BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of RAC Skills

Session: 2021-22 (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 SET-A

Section – A

10X01 = 10 Marks

1. Ventilation rate can be calculated using:-
   a) People Outdoor Air b) ACPH c) Outdoor Air per area d) All of the above
2. Which of the following is not a requirement for a barrier?
   a) Durability b) Strength c) Rigidity d) None of the above
3. Mechanically bringing in outside air by controlling the amount of air replacement is called:
   a). Infiltration b). Ventilation c) Exfiltration d) None of the above
4. Resistance of a material depends on:-
   a) Thickness and thermal conductivity
   b) Thickness and thermal resistance
   c) Specific heat and Area
   d) Specific Volume and thickness
5. Stack coefficient is denoted by:
   a) A b) B c) C d) D
6. The rated horsepower is multiplied with ____to convert it to Btu/h for a motor.
   a) 2545 b) 2245 c) 2125 d) 2985
7. Typical Fan efficiency average value is:
   a) 65% b) 70% c) 90% d) 30 %
8. Which of the following is done after zoning?
   a) Spacing
   b) Floor and Ceiling levels
   c) Load Calculations
   d) Room Bounding
9. Dependence on the wavelength is referred to as:
   a) Durability
   b) Spectral
   c) Specular
   d) Diffuse surface
10. The transport of energy in a fluid or gas by mixing in addition to conduction is called:
    a) Convection
    b) Radiation
    c) Insulation
    d) Evaporation

Section – B

04X04 = 16 Marks

1. What is the relationship between R-value and U value?
2. What is effective leakage area method?
3. How is convection heat transfer is calculated?
4. What is effect of cooling system on space heat ganin?

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Section – C

06X04 = 24 Marks

1. A 0.6 m thick uninsulated wall with an area of 16 m^2 is made out of concrete with a conductivity of 1.25 W/(m·K). What is the R-value of the wall? Under steady-state conditions, with the exterior surface temperature of the wall at 15°C and the interior surface temperature of the wall at 35°C, what is the total heat loss through the wall?

2. What are the properties of radiation?

3. A window with a surface area of 25 m^2 is heated by the sun to a temperature of 55°C at a time when the outdoor air is at 23°C, and a light breeze results in a convection coefficient of 42 W/(m^2·K). What is the heat lost by the surface due to convection?

4. A 200-seat school band room is used continuously from 10:00 am until 4:00pm each day. For the first two hours, it is at 40% capacity; during the last two hours, it is at 90% capacity. Estimate the sensible heat gain from people at 12:00 pm, 2:00 pm and 4:00 pm.

Degree of Activity		Total Heat, Btu/h: Adult, Male	Total Heat, Btu/h: Adjusted, M/F[a]	Sensible Heat, Btu/h	Latent Heat, Btu/h	% Sensible Heat that is Radiant[b]: Low V	% Sensible Heat that is Radiant[b]: High V
Seated at theater	Theater, matinee	390	330	225	105		
Seated at theater, night	Theater, night	390	350	245	105	60	27
Seated, very light work	Offices, hotels, apartments	450	400	245	155		
Moderately active office work	Offices, hotels, apartments	475	450	250	200		
Standing, light work; walking	Department store; retail store	550	450	250	200	58	38
Walking, standing	Drug store, bank	550	500	250	250		
Sedentary work	Restaurant[c]	490	550	275	275		
Light bench work	Factory	800	750	275	475		
Moderate dancing	Dance hall	900	850	305	545	49	35
Walking 3 mph; light machine work	Factory	1000	1000	375	625		
Bowling[d]	Bowling alley	1500	1450	580	870		
Heavy work	Factory	1500	1450	580	870	54	19
Heavy machine work; lifting	Factory	1600	1600	635	965		
Athletics	Gymnasium	2000	1800	710	1090		

