BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Refrigeration and Air-conditioning Skills

Session: 2021-22 (Winter Semester)

B. Voc. Program, III Semester,

End-Sem. Examination

Course Code: RAC1301 **Time: 2 Hour**

Course Name: Psychrometry & System Design **Max. Marks: 50**

SET A

Section – A

10*01 = 10 Marks

Note: Each question carries 01 mark.

Q. 1: For large commercial installations, NH 3 is used as a refrigerant because of its:
A. Large latent heat
B. Moderate working pressure
C. Relatively cheaper price
D. All of the above

Q. 2: The refrigerant affects _____.
A. COP of the system
B. Environment
C. Heat transfer
D. All of the above

Q. 3: The ozone friendly refrigerant R-134a contains:
A. One Chlorine atom
B. Four Chlorine atom
C. Two Chlorine atom
D. No Chlorine atom

Q. 4: The ODP value of HFC refrigerant is:
A. Higher than CFC refrigerant
B. Same as CFC refrigerant
C. Lower than CFC refrigerant
D. None of the above

Q. 5: Which of the following is an azeotrope refrigerant?
A. R-11
B. R-114
C. R-407
D. R-502

Q. 6: Solar gain depends on :-
A. Latitude of the location
B. Orientation of the building
C. U-factor of the material
D. All of the above

Q. 7: What is the nominal thermal comfort temperature for humans.
A. 75 °F
B. 85 °F
C. 65 °F
D. None of the above

Q. 8: The actual condition of atmospheric air is-
A. Dry air
B. moist air
C. both a & b
D. None of the ab above

Q. 9: Which of the following is not an unit of humidity ratio?
A.gr/lb
B. kg/kg
C. g/kg
D. None of the above

Q.10 In any cooling and dehumidification process which type of heat is being rejected?
A. Sensible heat
B. Latent heat
C. Both a & b
D. None of the above

Section – B

04*04 = 16 Marks

Note: Each question carries 04 mark.

Q. 1: Write down the definition of the following:

A. DBT B. Specific Volume C. Specific Humidity D. Relative Humidity

Q. 2: What is sensible and latent heat??

Q. 3: What do you mean by miscibility of oil in refrigerant?

Q.4 : Write down the definition of psychrometry.

Section – C

04*06 = 24 Marks

Note: Each question carries 06 mark.

Q. 1: Define different properties of air.

Q. 2: Discuss the cooling and humidification process in detail.

Q. 3: What is VRV and how is it different from a split AC?

Q. 4: What are some properties of refrigerants?

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Course Name: Psychrometry & System Design **Max. Marks: 50**

SET A

Section – A

10*01 = 10 Marks

Note: Each question carries 01 mark.

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

Section – B

04*04 = 16 Marks

Note: Each question carries 04 mark.

Q. 1: Dry-bulb temperature - Tdb, can be measured using a normal thermometer freely exposed to the air but shielded from radiation and moisture. Dry-bulb temperature - Tdb, can be measured using a normal thermometer freely exposed to the air but shielded from radiation and moisture. Relative humidity (RH) refers to the moisture content (i.e., water vapor) of the atmosphere, expressed as a percentage of the amount of moisture that can be retained by the atmosphere (moisture-holding capacity) at a given temperature and pressure without condensation.

Q. 2: Sensible heat causes change in temperature due to contact with colder or warmer air of surfaces. Latent heat is the energy absorbed by or released from a substance during a phase change from a gas to a liquid or a solid or vice versa.

Q. 3: Oil reduces friction on metal parts, reducing wear on the compressor and prolongs the life of the system. Refrigerant oil is a special high-temperature formulation designed for use in cooling systems, so it is important to use the recommended lubricant for the equipment.

Q.4 : Psychrometry is the study of the properties of mixtures of air and water vapour. Atmospheric air is a mixture of many gases plus water vapour and a number of pollutants.

Section – C

04*06 = 24 Marks

Note: Each question carries 06 mark.

Q. 1: Psychrometrics is the name given to the study of the air and water vapor mixture. Seven properties of atmospheric air are shown on the psychrometric chart. These properties are: dry bulb temperature, wet bulb temperature, dew point, humidity ratio, relative humidity, specific volume, and specific enthalpy.

Q. 2: The process in which the air is cooled sensibly and at the same time the moisture is removed from it is called as cooling and dehumidification process. Cooling and dehumidification process is obtained when the air at the given dry bulb and dew point (DP) temperature is cooled below the dew point temperature.

Q. 3: VRV stands for variable refrigerant Volume, which goes a surprisingly long way toward describing how this system uses refrigerant for both air conditioning and heating. In a nutshell, VRF is a ductless, large-scale system for HVAC that performs at a high capacity.

Unlike split AC equipment, VRF allows multiple indoor units to run on the same system, which is designed differently depending on the application. VRF systems are considered either a heat pump system or a heat recovery system, which can heat and cool simultaneously.

Q. 4: Physical Properties of Refrigerants

- Low Freezing Point. Refrigerants should have low freezing point than the normal operating conditions. ...
- Low Condensing Pressure. ...
- High Evaporator Pressure. ...
- High Critical Pressure. ...
- High Vapor Density. ...
- High Dielectric strength. ...
- High Latent Heat of Vaporization. ...
- High Heat Transfer Coefficient.

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Course Code: RAC1301 **Time: 2 Hour**

Course Name: Psychrometry & System Design **Max. Marks: 50**

SET -B

Section – A

10*01 = 10 Marks

Note: Each question carries 01 mark.

Q. 1: Which of the following is not an internal load?
A. Infiltration B. People
C. Appliances D. None of the above

Q. 2: R-410A is which type of refrigerant blend?
A. Zeotropic B. Azeotropic
C. Inorganic D. None of the above

Q. 3: Solar gain depends on :-
A. Latitude of the location B. Orientation of the building
C. U-factor of the material D. All of the above

Q. 4: What is the nominal thermal comfort temperature for humans.
A. 75 °F B. 85 °F
C. 65 °F D. None of the above

Q. 5: Which of the following is not an unit of humidity ratio?
A.gr/lb B. kg/kg
C. g/kg D. None of the above

Q. 6: Specific humidity is measured in-
A. g/ Kg of dry air B. kg/m 3
C. Both a & b D. None of the above

Q.7: In any cooling and dehumidification process which type of heat is being rejected?
A. Sensible heat B. Latent heat
C. Both a & b D. None of the above

Q.8: specific enthalpy is measured in-
A. KJ/Kg B. KJ/Kg-K
C. KJ D. None

Q.9: The comfort air conditioning system represents-
A. Indoor air quality B. Air motion
C. Both a and b D. None of the above

Q.10: The rate of body heat loss is affected by-
A. Air Humidity B. Air motion
C. Both a and b D. None of the above

Section – B

04*04 = 16 Marks

Note: Each question carries 04 mark.

Q. 1: What is specific heat and its impact on a refrigerant?

Q. 2: What do you mean by latent heat of vaporization?

Q. 3: What do you mean by miscibility of oil in refrigerant?

Q.4: What is the importance of inverter compressor in VRV?

Section – C

04*06 = 24 Marks

Note: Each question carries 04 mark.

Q. 1: What are the different categories of refrigerant?

Q. 2: Explain flammability and toxicity?

Q. 3: Explain the relation between pressure and temperature for a refrigerant and its role in determining freezing and boiling point of a refrigerant.

Q.4: What is the function of VRV and its diversity factor?

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Course Code: RAC1301 **Time: 2 Hour**

Course Name: Psychrometry & System Design **Max. Marks: 50**

SET -B

Section – A

10*01 = 10 Marks

Note: Each question carries 01 mark.

