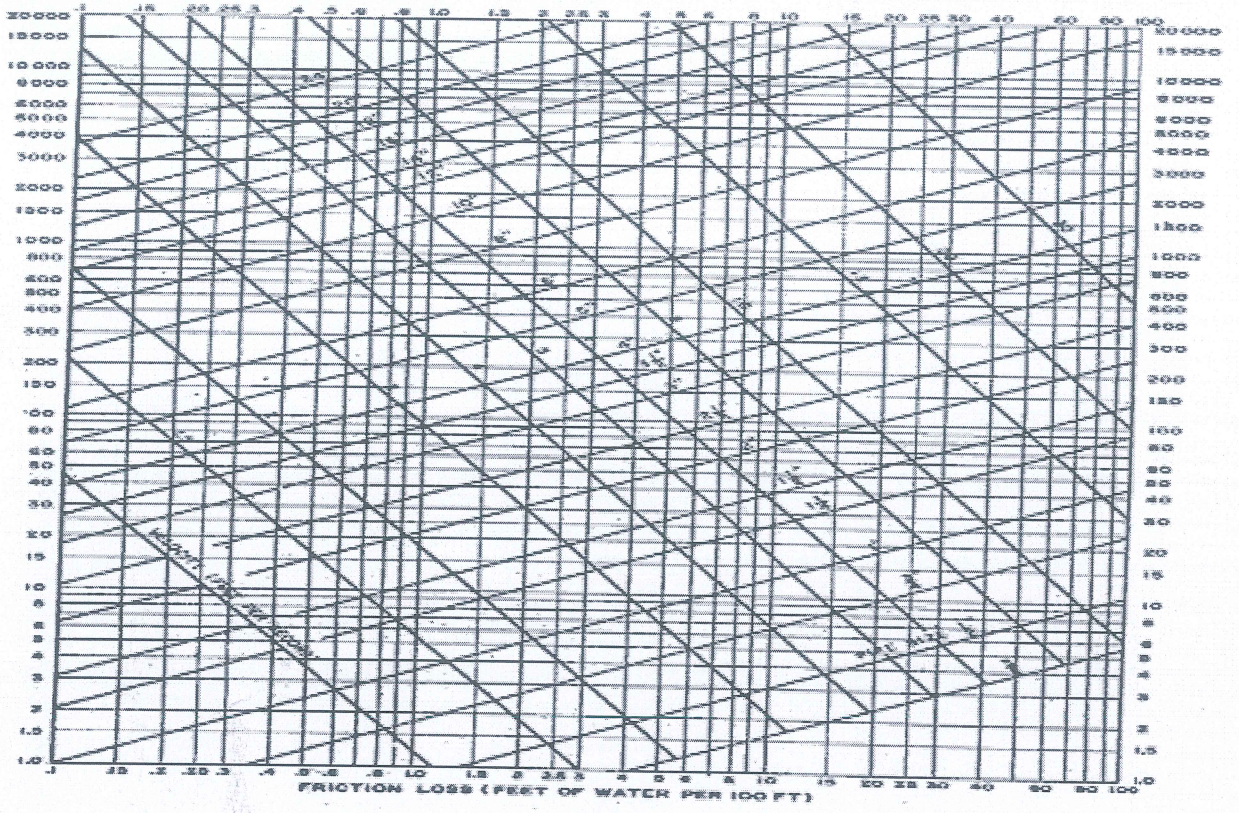
Q18. Draw the flow chart for building survey/Project?



Source : ASHRAE Handbook 2013

Figure 2.7 : Rigid Duct Design - Friction Chart
Friction chart for Round Duct, Air Density = 0.075 lb/ft3 and ε =0 0.003 ft.

Chart 1 - Friction Loss for Closed Piping Systems (Water)
Schedule 40 Pipe



BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Refrigeration & Air conditioning Skills

Session: 2020-21 (Winter Semester)

Answer key

B. Voc. Program, V-Semester,

End Sem. Examination

SET - B

Course Code: HVA1504 **Time: 2 Hour**

Course Name: AC system & Testing **Max. Marks: 50**

Instruction:

1.Read the question carefully.