Hours in Space	Number of Hours after Entry into Space or Equipment 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																								
2	0.75	0.88	0.18	0.08	0.04	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.75	0.88	0.93	0.95	0.22	0.10	0.05	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.75	0.88	0.93	0.95	0.97	0.97	0.23	0.11	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.75	0.88	0.93	0.95	0.97	0.97	0.98	0.98	0.24	0.11	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
10	0.75	0.88	0.93	0.95	0.97	0.97	0.98	0.98	0.99	0.99	0.24	0.12	0.07	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00
12	0.75	0.88	0.93	0.96	0.97	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.25	0.12	0.07	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.00	0.00
14	0.76	0.88	0.93	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	0.99	1.00	1.00	0.25	0.12	0.07	0.04	0.03	0.02	0.02	0.02	0.01	0.01
16	0.76	0.89	0.94	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	0.99	1.00	1.00	1.00	1.00	0.25	0.12	0.07	0.05	0.03	0.03	0.02	0.02
18	0.77	0.89	0.94	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.12	0.07	0.05	0.03	0.03
Zone Type B																								
2	0.65	0.74	0.16	0.11	0.08	0.06	0.05	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.65	0.75	0.81	0.85	0.24	0.17	0.13	0.10	0.07	0.06	0.04	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
6	0.65	0.75	0.81	0.85	0.89	0.91	0.29	0.20	0.15	0.12	0.09	0.07	0.05	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00
8	0.65	0.75	0.81	0.85	0.89	0.91	0.93	0.95	0.31	0.22	0.17	0.13	0.10	0.08	0.06	0.05	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.00
10	0.65	0.75	0.81	0.85	0.89	0.91	0.93	0.95	0.96	0.97	0.33	0.24	0.18	0.14	0.11	0.08	0.06	0.05	0.04	0.03	0.02	0.02	0.01	0.01
12	0.66	0.76	0.81	0.86	0.89	0.92	0.94	0.95	0.96	0.97	0.98	0.98	0.34	0.24	0.19	0.14	0.11	0.08	0.06	0.05	0.04	0.03	0.02	0.02
14	0.67	0.76	0.82	0.86	0.89	0.92	0.94	0.95	0.96	0.97	0.98	0.98	0.99	0.99	0.35	0.25	0.19	0.14	0.11	0.08	0.06	0.05	0.04	0.03
16	0.69	0.78	0.83	0.87	0.90	0.92	0.94	0.95	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	0.35	0.25	0.19	0.15	0.11	0.09	0.07	0.05
18	0.71	0.80	0.85	0.88	0.91	0.93	0.95	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	0.99	1.00	1.00	0.35	0.25	0.19	0.15	0.11	0.09
Zone Type C																								
2	0.60	0.68	0.14	0.11	0.09	0.07	0.06	0.05	0.04	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
4	0.60	0.68	0.74	0.79	0.23	0.18	0.14	0.12	0.10	0.08	0.06	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
6	0.61	0.69	0.74	0.79	0.83	0.86	0.28	0.22	0.18	0.15	0.12	0.10	0.08	0.07	0.06	0.05	0.04	0.03	0.03	0.02	0.02	0.01	0.01	0.01
8	0.61	0.69	0.75	0.79	0.83	0.86	0.89	0.91	0.32	0.26	0.21	0.17	0.14	0.11	0.09	0.08	0.06	0.05	0.04	0.04	0.03	0.02	0.02	0.02
10	0.62	0.70	0.75	0.80	0.83	0.86	0.89	0.91	0.92	0.94	0.35	0.28	0.23	0.18	0.15	0.12	0.10	0.08	0.07	0.06	0.05	0.04	0.03	0.03
12	0.63	0.71	0.76	0.81	0.84	0.87	0.89	0.91	0.93	0.94	0.95	0.96	0.37	0.29	0.24	0.19	0.16	0.13	0.11	0.09	0.07	0.06	0.05	0.04
14	0.65	0.72	0.77	0.82	0.85	0.88	0.90	0.92	0.93	0.94	0.95	0.96	0.97	0.97	0.38	0.30	0.25	0.20	0.17	0.14	0.11	0.09	0.08	0.06
16	0.68	0.74	0.79	0.83	0.86	0.89	0.91	0.92	0.94	0.95	0.96	0.96	0.97	0.98	0.98	0.98	0.39	0.31	0.25	0.21	0.17	0.14	0.11	0.09
18	0.72	0.78	0.82	0.85	0.88	0.90	0.92	0.93	0.94	0.95	0.96	0.97	0.97	0.98	0.98	0.99	0.99	0.99	0.39	0.31	0.26	0.21	0.17	0.14
Zone Type D																								
2	0.59	0.67	0.13	0.09	0.08	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
4	0.60	0.67	0.72	0.76	0.20	0.16	0.13	0.11	0.10	0.08	0.07	0.06	0.05	0.05	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01
6	0.61	0.68	0.73	0.77	0.80	0.83	0.26	0.20	0.17	0.15	0.13	0.11	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.03	0.03	0.03	0.02	0.02
8	0.62	0.69	0.74	0.77	0.80	0.83	0.85	0.87	0.30	0.24	0.20	0.17	0.15	0.13	0.11	0.10	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.03
10	0.63	0.70	0.75	0.78	0.81	0.84	0.86	0.88	0.89	0.91	0.33	0.27	0.22	0.19	0.17	0.14	0.12	0.11	0.09	0.08	0.07	0.06	0.05	0.05
12	0.65	0.71	0.76	0.79	0.82	0.84	0.87	0.88	0.90	0.91	0.92	0.93	0.35	0.29	0.24	0.21	0.18	0.16	0.13	0.12	0.10	0.09	0.08	0.07
14	0.67	0.73	0.78	0.81	0.83	0.86	0.88	0.89	0.91	0.92	0.93	0.94	0.95	0.95	0.37	0.30	0.25	0.22	0.19	0.16	0.14	0.12	0.11	0.09
16	0.70	0.76	0.80	0.83	0.85	0.87	0.89	0.90	0.92	0.93	0.94	0.95	0.95	0.96	0.96	0.97	0.38	0.31	0.26	0.23	0.20	0.17	0.15	0.13
18	0.74	0.80	0.83	0.85	0.87	0.89	0.91	0.92	0.93	0.94	0.95	0.95	0.96	0.97	0.97	0.97	0.98	0.98	0.39	0.32	0.27	0.23	0.20	0.17

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of RAC Skills

Session: 2021-22 (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 SET-A

Section – A

10X01 = 10 Marks

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

Section – B

04X04 = 16 Marks

1. **The greater the thermal resistance of a material, the slower heat passes through itwhen a given differential is maintained across the material**

R = 1 ÷ U (reciprocal)

2. The second method to determine the rate of air infiltration is based on the effective leakage area of various construction components used in both residential and commercial buildings.

- To obtain the building's total leakage area, multiply the overall dimensions or number of occurrences of each building component by the Leakage related to them.

3. The convection heat transfer rate is usually expressed:

$$q = hA(t-ts)$$

- where h = convection coefficient, W/(m2·K) t = bulk temperature of the air, °C ts = surface temperature, °C

4. Depending on the type of system installed, this heat gain will affect the system differently. For example, if the fan is in front of the cooling coil (blow-through), then the coil will remove the energy immediately, but the space load will be unaffected. However, when the fan is after the cooling coil (drawthrough), these losses become heat gains to the system. Either the supply air temperature must be reduced slightly, or the air flow through the system must be increased slightly to compensate for this energy gain.

Section – C

06X04 = 24 Marks

1. The convection heat transfer rate is usually expressed:

$$q = hA(t-ts)$$

- where h = convection coefficient, W/(m2·K) t = bulk temperature of the air, °C ts = surface temperature, °C

2. 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

3. The indicated zone type is B. The total installed wattage is 6 (bulbs)·34W/ bulb)= 204 W.

- The use factor is 1.0 (all lights are on) and the special allowance factor is 1.2.
- For a 3-hp motor (assuming a 3 phase/1750 rpm motor at 81% efficiency). The value in column A (for both the motor and fan within the air flow) is 9430 Btu/h. The value in column B (for the fan only within the air flow) is 7640 Btu/h. And the value in column C (motor only within the controlled space) is 1790 Btu/h (the difference between the previous two values).