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

Section – B

04*04 = 16 Marks

Note: Each question carries 04 mark.

Q. 1: specific heat, the quantity of heat required to raise the temperature of one gram of a substance by one Celsius degree. The units of specific heat are usually calories or joules per gram per Celsius degree

Q. 2: Latent heat of vaporization is a physical property of a substance. It is defined as the heat required to change one mole of liquid at its boiling point under standard atmospheric pressure. It is expressed as kg/mol or kJ/kg.

Q. 3: Oil reduces friction on metal parts, reducing wear on the compressor and prolongs the life of the system. Refrigerant oil is a special high-temperature formulation designed for use in cooling systems, so it is important to use the recommended lubricant for the equipment.

Q.4: An inverter compressor is a gas compressor that is operated with an inverter. In the hermetic type, it can either be a scroll or reciprocating compressor. This type of compressor uses a drive to control the compressor motor speed to modulate cooling capacity.

Section – C

04*06 = 24 Marks

Note: Each question carries 04 mark.

Q. 1: CFC = ChloroFluoroCarbons. ...

- HCFC = HydroChloroFluoroCarbons. ...
- HFC = HydroFluoroCarbons. ...
- FC = FluoroCarbons. ...
- HC = HydroCarbons. ...
- NH3 = Ammonia. ...
- CO2 = Carbon Dioxide

Q. 2: The most common toxic refrigerant is ammonia, and you would generally only find it in old appliances or large industrial applications. Propane (R290) is a flammable refrigerant and is becoming quite popular in small self-contained refrigeration units like vending machines and reach-in coolers.

Q. 3: The pressure of a given amount of gas is directly proportional to its absolute temperature, provided that the volume does not change (Amontons's law). The volume of a given gas sample is directly proportional to its absolute temperature at constant pressure (Charles's law).

Q.4: VRV systems obtain their high efficiency through the use of inverter compressors. Inverter systems allow the compressor to ramp up or down based on the needs within each space. A non-inverter system ramps up the compressor at full capacity all the time. Essentially it's either on or off. With inverter systems operating at lower speeds and capacity, the efficiency gains can be substantial.

This versatility means VRV products are customizable to meet the specifications of virtually any project, making them particularly appealing for commercial spaces and facility managers.

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School of Refrigeration & Air conditioning Skills

Session: 2021-22 (Winter Semester)

B. Voc. Program, III-Semester,

End-Sem. Examination

Set-A

Time: 2 Hours

Max. Marks: 50

Course Code: RAC1302

Course Name: Central air-conditioning system practices

Instruction: Read the question carefully, do attempt all

Section – A 10*01 = 10 Marks

Q1) Which lines in psychrometry shows dry bulb
a. Horizontal lines
b. vertical lines
c. Lines on curve left
d. enthalpy lines

Q2) humidity ratio is defined by
a. Grains/pound of dry air
b. kg/kg of dry air
c. gravitation/kg of dew point air
d. Number of air cumulated per hour

Q3) Chart of psychrometry is study of _____ Air?
a. Moist air
b. dry air
c. moisture at defined temperatures
d. pressure vs Enthalpy

Q4) Ratio of maximum dimension to minimum dimension is known as?
a. Aspect ratio
b. possession ratio
d. Pressure ratio
d. dimension ratio

Q5) ducting is classified according to_____?
a. Shapes
b. pressure
c. velocity
d. all of the above

Q6) Friction value of chart is taken per_____ ft of duct length?
b. 100
b. 200
c. 10
d. 50

Q7) Duct with high pressure have _____ friction value of?
a. 6.5 to 12.25
b. 3.5 to 4.25
c. 2.5 to 8.25
d. 1 to 3.25

Q8) Evaporators of chillers are _____ categories as?
a. Shell and tube
b. PHE
c. Coil and tube
d. all of the above

Q9) What G.I. in a metal sheet means?
b. Gram squared milli meter
b. Galvanized iron
e. Grinded edge sheet
d. Gram squared moles

Q10) What is Nacph _____?

a. Number of air change per hour
b. Number of air condensed per hour
c. Number of person cfm per hour
d. Number of air cumulated per hour