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Section – A 10X01 = 10 Marks

Q1. Supply Air Duct-(SAD)_____

a) Carries the supply air from A.H.U to room.

Q2. CFM determines the _____

a) Volume

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b) Head pressure

Q4. Primary water loop connects _____

a) Chiller and ahu

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Q6. GPM determines_____?

b) flow rate

Q7 Fire dampers are certified by.

a) Under writer's laboratory

Q8) Attic Space is the space _____?

a) Between BOFC & SSLB

Q9. In equal friction method _____ is kept constant?

A9.b) Velocity drop /100 ft of w.c

Q10. Pipe work has _____& _____?

a) Flow & Velocity

Section – B

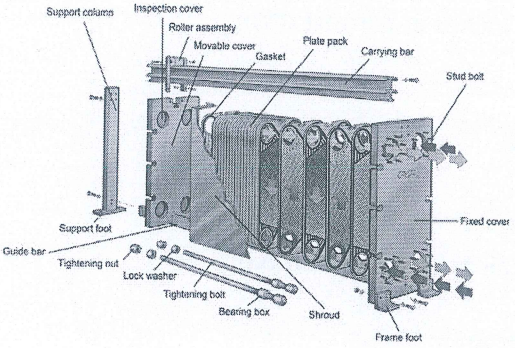
04X04 = 16 Marks

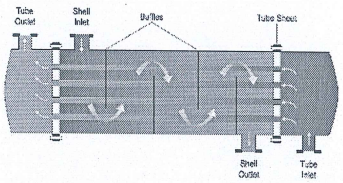
Q11. Types of evaporators used in chillers with diagram.

A11. 1.Shell Type-Used where the load is low with space constrain spiral tube in form of coil is shaped to cool the secondary refrigerant

2.Plate heat exchanger type- here two concentric plates are sandwiched between the tube where aluminum plates used as a fin to increase area for heat transfer

3.Flooded shell and tube- here tubes carry refrigerant or secondary refrigerant and as per the application shell part are exposed to these number of tubes for better heat transfer coefficient.





Q12. Limitation and advantages of Scroll and reciprocating Compressor?

12. Scroll type compressor are mostly silent working as no of assemblies are very low and they are highly process efficient high discharge low maintenance.

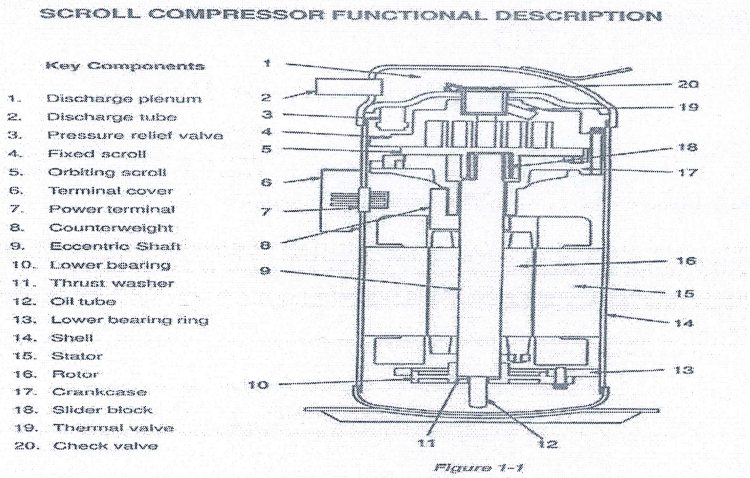


Figure 1-1

Q13. Using the continuity equation calculate the sizes of duct?

whose area is.

1)100 sq.ft-10'*10'

2)156 sq. inches-(13'*12') 14*12

3) 64 sq. ft----(8*8)

4) 225 sq. inches(15*15)

Q14. Using the continuity equation calculate the sizes of square duct?

whose area is.

1) 49 sq ft 2) 441 sq inches

7'x7' 21"x21"

3) 64 sq ft

8'X8' 4) 225 sq inches-15"X15"

Section – C 06X04 =24Marks

Q15. What are the basic differences between F.C.U & A.H.U?

A15.