The CLF from Table for zone type B, 8 h on, 6 h after being turned on is 0.95. The values at 4 pm and 6 pm are 0.96 and 0.12, respectively.

4. The indicated zone type is B. The total installed wattage is 6 (bulbs)·34W/ bulb)= 204 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, 8 h on, 6 h after being turned on is 0.95. The values at 4 pm and 6 pm are 0.96 and 0.12, respectively.

People	Heat Gain (each)	Hours/ Day	Start Time	CLF at 2:00	CLF at 4:00	CLF at 6:00	Cooling Load at 2:00	Cooling Load at 4:00	Cooling Load at 6:00
50	275	4	12:00	0.68	0.79	0.18	9350	10863	2475
30	275	2	2:00	0	0.68	0.11	0	5610	908
	275	(Latent)					13750	0	0
Sensible Total, Btu/h							9350	16473	3383
Latent Total, Btu/h							13750	0	0

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Refrigeration and Air-conditioning Skills

Session: 2021-22 (Winter Semester)

B. Voc. Program, V Semester,

End-Sem. Examination

Course Code: HVA1501 **Time: 2 Hour**

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

SET B

Section – A

10*01 = 10 Marks

Note: Each question carries 01 mark.

Q. 1: R value depends upon:
A. Thermal conductivity
B. Length
C. Infiltration
D. None of the above

Q. 2: Heat gain due to outside air is called____load.
A. Infiltration
B. Exfiltration
C. Ventilation
D. None of the above

Q. 3: Typical Fan efficiency average value is:
A. 65%
B. 70%
C. 80%
D. None of the above

Q. 4 Which of the following is done after zoning?
A. Spacing
B. Floor Ceiling levels
C. load calculations
D. None of the above

Q. 5: Dependance on the wavelength is known as:
A. Spectral
B. Specular
C. Diffused
D. None

Q. 6: The transport of energy in a fluid or gas by mixing in addition to conduction is called.
A. Convection
B. Radiation
C. Evaporation
D. None of the above

Q. 7: Providing a _____ at entrances can help reduce infiltration.
A. Awning
B. Slat screen
C. Airlock
D. None of the above

Q. 8: Stack effect happens in building above _____floor.
A. Single
B. Double
C. Triple
D. Four

Q. 9: Which of the following is not a part of internal load:

A. People
B. Lighting
C. Motors
D. None of the above

Q. 10: Which of the following methods is not used to estimate infiltration?
A. ACPH
B. Effective leakage Area
C. Outside Air ventilation
D. None of the above

Section – B

04*04 = 16 Marks

Note: Each question carries 04 mark.

Q. 1: What is zoning and why is it important?

Q. 2: Explain ventilation gains.

Q.3: What are appliance internal loads? What effect does CLF has on them?

Q. 4: What is U-factor and how is it related to R value of a material?

Section – C

06*04 = 24 Marks

Note: Each question carries 06 mark.

Q. 1: A window with a surface area of 25 m2 is heated by the sun to a temperature of 45°C at a time when the outdoor air is at 33°C, and a light breeze results in a convection coefficient of 42 W/(m2·K). What is the heat lost by the surface due to convection?

Q. 2: Explain the difference between wind and stack effects.

Q. 3: How do you calculate conduction heat gain/losses?

Q. 4: A window with a surface area of 25 m2 is heated by the sun to a temperature of 55°C at a time when the outdoor air is at 23°C, and a light breeze results in a convection coefficient of 42 W/(m2·K). What is the heat lost by the surface due to convection?

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of RAC Skills

Session: 2021-22 (Winter Semester)

B. Voc. 5th Semester

End Sem. Examination

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

Section – B

04X04 = 16 Marks

1. Zoned air conditioning is achieved when a ducted air con system is divided into areas (or "zones") which can be cooled or heated independently. It consists of a series of ducts in your roof, which channel air to the various zones in a home.

2. Ventilation is the process of mechanically moving air through building through an air handler system to the rooms. By having ductwork leakages, it can cause losses and efficiency by losing air that was condition into areas that it doesn't matter.

3. Ventilation is the process of mechanically moving air through building through an air handler system to the rooms. By having ductwork leakages, it can cause losses and efficiency by losing air that was condition into areas that it doesn't matter.

4. Ventilation is the process of mechanically moving air through building through an air handler system to the rooms. By having ductwork leakages, it can cause losses and efficiency by losing air that was condition into areas that it doesn't matter.

Section – C

06X04 = 24 Marks

1. $5.68 \times 10^{-8} \quad (280^4 - 272^4) = 6146560000-5473632256$

   $=672927744$

   6.7×10^8

2. 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. 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

3.

$$Q = A\left(\frac{k}{\Delta x}\right)(\Delta T)$$

where:

Q = rate of heat transfer through the material (Btu/hr)
k = thermal conductivity of the material (Btu/°F • hr • ft)
Δx = thickness of the material in the direction of heat flow (ft)
ΔT = temperature difference across the material (°F)
A = area heat flows across (ft^2)

4. The indicated zone type is B. The total installed wattage is 6 (bulbs)·34W/ bulb)= 204 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, 8 h on, 6 h after being turned on is 0.95. The values at 4 pm and 6 pm are 0.96 and 0.12, respectively.

Registration No.: .....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Refrigeration & Air Conditioning Skills

Session: 2021-22 (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-A

Instruction:

All questions are compulsory.

Scientific calculator is allowed

Section A is objective type.

Section B is short answer type.

Section C is long answer type.