Section – B

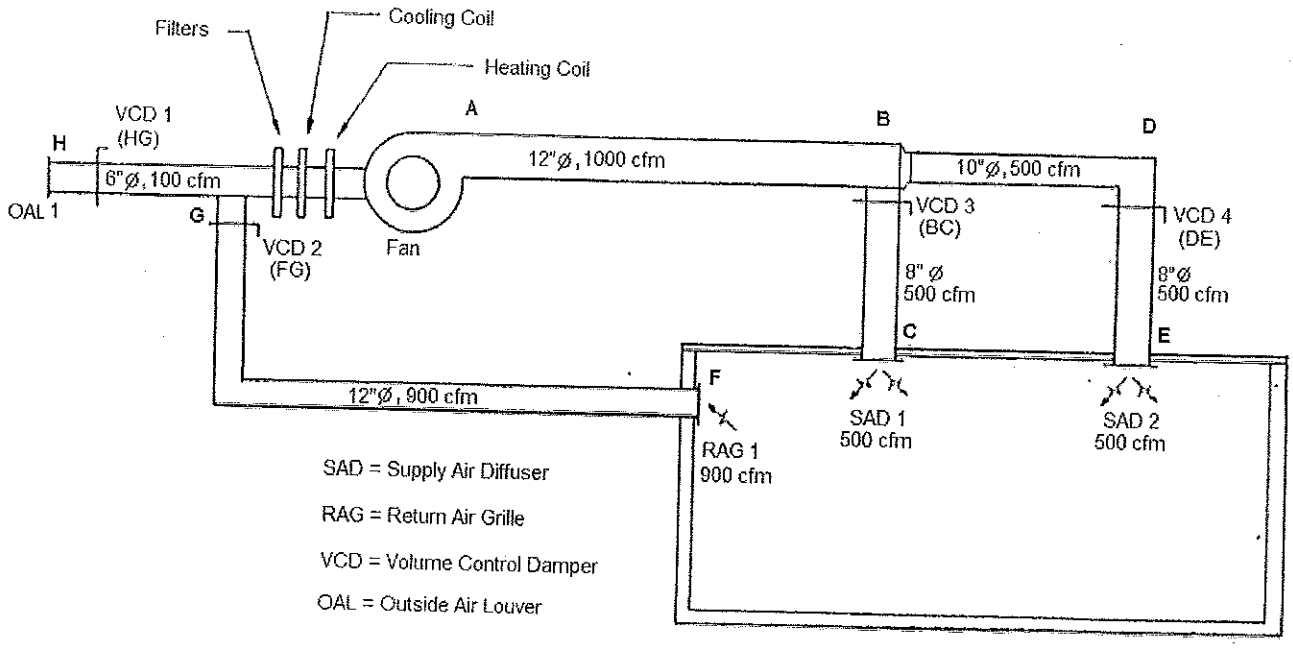
04*04 = 16 Marks

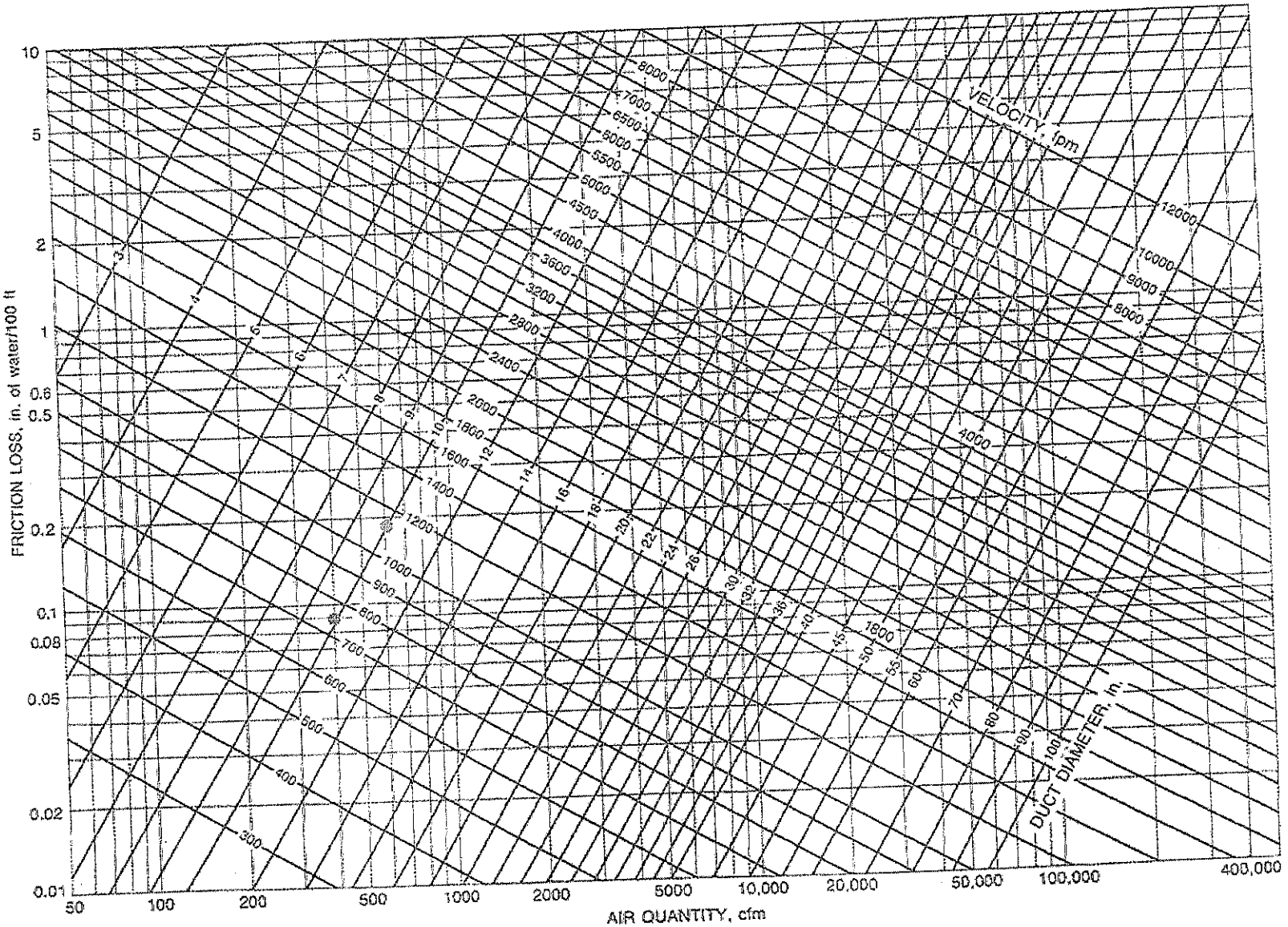
Q1) What is aspect ratio?
Q2) Write down about; CFM, FPM and area. Also, write relation among them.
Q3) Define gauge pressure, absolute pressure and atmospheric pressure. Write relation among them.
Q4) Classify dust based on various velocity range.

Section – C

04*06 = 24 Marks

Q1) Explain duct components with neat sketch?
Q2) Write types of duct materials along with application?
Q3) Explain round duct with neat sketch. Also, write advantage and disadvantage.
Q4) An air conditioning layout below depicts an air handling unit (AHU) supplying cool air to an office space. The supply air fan discharges to supply air diffusers SAD -1 & SAD - 2 through the supply duct and draws air through the return duct via the return air grille (RAG - 1). It also draws fresh air through a louver (OAL -1). Estimate the total pressure loss for sizing the fan.




FRICTION LOSS, in. of water/100 ft
AIR QUANTITY, cfm
VELOCITY, fpm
DUCT DIAMETER, in.
10
5
2
1
0.6
0.5
0.2
0.1
0.08
0.05
0.02
0.01
50
100
200
500
1000
2000
5000
10,000
20,000
50,000
100,000
400,000

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Set-A

Course Code: RAC1302 **Time: 2 Hours**

Course Name: Central air-conditioning system practices **Max. Marks: 50**

Answer key

Section – A

10*01 = 10 Marks

A1) B
A2) B
A3) C
A4) A
A5) D
A6) A
A7) A
A8) D
A9) B
A10) A

Section – B

04*04 = 16 Marks

A 1. What is aspect ratio?
It is the ratio of maximum dimension to minimum dimension of the duct.

A 2. Write down about; CFM, FPM and area. Also, write relation among them.

- CFM: volume of air flow; cubic feet/minute
- FPM: velocity or speed of air flow; feet/minute
- Area (sq.ft): duct size or cross-sectional area; square feet

Relation, CFM = FPM*Area

A 3. Define gauge pressure, absolute pressure and atmospheric pressure. Write relation among them.

Gauge pressure is indicated on the gauge; absolute pressure is the total of the indicated gauge pressure plus atmospheric pressure. The general equation for absolute pressure is:

Gauge pressure + atmospheric pressure = absolute pressure

A 4. Classify dust based on various velocity range.

Ducts are classified into 3 basic categories:
Low Velocity Systems: They are characterized by air velocities up to 2000 fpm.

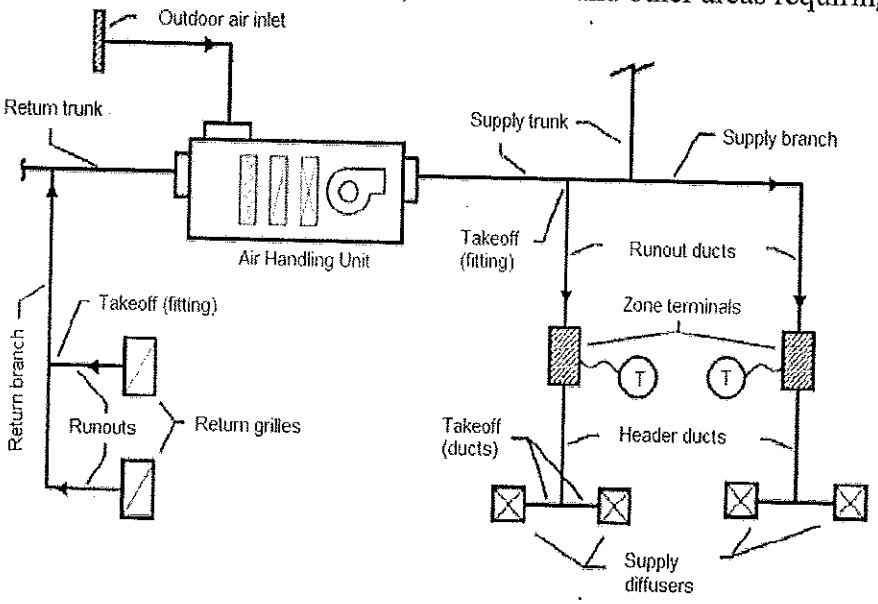
Medium Velocity Systems: They are characterized by air velocities in the range of 2,000 to 2,500 fpm.

High Velocity Systems: They are characterized by air velocities greater than 2,500 fpm.

Section – C 04*06 = 24 Marks

A 1. Explain duct components with neat sketch?