AHU'S	FCU'S
AHU's are often used outside, especially as rooftop units	FCU's have only one fan, whereas AHU's can have multiple fans
AHU's often have different controls for parts of the system, for instance they might have temperature sensors, actuators, and humidity sensors.	FCU's are generally used for controlling the space where they are installed. AHU's are part of a larger system.
AHU's are more complex and can have sections for humidifying and reheating. They often have vibration isolators, mixing chambers, and other components. Since they often take air from outside, they almost always have a filter of some sort in the first section of the device so that the debris from the air doesn't contaminate the other sections.	FCU's don't generally use ductwork to cool or heat air. The fan pulls the air over the coil. FCU's can handle water.

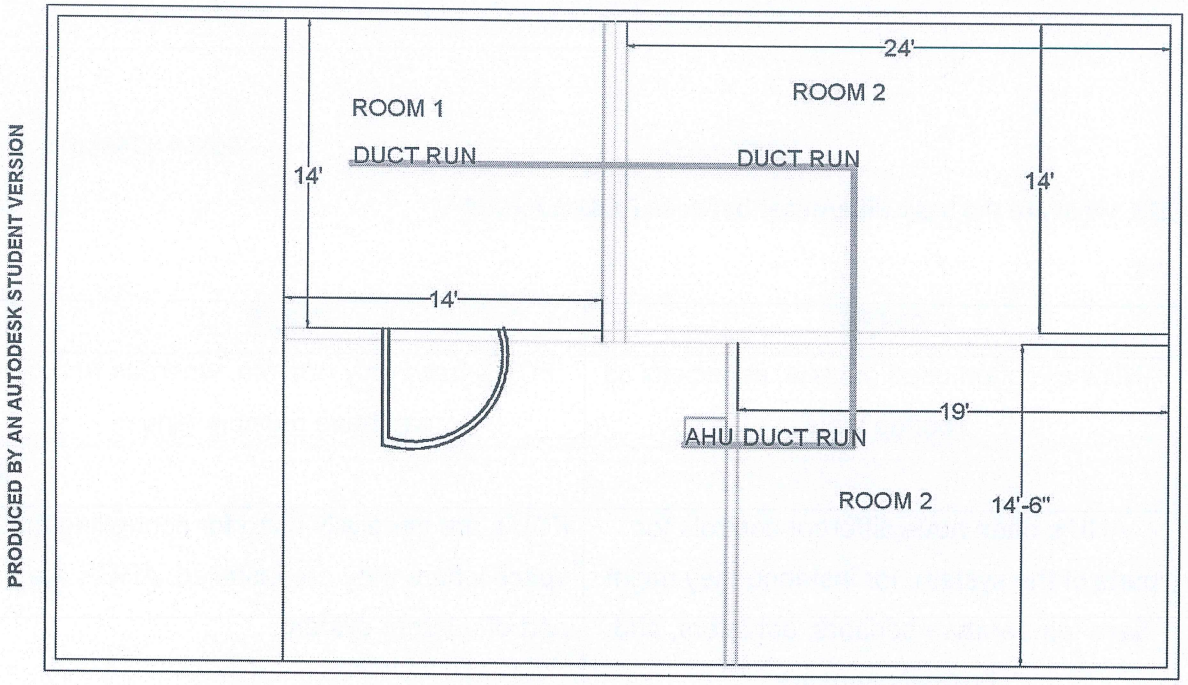
Q16. Calculate the required CFM and design the Duct for given building? Height to take 10.'

1) CFM of air required

2) Line diagram for duct design using EFM

3) Line diagram for duct design using EFM.

DUCT	CFM	VELOCITY	PRESSURE AT	Duct size D equivalent	DUCT	CFM
A	65.33	400	0.05"	6"	A	65.33
A1	112	450	0.05"	6.5"	A1	112
B	92.46/93	420	0.05"	6"	B	92.46/93



1.CALCULATE CFM FOR ROOM 1,2 AND 3
2.WRITE DUCT DIMENSIONS
3.Make a table and fill in values for blanks

Q17. What are the types of Air Ventilation Explain with the help of A neat sketch?

A.17 Natural Ventilation

1) single – side ventilation

2) cross flow ventilation

3) stack ventilation

4) Top - down ventilation