Section – A

10X01 = 10 Marks

1 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

2. Which of the following are Milk Processing Operations?
   a. Clarification
   b. Pasteurization
   c. Homogenization
   d. All of the mentioned

3. 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

4. Psychrometry is the study of-
   a. moist air
   b. stasis point
   c. metrics in Canada
   d. none of the above

5. The length of storage of fruits and vegetables is a function of _____
   a. Resistance to attack by microorganisms
   b. Composition
   c. Gases in the environment
   d. All of the mentioned

6. Fats in frozen fish tissue tend to become rancid quicker than fats in frozen animal tissues.
   a. True
   b. FalseProvide customer satisfaction
   c. Improve quality of a product
   d. None of the above

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7. Pork has a higher shelf life than beef.
   a. True
   b. False
   c. Not Comparable
   d. Services
8. 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

9. Evaporation, desiccation and dehydration all mean the same thing.
   a. True
   b. False
   c. Both
   d. None of the above
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. Explain postharvest physiology of fruits and vegetables through neat sketch.
2. Write down the importance of food preservation.
3. How multistage compressors are useful than single stage compressors?
4. Write a short note on cold store doors.

Section – C

04X06 = 24 Marks

1. Write down the advantages of forced draft cooling towers.
2. A cold room of size 20mx15mx8m. Outside and inside temperatures are 30°C and 6°C. Overall heat transfer coefficient is 0.37 w/sqm°C. 5000 Kgs of apple are to be stored and 4 people work daily for four hours inside the cold storage and each person generates heat of 270 W. find out the sum of occupancy and product load. (use specific heat of apple 2.2 kJ $kg^{-1}\,°C^{-1}$).
3. What are the expansion devices? Explain the different types of it.
4. A cold room with dimension 10mX8mX6m. Over all U Value - 0.35 w/sqm°C. Outside Design Conditions: 35°C DBT, 20°C WBT (Enthalpy = 66 KJ/Kg), Inside Design Conditions: 5°, 75%RH. Daily 2000Kg/24 hrs coming at 35°C with specific heat 3.0 KJ/Kg°C and 4 APCH. Each cubic meter of new air provides 2KJ/cm°C. Consider 4 fan motors rated 250 w working for 10 hours daily. Find out total load.

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School of Refrigeration & Air Conditioning Skills

Session: 2021-22 (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 -A

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. Which of the following is true about fruits and vegetable processing?
   d. All of the mentioned

2. Which of the following are Milk Processing Operations?
   d. All of the mentioned

3. The horizontal line in psychrometric chart joining the change of state of air represents
   b. sensible cooling or heating

4. Psychrometry is the study of-
   a. moist air

5. The length of storage of fruits and vegetables is a function of _____
   d. All of the mentioned

6. Fats in frozen fish tissue tend to become rancid quicker than fats in frozen animal tissues.
   a. True

7. Pork has a higher shelf life than beef.
   b. False

8. Which of the following nutrients are lost in all steps of food engineering (including packaging and freezing)?
   b. Vitamins

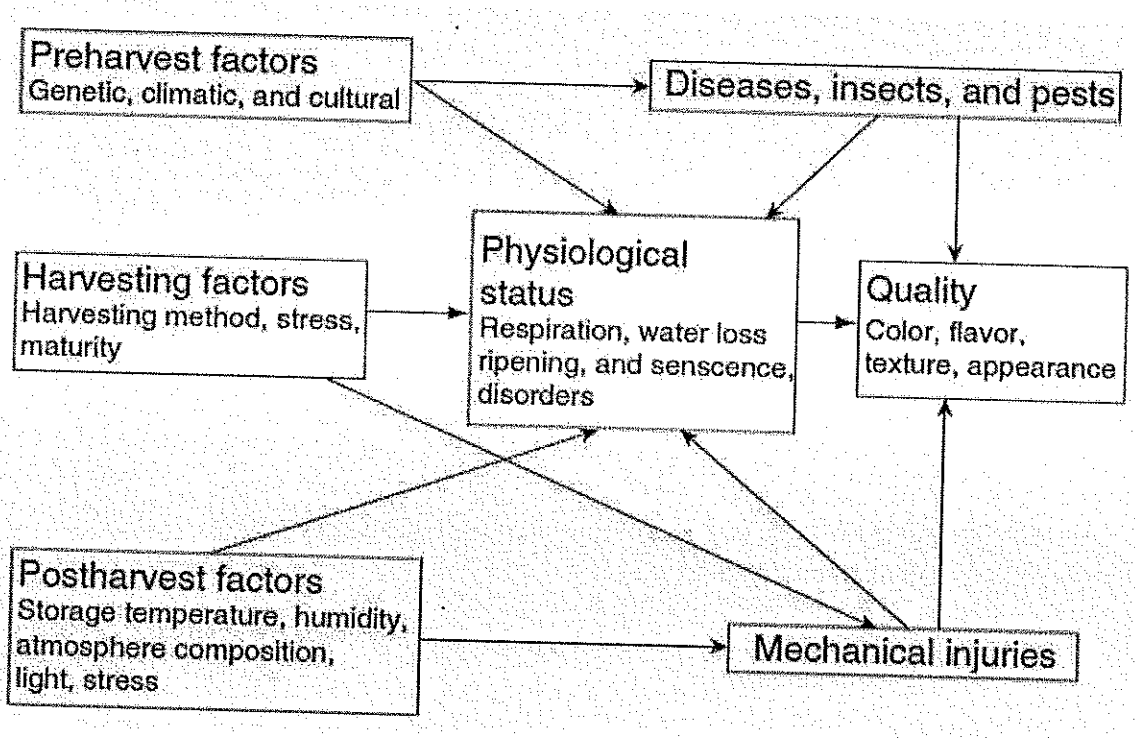
9. Evaporation, desiccation and dehydration all mean the same thing.
   b. False

10. At 100% relative humidity, the wet bulb temperature is-
    c. equal to the dew point temperature

Section – B

04X04 = 16 Marks

1. Explain postharvest physiology of fruits and vegetables through neat sketch.



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. 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. Write a short note on cold store doors.

When choosing a door system the following should be considered

- Is the track designed to give a good positive sealing action without undue wear to the sealing gaskets and will it be strong enough for its usage?
- Does it allow the door to be adjusted easily and accurately in all directions?
- Are the runners durable and will they allow free running?
- Will the handles, both inside and outside, allow easy opening of the door?
- Can the system be locked and does it have an emergency release facility?
- Do the moving parts require little maintenance and can they be easily replaced in the event of damage?