1. Supply air ductwork supplies conditioned air from the air handling unit to the conditioned area.
2. Return air ductwork removes air from the conditioned building spaces and returns the air to the air handling unit, which reconditions the air. In some cases, part of the return air in this ductwork is exhausted to the building exterior.
3. Fresh air ductwork supplies outdoor air to the air handling unit. Outdoor air is used for ventilating the occupied building space.
4. Exhaust (relief) air ductwork carries and discharges air to the outdoors. Exhaust air is taken from toilets, kitchen, laboratories and other areas requiring ventilation.



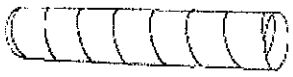
A 2. Write types of duct materials along with application?

1. Galvanized Steel: It is a standard, most common material used in fabricating ductwork for most comfort air conditioning systems.
2. Aluminum: It is widely used in clean room applications. These are also preferred systems for moisture laden air, special exhaust systems and ornamental duct systems.
3. Stainless Steel: It is used in duct systems for kitchen exhaust, moisture laden air, and fume exhaust.
4. Copper: It is mainly used for certain chemical exhaust and ornamental ductwork.
5. Fiber-glass Reinforced Plastic (FRP)
6. PVC
7. Fabric

A 3. Explain round duct with neat sketch. Also, write advantage and disadvantage.

Round Ducts

The duct shape that is the most efficient (offers the least resistance) in conveying moving air is a round duct, because it has the greatest cross-sectional area and a minimum contact surface. In other words, it uses less material compared to square or rectangular ducts for the same volume of air handled.



Round Duct

Some of the advantages of round ductwork include:

- Round shape results in lower pressure drops, thereby requiring less fan horsepower to move the air and, consequently, smaller equipment.
- Round shape also has less surface area and requires less insulation when externally wrapped.
- Round ducts are available in longer lengths than rectangular ducts, thereby eliminating costly field joints. Spiral lock-seams add rigidity; therefore, spiral ducts can be fabricated using lighter gauges than longitudinal seam ducts. Spiral ducts leak less and can be more easily sealed compared to rectangular ducts.
- The acoustic performance of round and oval ducts is superior because their curved surfaces allow less breakout noise. The low-frequency sound is well contained in round ducts.

One of the most notable drawbacks of round air ducts is that they need more clear height for installation.

A 4. An air conditioning layout below depicts an air handling unit (AHU) supplying cool air to an office space. The supply air fan discharges to supply air diffusers SAD -1 & SAD - 2 through the supply duct and draws air through the return duct via the return air grille (RAG - 1). It also draws fresh air through a louver (OAL -1). Estimate the total pressure loss for sizing the fan.

The layout shows four (4) paths of air flow and six (6) duct sections.
Path #1: Air supply through duct sections AB and BC
Path #2: Air supply through duct sections AB, BD and DE
Path #3: Air return through duct section FG
Path #4: Outdoor air intake through duct section HG
The section occurs at:

- Change in duct size
- Change in air volume

Now using the friction charts, let's find out the duct pressure losses per 100-ft. length of duct.
Path #1:
a. Duct run AB; (12" diameter, 1000 cfm) = 0.2 in.- wc/100 ft. duct length
b. Duct run BC; (8 "diameter, 500 cfm) = 0.37 in.-wc/100 ft. duct length
c. SAD-1 = 0.12 in.-wc (from manufacturer's catalog)
d. Total Pressure Loss = [0.2 + 0.37 + 0.12] = 0.69 in.-wc/100 ft. of duct length

Path #2:

a. Duct run AB; (12" diameter, 1000 cfm) = 0.2 in.-wc/100 ft. duct length

b. Duct run BD; (10" diameter, 500 cfm) = 0.14 in.- wc/100 ft. duct length

c. Duct run DE; (8" diameter, 500 cfm) = 0.37 in.-wc/100 ft. duct length

d. SAD-2 = 0.12 in. -wc (from manufacturer's catalog)

e. Total Pressure Loss = [0.2 + 0.14 + 0.37 + 0.12] = 0.83 in.-wc/100 ft. duct length

Path #3:

a. RAG -1 = 0.08 in.- wc (from manufacturer's catalog)

b. Duct runs FG; (12" diameter, 900 cfm) = 0.16 in.-wc/100 ft. duct length

c. Total Pressure Loss = [0.08 + 0.16] = 0.24 in. – wc/100 ft. duct length

Path #4:

a. OAL-1 = 0.08 in. - wc (from manufacturer's catalog)

b. Duct runs HG; (6" diameter, 100 cfm) = 0.08 in.-wc/100 ft. duct length

c. Total Pressure Loss = [0.08 + 0.08] = 0.16 in.-wc/100 ft. duct length

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End-Sem. Examination

Set-B

Course Code: RAC1302 **Time: 2 Hours**

Course Name: Central air-conditioning system practices **Max. Marks: 50**

Instruction: Read the question carefully, do attempt all

Section – A

10*01 = 10 Marks

Q1) Part of central air-conditioning system is
a. Split AC b. VRV
c. Chiller d. All

Q2) Duct with low pressure have _____ friction value of?
a. 6.5 to 12.25 b. 3.5 to 4.25
c. 2.5 to 8.25 d. 1 to 3.25

Q3) condensers of chillers are _____ categories as?
a. Shell and tube b. PHE
c. Coil and tube d. all of the above

Q4) What commonly used material in a metal sheet are
a. Copper b. Galvanized iron
c. Silver d. None of the above

Q5) What is CFM _____?
a. Centimeter feet meter b. cubic feet meter
c. None of the above d. all of the above

Q6) Which lines in psychrometry shows wet bulb
a. Horizontal lines b. vertical lines
c. Lines on curve left d. enthalpy lines

Q7) Humidity ratio is shown on _____psychrometry chart.
a. Horizontal line b. vertical line
c. inclined line d. all

Q8) Horizontal lines in psychrometry chart show _____ .
a. WBT b. DBT
c. DPT d. None

Q9) Ratio of maximum dimension to minimum dimension is known as?
a. Aspect ratio b. possession ratio
c. Pressure ratio d. dimension ratio

Q10) Duct shapes are

a. Round
b. Rectangular
c. Oval
d. all of the above

Section – B

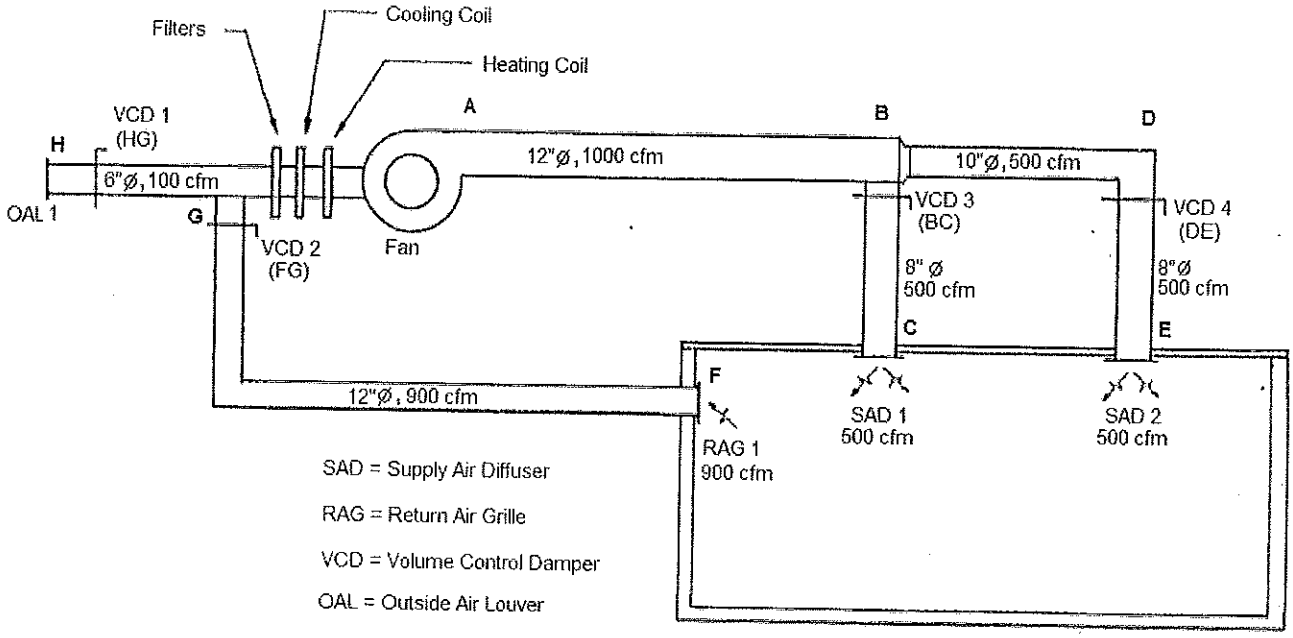
04*04 = 16 Marks

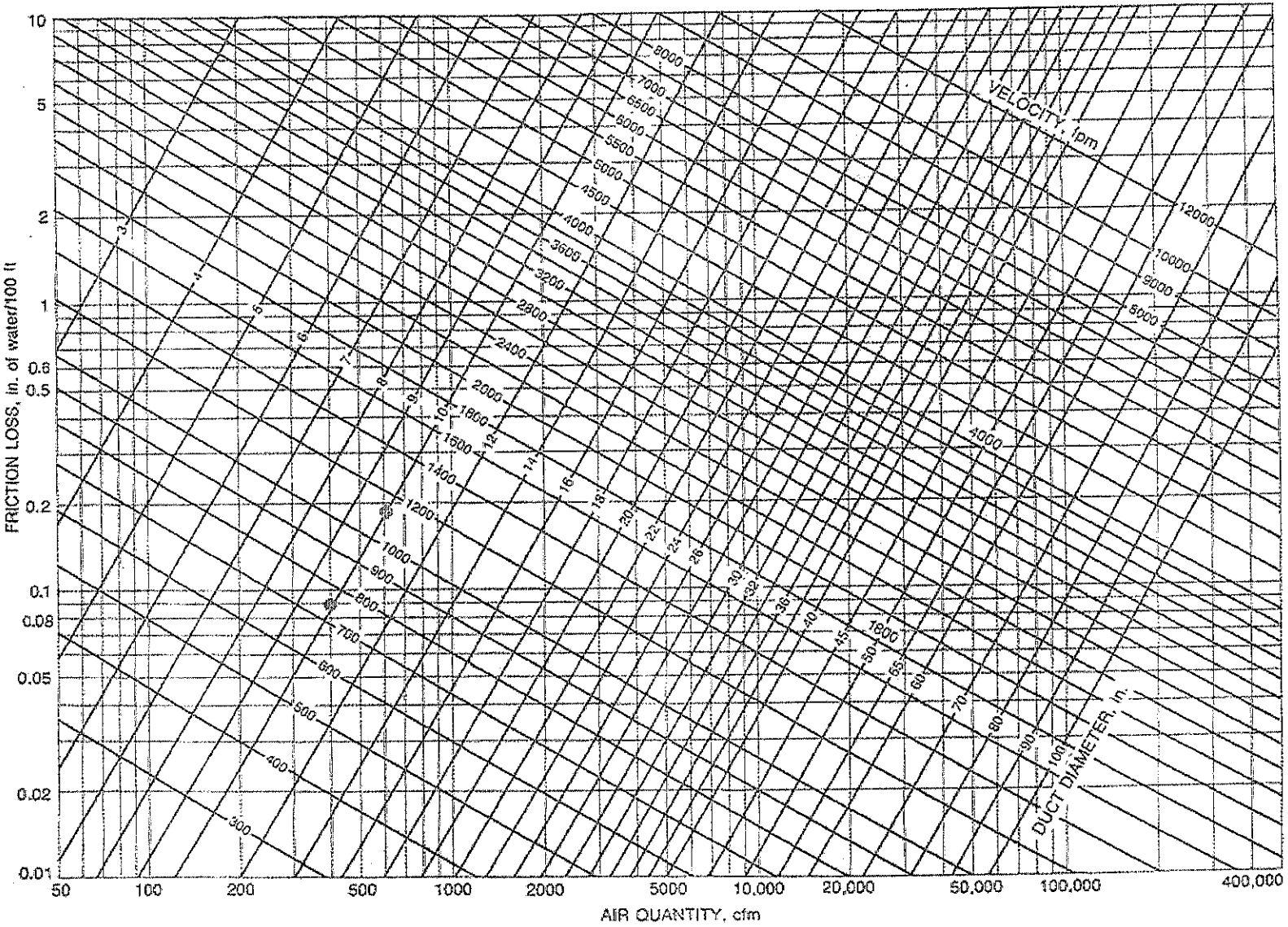
Q1) Define total pressure, static pressure and velocity pressure.
Q2) Write down the name of duct sizing method.
Q3) Write down about; CFM, FPM and area. Also, write relation among them.
Q4) Classify dust based on various pressure range.

Section – C

04*06 = 24 Marks

Q1) Explain equal friction method.
Q2) Differentiate round duct and rectangular duct with neat sketch.
Q3) Explain converging, diverging and constant cross-sectional areas with neat sketch?
Q4) An air conditioning layout below depicts an air handling unit (AHU) supplying cool air to an office space. The supply air fan discharges to supply air diffusers SAD -1 & SAD - 2 through the supply duct and draws air through the return duct via the return air grille (RAG - 1). It also draws fresh air through a louver (OAL -1). Estimate the total pressure loss for sizing the fan.




FRICTION LOSS, in. of water/100 ft
AIR QUANTITY, cfm
VELOCITY, fpm
DUCT DIAMETER, in.
10
5
2
1
0.8
0.5
0.2
0.1
0.08
0.05
0.02
0.01
50
100
200
500
1000
2000
5000
10,000
20,000
50,000
100,000
400,000

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Refrigeration & Air conditioning Skills

Session: 2021-22 (Winter Semester)

B. Voc. Program, III-Semester,

End-Sem. Examination

Set-B

Course Code: RAC1302 **Time: 2 Hours**

Course Name: Central air-conditioning system practices **Max. Marks: 50**

Answer key

Section – A 10*01 = 10 Marks

A1) D
A2) D
A3) D
A4) B
A5) B
A6) D
A7) A
A8) D
A9) A
A10) D

Section – B 04*04 = 16 Marks

A 1. Define total pressure, static pressure and velocity pressure.

Duct system is pressurized by three pressures:

- Static pressure: It is the air pressure in the duct, which is used for fan selection.
- Velocity pressure: It is the pressure generated by the velocity and weight of the air, which is used for measuring the flow (cfm) in a system.
- Total pressure: It is used to find velocity pressure. Static pressure plus velocity pressure equals total pressure.

Pressure in the ductwork is measured in inches of water column (in-wc).

A 2. Write down the name of duct sizing method.

1. Equal friction method
2. Velocity reduction method
3. static regain method

A 3. Write down about; CFM, FPM and area. Also, write relation among them.

- CFM: volume of air flow; cubic feet/minute
- FPM: velocity or speed of air flow; feet/minute
- Area (sq.ft): duct size or cross-sectional area; square feet

Relation, CFM = FPM*Area

A 4. Classify dust based on various pressure range.