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. A cold room of size 20mx15mx8m. Outside and inside temperatures are 30°C and 6°C. Overall heat transfer coefficient is 0.37 w/sqm°C. 5000 Kgs of apple are to be stored and 4 people work daily for four hours inside the cold storage and each person generates heat of 270 W. find out the sum of occupancy and product load. (use specific heat of apple 2.2 kJ kg^{-1} $°C^{-1}$).

Answer: **Transmission Load**

Q = U*A*(Outside Temperature – Inside Temperature)*24/1000

= 0.37*1160(30-6) *24/1000

total transmission load = 247 Kwh/Day

Product Load

Q = M*C_P*(Outside Temperature – Inside Temperature)/(3600)

= 73.3 Kwh/Day

Occupancy Load

Q = persons* Time* Heat/1000

= 4.32 Kwh/Day

Total Load = 324.62 Kwh/Day ans.

3. 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

4. A cold room with dimension 10mX8mX6m. Over all U Value - 0.35 w/sqm°C. Outside Design Conditions: 35°C DBT, 20°C WBT (Enthalpy = 66 KJ/Kg), Inside Design Conditions: 5°, 75%RH. Daily 2000Kg/24 hrs coming at 35°C with specific heat 3.0 KJ/Kg°C and 4 APCH. Each cubic meter of new air provides 2KJ/cm°C. Consider 4 fan motors rated 250 w working for 10 hours daily. Find out total load.

Answer: **Transmission Load**
Q = U*A*(Outside Temperature – Inside Temperature) *24/1000
= 0.35*376(35-5) *24/1000
total transmission load = 94.7 Kwh/Day

Product Load

Q = M*C_P*(Outside Temperature – Inside Temperature)/(3600)

= 50 Kwh/Day

Equipment Load

Q = Fan* Time* Watt/1000

= 10 Kwh/Day

Infiltration Load

Q = Changes* Energy* Volume*(Outside Temperature – Inside Temperature)/3600

= 32 Kwh/Day

Total Load = 186.7 Kwh/Day ans.

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BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Refrigeration & Air Conditioning Skills

Session: 2021-22 (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.

Scientific calculator is allowed

Section – A

10X01 = 10 Marks

1. If the evaporator temperature of a plant is lowered, keeping the condenser temperature constant, the h. p. of compressor required will be;
    a) Same
    b) More
    c) Less
    d) Depends upon rating
2. Mechanical benders are used for;
    a) Bending the copper tube
    b) Cutting the copper tube
    c) Joining the copper tube
    d) Pinching the copper tube
3. Reaming tool is used for;
    a) Cleaning inner surface of copper tube
    b) Cleaning outer surface of copper tube
    c) Both A and B
    d) None
4. Pinching plier is used for;
    a) Enlarging the diameter of copper tube
    b) Reducing the diameter of copper tube
    c) Cutting the copper tube
    d) Bending the copper tube
5. Which is a threaded joint?
    a) Flaring joint
    b) Swaging joint
    c) Both A and B
    d) None
6. Vacuuming process is for;
    a) Removing the moisture from inside
    b) Removing the dirt from inside

c) Both A and B
d) None

7. Nitrogen is used during the process of;
   a) Leak testing
   b) Brazing
   c) Both A and B
   d) None
8. Vacuuming process is applied;
   a) Before Nitrogen holding in the line
   b) After Nitrogen holding in the line
   c) Before leak testing
   d) None
9. In case of additional piping length, the standard refrigerant requirement is;
   a) 20 gm/m
   b) 30 gm/m
   c) 40 gm/m
   d) 50 gm/m
10. Flaring joint is a type of;
   a) Permanent Joint
   b) Temporary Joint
   c) Both A and B
   d) None

Section – B

04X04 = 16 Marks

11. Write down the different types of cold storages.
12. Write down the importance of food preservation.
13. Write a short note on raking system.
14. Explain the food preservation methods.

Section – C

04X06 = 24 Marks

15. Write down the type of heat exchangers for rejecting heat in detail.
16. Following data given for a cold room:
    Store Dimensions: 15mX10mX5m. Over all U Value - 0.35 w/sqm°C. Outside Design Conditions: 35°C DBT, 20°C WBT (Enthalpy = 66 KJ/Kg), Inside Design Conditions: 4°C+/- 1°C, 75%RH (Enthalpy = 13 KJ/Kg). Product: Daily 2500Kg/24 hrs coming at 35°C with specific heat 3.0 KJ/Kg°C and 2APCH. Consider 4 men working for 4 hours daily. Each cubic meter of new air provides 2KJ/cm°C. Find out total load.
17. A cold room of size 20mx15mx8m. Outside and inside temperatures are 30°C and 6°C. Overall heat transfer coefficient is 0.37 w/sqm°C. 5000 Kgs of apple are to be stored and 4 people work daily for four hours inside the cold storage and each person generates heat of 270 W. find out the sum of occupancy and product load. (use specific heat of apple 2.2 kJ $kg^{-1}°C^{-1}$).
18. What are the climacteric and non-climacteric type fruits?