Duct systems are also divided into three pressure classifications, matching the way supply fans are classified.
Low Pressure: The term low-pressure applies to systems with fan static pressures less than 3 inches WC. Generally, duct velocities are less than 1,500 fpm.

Medium Pressure: The term medium pressure applies to systems with fan static pressures between 3 to 6 inches WC. Generally, duct velocities are less than or equal to 2,500 fpm.

High Pressure: The term high pressure applies to systems with fan static pressures between 6 to 10 inches WC.

Section – C

04*06 = 24 Marks

A 1. Explain equal friction method

The Equal Friction design method sizes the ducts for a constant "Friction Rate", which describes the average pressure drop per 100 feet of duct in a system. A very common friction rate for a reasonably well-designed system is 0.1 in.-wc per 100 ft. of duct length. Reduced friction rates of 0.05 in.-wc per 100 ft. increases the duct size and costs by 15%, but cuts the portion of the total pressure drop in ductwork by 50%, resulting in fan energy savings of 15% to 20%.

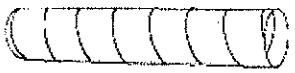
Procedure:

Equal friction method uses a duct slide rule, duct calculator, or friction rate chart to determine the relationship between duct size and air flow, i.e., how much air will come out of a given size duct. The methodology is as follows:

a) Select maximum air velocity in main duct after fan outlet.
b) Enter the friction chart knowing the cfm and velocity to determine the friction rate per 100 feet of duct length and select the diameter (refer to chart below).
c) From the friction rate obtained in the previous step, use the same value to determine diameters for all other sections of the ductwork.
d) The total friction loss in the duct system is then calculated by multiplying the friction loss per 100-foot of length to the equivalent length of the most critical path of the ductwork having maximum resistance.

A 2. Differentiate round duct and rectangular duct with neat sketch.

Round Ducts
The duct shape that is the most efficient (offers the least resistance) in conveying moving air is a round duct, because it has the greatest cross-sectional area and a minimum contact surface. In other words, it uses less material compared to square or rectangular ducts for the same volume of air handled.



Round Duct

Some of the advantages of round ductwork include:

• Round shape results in lower pressure drops, thereby requiring less fan horsepower to move the air and, consequently, smaller equipment.

• Round shape also has less surface area and requires less insulation when externally wrapped.

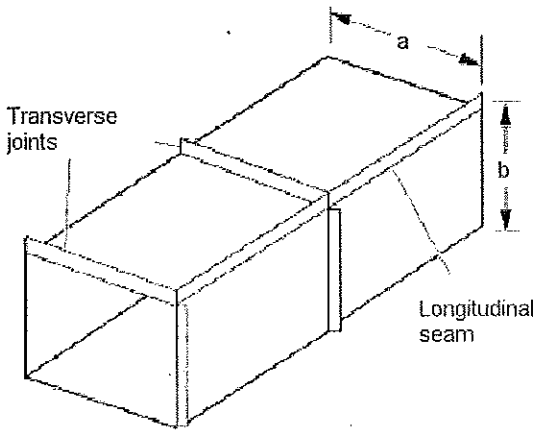
• Round ducts are available in longer lengths than rectangular ducts, thereby eliminating costly field joints. Spiral lock-seams add rigidity; therefore, spiral ducts can be fabricated using lighter gauges than longitudinal seam ducts. Spiral ducts leak less and can be more easily sealed compared to rectangular ducts.

• The acoustic performance of round and oval ducts is superior because their curved surfaces allow less breakout noise. The low-frequency sound is well contained in round ducts.

Rectangular Ducts

Square or rectangular ducts fit better to building construction. They fit above ceilings and into walls, and they are much easier to install between joists and studs.

When rectangular ducts must be used due to space limitations, keep the width-to-height ratio (aspect ratio) low. A rectangular duct section with an aspect ratio close to 1 yields the most efficient rectangular duct shape in terms of conveying air. A duct with an aspect ratio above 4 is much less efficient in use of material and experiences great pressure losses. Aspect ratios of 2 to 3 are ideal in trading off added duct cost of material and fan energy for headroom savings.



A 3. Explain converging, diverging and constant cross-sectional areas with neat sketch?

Static and velocity pressure are mutually convertible. The magnitude of each is dependent on the local duct cross-section which determines the flow velocity. The following pressure changes are affected in the ducts:

- Constant cross-sectional areas: Total and static losses are equal.
- Diverging sections (increase in duct size): Velocity pressure decreases, total pressure decreases, and static pressure may increase (static regain).
- Converging sections (decrease in duct size): Velocity pressure increases in the direction of flow, total and static pressure decrease.

A 4. An air conditioning layout below depicts an air handling unit (AHU) supplying cool air to an office space. The supply air fan discharges to supply air diffusers SAD -1 & SAD - 2 through the supply duct and draws air through the return duct via the return air grille (RAG - 1). It also draws fresh air through a louver (OAL -1). Estimate the total pressure loss for sizing the fan.

The layout shows four (4) paths of air flow and six (6) duct sections.
Path #1: Air supply through duct sections AB and BC
Path #2: Air supply through duct sections AB, BD and DE
Path #3: Air return through duct section FG
Path #4: Outdoor air intake through duct section HG
The section occurs at:
• Change in duct size
• Change in air volume

Now using the friction charts, let's find out the duct pressure losses per 100-ft. length of duct.
Path #1:
a. Duct run AB; (12" diameter, 1000 cfm) = 0.2 in.- wc/100 ft. duct length
b. Duct run BC; (8 "diameter, 500 cfm) = 0.37 in.-wc/100 ft. duct length
c. SAD-1 = 0.12 in.-wc (from manufacturer's catalog)
d. Total Pressure Loss = [0.2 + 0.37 + 0.12] = 0.69 in.-wc/100 ft. of duct length

Path #2:
a. Duct run AB; (12" diameter, 1000 cfm) = 0.2 in.-wc/100 ft. duct length
b. Duct run BD; (10" diameter, 500 cfm) = 0.14 in.- wc/100 ft. duct length
c. Duct run DE; (8" diameter, 500 cfm) = 0.37 in.-wc/100 ft. duct length
d. SAD-2 = 0.12 in. -wc (from manufacturer's catalog)
e. Total Pressure Loss = [0.2 + 0.14 + 0.37 + 0.12] = 0.83 in.-wc/100 ft. duct length

Path #3:
a. RAG -1 = 0.08 in.- wc (from manufacturer's catalog)
b. Duct runs FG; (12" diameter, 900 cfm) = 0.16 in.-wc/100 ft. duct length
c. Total Pressure Loss = [0.08 + 0.16] = 0.24 in. – wc/100 ft. duct length

Path #4:
a. OAL-1 = 0.08 in. - wc (from manufacturer's catalog)
b. Duct runs HG; (6" diameter, 100 cfm) = 0.08 in.-wc/100 ft. duct length
c. Total Pressure Loss = [0.08 + 0.08] = 0.16 in.-wc/100 ft. duct length

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of RAC Skills

Session: 2021-22 (Winter Semester)

B. Voc. Program, 3rd Semester

End-Sem. Examination

Course Code: RAC1303 **Time: 2 Hour**

Course Name: RAC Electrical,Electronics & Instrumentation-II **Max. Marks: 50**

Instruction: Attempt all questions

Set-A

Section – A

10X01 = 10 Marks

1. A capacitor is a device that stores electrical energy in _____.
   a. cylinder
   b. magnetic field
   c. electric field
   d. electricity
2. A DC motor is any of a class of rotary electrical motors that converts direct current (DC) electrical energy into _____.
   a. Potential energy
   b. speed
   c. energy
   d. mechanical energy
3. A relay is an _____operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals.
   a. hand
   b. electrically
   c. mechanically
   d. automatically
4. It is a type of split-phase induction motor in which the capacitor is permanently connected (as opposed to only being connected when starting).
   a. RSIR
   b. PSC
   c. Shaded pole
   d. CSIR

5. The production of _____from magnetism is known as electromagnetic induction.
    a. electricity
    b. voltage
    c. force
    d. Speed
6. If a DC motor is connected with AC supply it will
    a. Run at normal speed
    b. Not run
    c. Run at lower speed
    d. Burn due to heat produced in the field winding by eddy currents
7. The speed of DC shunt motor can be increased by
    a. Increasing the resistance in armature circuit
    b. Increasing the resistance in field circuit
    c. Reducing the resistance in the field circuit
    d. Reducing the resistance in the armature circuit
8. The armature voltage control provide control of DC motor provides
    a. Constant torque drive
    b. Constant voltage drive
    c. Constant current drive
    d. None of the above
9. Starter are used with DC motor because
    a. These motors have high starting torque
    b. These motors are not self-starting
    c. Back e.m.f. of these motors is zero initially
    d. To restrict armature current as there is no back e.m.f. while starting
10. A direct online starter is used: for starting motors
    a. Up to 5 H.P.
    b. Up to 10 H.P.
    c. Up to 15 H.P.
    d. Up to 20 H.P.

Section – B

04X04 = 16 Marks

11. What are the differences between squirrel cage and slip ring rotor?
12. What is self and mutual induction?
13. What are the various parts of an AC motor?
14. How to check the condition of the capacitor?

Section – C

06X04 = 24 Marks

15. Explain the fault-finding procedure of a compressor.
16. Explain the difference between AC and DC motors

17. Draw the wiring diagram of following motors
    a. RSIR
    b. CSR
    c. PSC
18. What are the various types and application of DC brushed motor, explain with clean diagrams?

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of RAC Skills

Session: 2021-22 (Winter Semester)

B. Voc. Program, 3rd Semester

End-Sem. Examination

Course Code: RAC1303 **Time: 2 Hour**

Course Name: RAC Electrical,Electronics & Instrumentation-II **Max. Marks: 50**

Instruction: Attempt all questions

Set A

Section – A

Answer Key 10X01 = 10 Marks

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   a. cylinder
   b. magnetic field
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   d. electricity
2. A DC motor is any of a class of rotary electrical motors that converts direct current (DC) electrical energy into _____.
   a. Potential energy
   b. speed
   c. energy
   d. mechanical energy
3. A relay is an _____operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals.
   a. hand
   b. electrically
   c. mechanically
   d. automatically
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   b. PSC
   c. Shaded pole
   d. CSIR
5. The production of _____from magnetism is known as electromagnetic induction.
   a. electricity
   b. voltage
   c. force

d. Speed

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    d. Up to 20 H.P.

Section – B

04X04 = 16 Marks

11. What are the differences between squirrel cage and slip ring rotor?

Sr. No.	Wound or slip ring rotor	Squirrel cage rotor
1	Rotor consists of a three phase winding similar to the stator winding.	Rotor consists of bars which are shorted at the ends with the help of end rings.
2	Construction is complicated.	Construction is very simple.
3	Resistance can be added externally.	As permanently shorted, external resistance cannot be added.
4	Slip rings and brushes are present to add external resistance.	Slip rings and brushes are absent
5	The construction is delicate and due to brushes, frequent maintenance is necessary.	The construction is robust and maintenance free.
6	The rotors are very costly.	Due to simple construction, the rotors are cheap.
7	Only 5% of induction motors in industry use slip ring rotor.	Very common and almost 95% induction motors use this type of rotor.
8	High starting torque can be obtained	Moderate starting torque which cannot be controlled
9	Rotor resistance starter can be used.	Rotor resistance starter cannot be used.
10	Rotor must be wound for the same number of poles as that of stator.	The rotor automatically adjusts itself for the same number of poles as that of stator.
11	Speed control by rotor resistance is possible	Speed control by rotor resistance is not possible.
12	Rotor copper losses are high hence efficiency is less.	Rotor copper losses are less hence more higher efficiency.
13	Used for lifts, hoists, cranes, elevators, compressors etc.	Used for lathes, drilling machines, fans, blowers, water pumps, grinders, printing machines etc

12. What is self and mutual induction?

In self inductance, the change in the strength of current in the coil is opposed by the coil itself by inducing an e.m.f.

In mutual inductance out of the two coils one coil opposes change in the strength of the current flowing in the other coil.

13. What are the various parts of an AC motor?

The main components of an AC motor are the stator, stationary outer drum, and the rotor, the rotating inner portion attached to the motor shaft. The stator and the rotor produce rotating magnetic fields. The winding of the stator that creates the rotating field is created by alternating current.

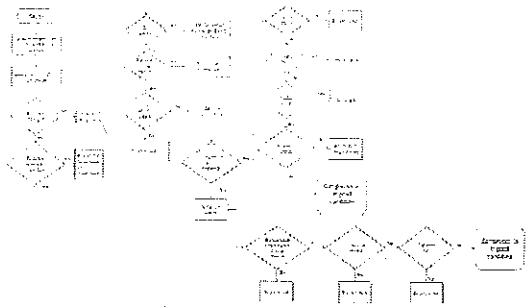
14. How to check the condition of the capacitor?

Connect the leads of the capacitor to the multimeter probes and observe the readings on the multimeter. For a good capacitor, the resistance will be low in the beginning and will gradually increase. If the resistance is low at all times, the capacitor is a Shorted Capacitor and we have to replace it

Section – C

06X04 = 24 Marks

15. Explain the fault-finding procedure of a compressor.

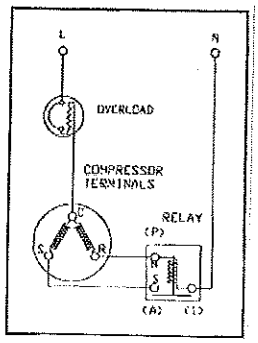


16. Explain the difference between AC and DC motors

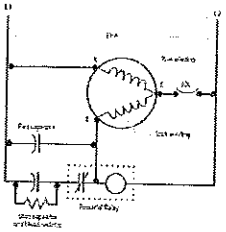
Answer: The most obvious difference is the type of current each motor turns into energy, alternating current in the case of AC motors, and direct current in the case of DC motors. AC motors are known for their increased power output and efficiency, while DC motors are prized for their speed control and output range.

17. Draw the wiring diagram of following motors

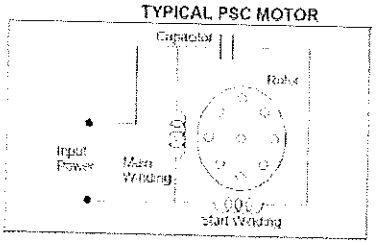
a. RSIR



b. CSR



c. PSC



18. What are the various types and application of DC brushed motor, explain with clean diagrams?

Answer: Applications of Brushed DC motor

Though these motors mainly use in household appliances and in automobiles.

These motors still use for industrial purposes for both low and high power, fixed and variable speed electric drives.

They still use for paper machines, cranes, electrical propulsion, sewing machines, power tools, and steel rolling mills.

Shunt DC Motors

In shunt DC motors the field is connected in parallel (shunt) with the armature windings.

Compound DC Motors

Compound DC motors, like shunt DC motors, have a separately excited shunt field.