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BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Refrigeration & Air Conditioning Skills

Session: 2021-22 (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. If the evaporator temperature of a plant is lowered, keeping the condenser temperature constant, the h. p. of compressor required will be;

   b) More

2. Mechanical benders are used for;
   a) Bending the copper tube
3. Reaming tool is used for;
   a) Cleaning inner surface of copper tube
4. Pinching plier is used for;

   b) Reducing the diameter of copper tube

5. Which is a threaded joint?
   a) Flaring joint
6. Vacuuming process is for;
   a) Removing the moisture from inside
7. Nitrogen is used during the process of;

   c) Both A and B

8. Vacuuming process is applied;

   b) After Nitrogen holding in the line

9. In case of additional piping length, the standard refrigerant requirement is;
   a) 20 gm/m
10. Flaring joint is a type of;

    b) Temporary Joint

Section – B

04X04 = 16 Marks

11. Write down the different types of cold storages.

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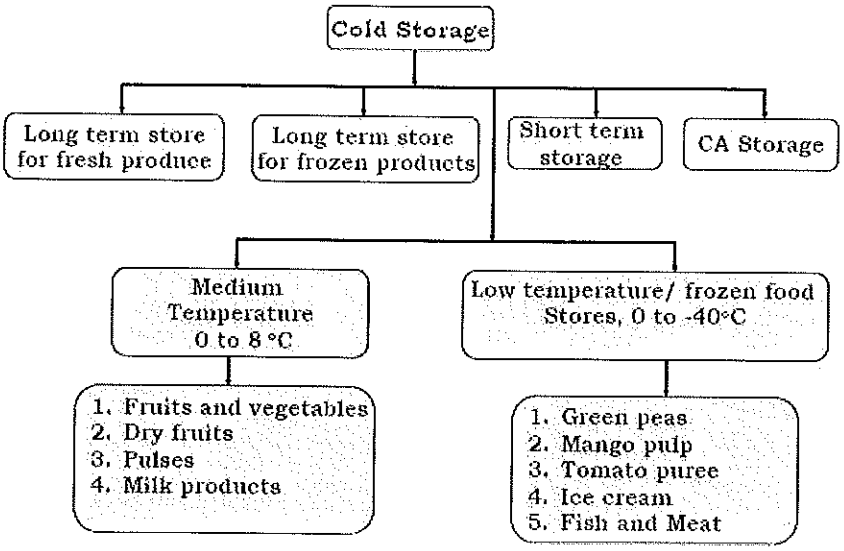

12. Write down the importance of food preservation.

    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).

13. 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.

14. Explain the food preservation methods.

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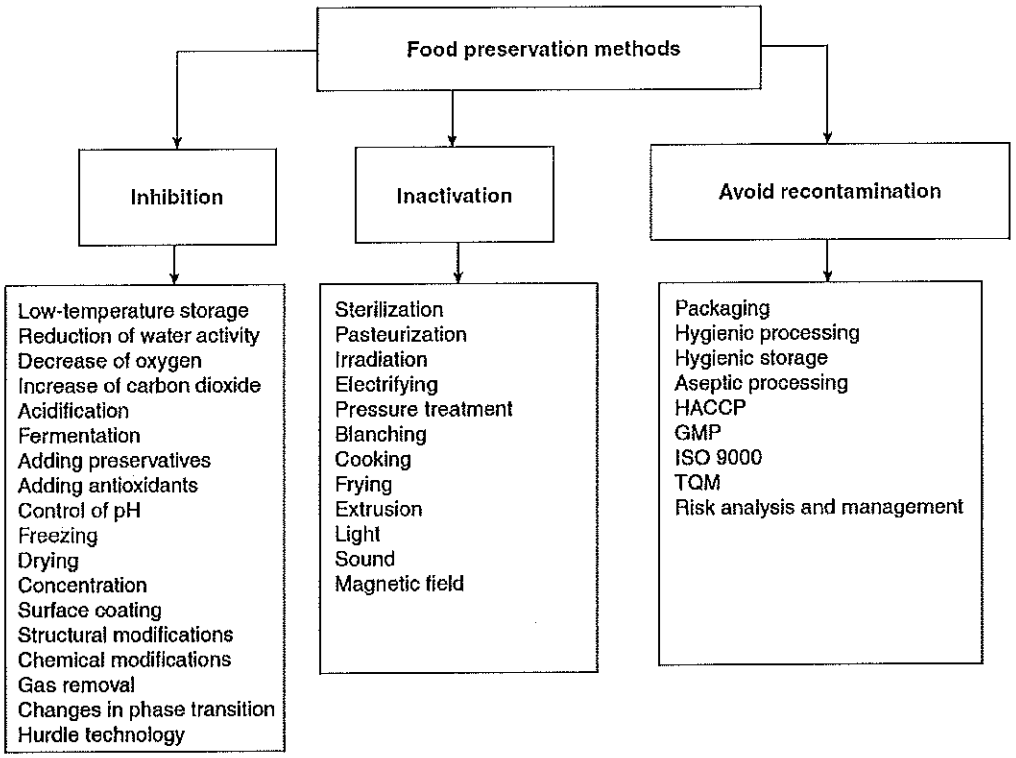

Section – C

04X06 = 24 Marks

15. Write down the type of heat exchangers for rejecting heat in detail.

Answer:

Air-Cooled Condensers

In air-cooled condensers, heat is removed by the air using either natural or forced circulation. The condensers are made of steel, copper, or aluminium tubing provided with fins to improve airside heat transfer. The refrigerant flows inside the tubes and the air outside.

Water-Cooled Condensers

Water-cooled condensers can be of three types: shell and tube, shell and coil, and double tube. The shell and tube type, in which water flows inside tubes and the refrigerant passes outside the tubes and condenses in the shell, is the most commonly used condenser.

The shell and coil condenser consists of an electrically welded closed shell that contains a water coil, sometimes of finned tubing.

In the double tube arrangement, the refrigerant condenses in the outer tube and water flows through the inner tube in the opposite direction.

Evaporative condensers

Evaporative condensers are commonly used on large ammonia plants because they are found to be lower in cost. Such condensers require a large amount of the refrigerant charge due to the longer length of the refrigerant piping.

16. Following data given for a cold room:
Store Dimensions: 15mX10mX5m. Over all U Value - 0.35 w/sqm°C. Outside Design Conditions: 35°C DBT, 20°C WBT (Enthalpy = 66 KJ/Kg), Inside Design Conditions: 4°C+/-

1 °C, 75%RH (Enthalpy = 13 KJ/Kg). Product: Daily 2500Kg/24 hrs coming at 35°C with specific heat 3.0 KJ/Kg°C and 2APCH. Consider 4 men working for 4 hours daily. Each cubic meter of new air provides 2KJ/cm°C. Find out total load.

Answer: **Transmission Load**
Q = U*A*(Outside Temperature – Inside Temperature) *24/1000
= 0.35*550(35-4) *24/1000
total transmission load = 143 Kwh/Day

Product Load

Q = M*C_P*(Outside Temperature – Inside Temperature)/(3600)

= 64.5 Kwh/Day

Occupancy Load

Q = persons* Time* Heat/1000

= 4 Kwh/Day

Infiltration Load

Q = Changes* Energy* Volume*(Outside Temperature – Inside Temperature)/3600

= 25.8 Kwh/Day

Total Load = 237.3 Kwh/Day ans.

17. A cold room of size 20mx15mx8m. Outside and inside temperatures are 30°C and 6°C. Overall heat transfer coefficient is 0.37 w/sqm°C. 5000 Kgs of apple are to be stored and 4 people work daily for four hours inside the cold storage and each person generates heat of 270 W. find out the sum of occupancy and product load. (use specific heat of apple 2.2 kJ $kg^{-1}°C^{-1}$).
Answer: **Transmission Load**
Q = U*A*(Outside Temperature – Inside Temperature) *24/1000
= 0.37*1160(30-6) *24/1000
total transmission load = 247 Kwh/Day

Product Load

Q = M*C_P*(Outside Temperature – Inside Temperature)/(3600)

= 73.3 Kwh/Day

Occupancy Load

Q = persons* Time* Heat/1000

= 4.32 Kwh/Day

Total Load = 324.62 Kwh/Day ans.

18. What are the climacteric and non-climacteric type fruits?

Climacteric fruits

Those in which ripening is associated with a distinct increase in respiration and ethylene production, the respiration rate rising up to the climacteric peak and then declining. Such an increase can occur either while the fruit is attached to or separated from the plant. A further distinguishing feature is that treatment of climacteric fruits with ethylene or propylene stimulates both respiration and autocatalytic ethylene production. Low temperatures greatly reduce the magnitude of the climacteric. The climacteric generally coincides with changes associated with ripening such as colour changes, softening, increased tissue permeability, and the development of characteristic aromas. Typical climacteric fruits include apples, pears, peaches, nectarines, bananas, mangoes, plums, tomatoes, and avocadoes.

Non-Climacteric fruits

In non climacteric fruits, ripening is protracted and the attainment of the ripe state is not associated with a marked increase in respiration or ethylene production. Treatment of non climacteric fruits with ethylene stimulates respiration only; there is no increase in autocatalytic ethylene production. Fruits such as citrus, strawberries, and pineapples are non climacteric.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Refrigeration and Air-conditioning Skills

Session: 2021-22 (Winter Semester)

B. Voc. Program, V Semester,

End-Sem. Examination

Course Code: HVA1503 **Time: 2 Hours**

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

SET B

Section – A

10*01 = 10 Marks

Note: Each question carries 01 mark.

Q. 1: For obtaining high COP, the pressure range of compressor should be?

A. High B. Low
C. Optimum D. Any value

Q. 2: Which valve is used in controlling blending of water in chiller configurations?

A. Relief Valve B. Safety Valve
C. Solenoid valve D. One way Valve

Q.3: Which material is used to making air ducts in Chiller plants?

A. Cast iron B. Glass wool
C. Galvanized Iron D. None of the above

Q. 4: The COP of a vapor compression plant in comparison to vapour absorption plant is?

A. More B. Less
C. Same D. None of the above

Q.5: What is meant by velocity pressure?

A. Moving air pressure B. Ambient air pressure
C. Air diffusing pressure D. Still air pressure in duct

Q. 6: Which refrigerant spreads pungent odour if it leaks?

A. NH3 B. CO2
C. R32 D. H2O

Q. 7: Which of the following compressor type is used mostly in modern chillers?

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

Q. 8: Which of the following compressors is used for small scale chillers?

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

Q. 9: Which of the following is used in a air cooled chiller?

A. R-32
B. R-134a
C. R-123
D. R-717A

Q. 10: R-507 is a :

A. Azeotropic blend
B. zeotropic
C. Inorganic blend
D. None of the above

Section – B

04*04 = 16 Marks

Note: Each question carries 04 mark.

Q. 1: What is a scroll compressor?

Q. 2: Explain the difference between organic and inorganic refrigerants.

Q. 3: What are the differences between single pump and multi pump chiller configurations?

Q. 4: What is the difference between hermetic type and open drive compressors?

Section – C

04*06 = 24 Marks

Note: Each question carries 04 mark.

Q. 1: Why are the differences between Cooling tower and air cooled condensers? Write their advantage and disadvantages as well.

Q. 2: What is the best chiller configuration and why?

Q. 3: Write a brief note on screw compressors.

Q.4: What are the different type of schedules in chiller piping?

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Refrigeration and Air-conditioning Skills

Session: 2021-22 (Winter Semester)

B. Voc. Program, V Semester,

End-Sem. Examination

Course Code: HVA1503 **Time: 2 Hours**

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

SET A

Section – A

10*01 = 10 Marks

Note: Each question carries 01 mark.

Q. 1: Which of the following is not a fully saturated organic refrigerant?

A. R-11 B. R-134a
C. R32 D. R-764

Q. 2: What is the general COP of a Electric drive air-cooled scroll?

A. 1.1 B. 3.3
C. 5.8 D. 7

Q.3: Which is the desirable physical property of refrigerant?

A. Toxic B. Explosive
C. Low Boiling point D. High freezing point

Q. 4: Which secondary refrigerant is used for human comfort in chiller plant AC?

A. Brine B. Ammonia
C. Water D. Ethylene glycol

Q.5: What is meant by static pressure?

A. Moving air pressure B. Ambient air pressure
C. Air diffusing pressure D. Still air pressure in duct

Q. 6: Which of the following is not a natural refrigerant?

A. NH3 B. CO2
C. R32 D. H2O

Q. 7: Which of the following compressor type is nonexistent in modern chillers?

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

Q. 8: Which of the following compressors is used for large scale chillers?

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

Q. 9: Which of the following refrigerant is used in cold storages?

A. R-32
B. R-134a
C. R-123
D. R-717A

Q. 10: R-600a is a replacement for

A. NH_3
B. CO_2
C. R-12
D. R-134a

Section – B

04*04 = 16 Marks

Note: Each question carries 04 mark.

Q. 1: What is a screw compressor?

Q. 2: Explain the difference between zeotropic and azeotropic refrigerants.

Q. 3: What are the differences between water cooled and air-cooled chillers?

Q. 4: What is the difference between hermetic type and open drive compressors?

Section – C

04*06 = 24 Marks

Note: Each question carries 04 mark.

Q. 1: Why are the differences between single and multi-stage compressors? Write their advantage and disadvantages as well.

Q. 2: What are the different types of multi chiller configurations?

Q. 3: Write a brief note on chilled oil return system.

Q.4: What are the different type of chiller efficiency ratings?

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Refrigeration and Air-conditioning Skills

Session: 2021-22 (Winter Semester)

B. Voc. Program, V Semester,

End-Sem. Examination

Time: 2 Hours

Course Code: HVA1503

Max. Marks: 50

Course Name: Chilled water supply system design

SET A

Section – A

10*01 = 10 Marks

Note: Each question carries 01 mark.

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

Section – B

04*04 = 16 Marks

Note: Each question carries 04 mark.

Q. 1: Screw compressors generally come in two basic designs: dry screw compressors or wet/ oil-flooded screw compressors. Both compressor types consist of rotors that are closely mated. Dry screw compressors do not have any oil in-between the screws. A dry screw compressor consists of two rotors, a closely mating pair that are installed in a tight clearance cylindrical bore.

Q. 2: An azeotropic mixture is a mixture of substances that has the same concentration of vapour and fluid phases. It is basically a mixture that contains two or more liquids. A zeotropic mixture basically has constant or the same boiling points and the mixtures' vapour will also have the same composition as the liquid.

Q. 3: Water-cooled chillers usually don't need replacement as often as air-cooled chillers do. They aren't exposed to outdoor elements such as rain, snow, ice, and heat, which makes them less vulnerable. While air-cooled chillers have ducts and vents that create noise, water-cooled chillers operate quietly

Q. 4: With **open-drive chillers**, the compressor and motor are separated, with their shafts being connected via a flexible coupling.

- The **advantage** of this concept is that in the event of motor failure, it does not contaminate the refrigerant and the motor can be readily replaced
- The alternative, and by far more popular design, contains both the motor and the compressor within a common, **sealed enclosure.**
- In this configuration, the compressor is rigidly connected directly to the motor shaft, **eliminating the need for a flexible coupling.**

Section – C

04*06 = 24 Marks

Note: Each question carries 04 mark.

Q. 1: In a single-stage compressor only one cylinder for the compression process, While in a multi-stage compressor more than one cylinder is connected in series. In a single-stage compressor used in low-pressure ratio application, while in a multi-stage compressor achieve a very high-pressure ratio.

Q. 2: 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.

- Load ratios other than 50/50 are possible, but this is by far the most common condition because of control problems with chillers at very small temperature differences.
- 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.

Q. 3: **An oil pump can reduce the minimum lift to about 5.5°C, resulting in improved chiller efficiencies at low condenser water temperatures, particularly with variable-speed chillers.**

- With oil-free chillers, the minimum lift need only be a few degrees and, in some chillers, may be zero or even negative.

Chillers may have an oil pump, but most require a minimum DP between the condenser and evaporator to be maintained to ensure proper refrigerant flow.

Q.4: The efficiency of water chillers is characterized by the coefficient of performance (COP).

- The **COP is the ratio** of the rate of heat removal to the rate of energy input in consistent units for a complete refrigerating system or some specific portion of that system under designated operating conditions.
- **ANSI/ ASHRAE/IES Standard 90.1-2016 and California's Title 24** energy standards (CBSC 2016) provide minimum energy efficiency standards for water chillers.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Refrigeration and Air-conditioning Skills

Session: 2021-22 (Winter Semester)

B. Voc. Program, V Semester,

End-Sem. Examination

Course Code: HVA1503

Time: 2 Hours

Course Name: Chilled water supply system design

Max. Marks: 50

SET B

Section – A

10*01 = 10 Marks

Note: Each question carries 01 mark.

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

Q. 10:A

Section – B

04*04 = 16 Marks

Note: Each question carries 04 mark.

Q. 1: Scroll compressors run quieter and smoother than reciprocating compressors because they only have two moving parts: a fixed and orbital scroll. Fewer parts make the scroll compressor energy efficient, highly reliable, and less prone to mechanical failure.

Q. 2: The inorganic refrigerants were exclusively used before the introduction of hydrocarbon refrigerants these refrigerants are still in use due to their inherent thermodynamic and physical properties.

Q. 3: The one-pump parallel chiller configuration and the overall system performance and temperature conditions are summarized in Table.

- 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.

Q. 4: The alternative, and by far more popular design, contains both the motor and the compressor within a common, **sealed enclosure.**

- In this configuration, the compressor is rigidly connected directly to the motor shaft, **eliminating the need for a flexible coupling.**
- With **open-drive chillers,** the compressor and motor are separated, with their shafts being connected via a flexible coupling.
- The **advantage** of this concept is that in the event of motor failure, it does not contaminate the refrigerant and the motor can be readily replaced.

Section – C

04*06 = 24 Marks

Note: Each question carries 04 mark.

Q. 1: Air cooled condensers are more flexible than water cooled condensers. Air cooled condensers required less maintenance than water cooled condensers. It does not produce more cooling than water cooled condensers. Installation cost is comparatively less than water cooled condensers.

Q. 2: 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.** To attempt to eliminate the blended supply water problem with the one-pump configuration, some designers have used chiller flow isolation valves, as shown in Figure.

- With this configuration, **flow through the nonoperating chiller is closed off** when the chiller is not in operation.

Q. 3: Screw compressors are increasingly used in refrigeration and natural gas industries due to their high efficiency and profound reliability compared to the other types of compressors.

Q.4: 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.