Compound DC motors have good starting torque but may experience control problems in variable speed drive applications

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of RAC Skills

Session: 2021-22 (Winter Semester)

B. Voc. Program, 3rd Semester

End-Sem. Examination

Course Code: RAC1303 **Time: 2 Hour**

Course Name: RAC Electrical, Electronics and Instrumentation II **Max. Marks: 50**

Instruction: Attempt all questions

Set-B

Section – A

10X01 = 10 Marks

1. In resistor split phase motors main winding m has a
   a) High Resistance
   b) Low Resistance
   c) None Of the Above
   d) All Of the Above

2. The Two Windings of Split Phase Single Phase Motors Are Connected In
   a) Series
   b) Parallel
   c) Axial
   d) Radial

3. What is CSR?
   a) Capacitor Start Capacitor
   b) Capacitor Start Induction Run
   c) Control Start Induction Run
   d) None Of the Above

4. Fleming's right-hand rule is for:
   a) Motor
   b) Generators
   c) Transformers
   d) Transistors

5. In resistor split phase motors starting winding has a:
   a) High Resistance
   b) Low Resistance
   c) None Of the Above
   d) All Of the Above

6. The main parts of an induction motor are
   a) Stator
   b) Rotor
   c) Both
   d) None

7. RSIR motor is?
   a) Resistor Start Induction Run

b) Resistor Start Impedance Run
c) Reactance Start Induction Run
d) Resistor Start Inductance Run

8. Split phase induction motors have two winding naming
   a) Starting And Running
   b) Main And Auxiliary Winding
   c) Current And Relay
   d) Both A And B

9. What is CSIR?
   a) Capacitor Start Capacitor Run
   b) Capacitor Start Induction Run
   c) Control Start Induction Run
   d) None Of the Above

10. Fleming's left-hand rule is for
   a) Motor
   b) Generators
   c) Transformers
   d) Transistors

Section – B

04X04 = 16 Marks

11. Consider a situation, you found a random compressor and you need to fix this compressor into a VCR system, what steps would you follow before fit this compressor into a system?
12. How induction motor differs from direct current motor, describe the difference based upon electromagnetic induction?
13. Draw the wiring diagram of any three types of single-phase induction motor.
14. Write short note on following:
    a. DC shunt motor
    b. DC brushed series motor

Section – C

04X06 = 24 Marks

15. What are the two types of induction motor rotor?
16. What is the basic working principle of a motor and transformer?
17. Draw the nomenclature of a single-phase asynchronous motor.
18. A CSR motor is not getting started, how would you check its electrical connection of capacitor describe the procedure?

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of RAC Skills

Session: 2021-22 (Winter Semester)

B. Voc. Program, 3rd Semester

End-Sem. Examination

Course Code: RAC1303 **Time: 2 Hour**

Course Name: RAC Electrical, Electronics and Instrumentation -II **Max. Marks: 50**

Instruction: Attempt all questions

Answer Sheet

Set-B

Section – A

10X10 = 10 Marks

1. In resistor split phase motors main winding m has
   A. High Resistance
   B. **Low Resistance**
   C. High reactance
   D.All Of The Above

2. The two windings of split phase single phase motors are connected in
   A. Series
   B. Parallel
   C. Axial
   D. Radial

3. What Is CSR?
   A. **Capacitor Start Capacitor Run**
   B. Capacitor Start Induction Run
   C. Control Start Induction Run
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   C. Transformers
   D. Transistors

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   D. All Of the above

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   B) Rotor
   C) **Both**
   D) None

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   A) **Starting And Running Winding**
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   D) Both A And B

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A. **Motor**
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Section – B

04X04 = 16 Marks

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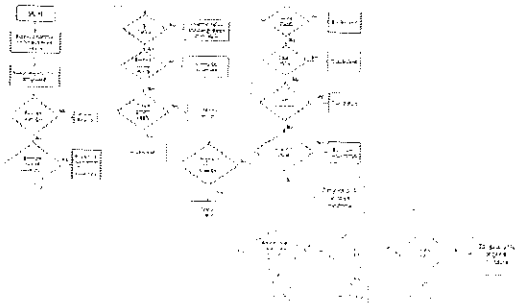

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Answer: The most obvious difference is the type of current each motor turns into energy, alternating current in the case of AC motors, and direct current in the case of DC motors. AC motors are known for their increased power output and efficiency, while DC motors are prized for their speed control and output range.

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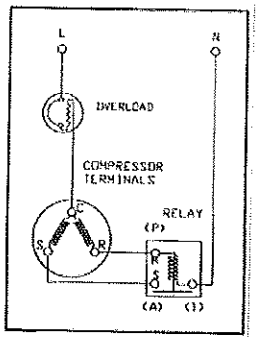
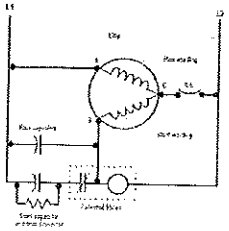
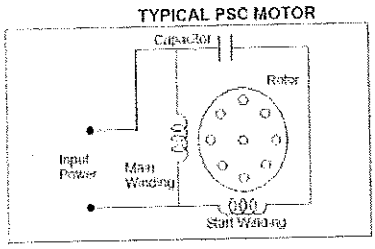


b. CSR



c. PSC



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Compound DC motors, like shunt DC motors, have a separately excited shunt field.

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Section – C

04X06 = 24 Marks

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9	Rotor resistance starter can be used.	Rotor resistance starter cannot be used.
10	Rotor must be wound for the same number of poles as that of stator.	The rotor automatically adjusts itself for the same number of poles as that of stator.
11	Speed control by rotor resistance is possible.	Speed control by rotor resistance is not possible.
12	Rotor copper losses are high hence efficiency is less.	Rotor copper losses are less hence have higher efficiency.
13	Used for lifts, hoists, cranes, elevators, compressors etc.	Used for lathes, drilling machines, fans, blowers, water pumps, grinders, printing machines etc.

16. What is the basic working principle of a motor and transformer?

Answer: The transformer works on the principle of Faraday's law of electromagnetic induction and mutual induction. There are usually two coils primary coil and secondary coil on the transformer core. The core laminations are joined in the form of strips. The two coils

have high mutual inductance. In mutual inductance out of the two coils one coil opposes change in the strength of the current flowing in the other coil.

17. Draw the nomenclature of a single-phase asynchronous motor.

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Answer: Connect the leads of the capacitor to the multimeter probes and observe the readings on the multimeter. For a good capacitor, the resistance will be low in the beginning and will gradually increase. If the resistance is low at all times, the capacitor is a Shorted Capacitor and we have to replace it

Registration No.: .....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Refrigeration & Air Conditioning Skills

Session: 2021-22 (Winter Semester)

B. Voc. Program, III Semester,

End-Sem. Examination

Course Code: RAC1304 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. 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
2. Pork has a higher shelf life than beef.
   a. True
   b. False
   c. Not Comparable
   d. Services
3. 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
4. Evaporation, desiccation and dehydration all mean the same thing.
   a.True
   b. False
   c. Both
   d. None of the above
5. 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
6. 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

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7. Which of the following are Milk Processing Operations?
   a. Clarification
   b. Pasteurization
   c. Homogenization
   d. All of the mentioned
8. 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
9. Psychrometry is the study of-
   a. moist air
   b. stasis point
   c. metrics in Canada
   d. none of the above
10. 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

Section – B

04X04 = 16 Marks

1. Write down the importance of food preservation.
2. Explain postharvest physiology of fruits and vegetables through neat sketch.
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. What are the expansion devices? Explain the different types of it.
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. Write down the advantages of forced draft cooling towers.
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, III Semester,

End-Sem. Examination

Course Code: RAC1304 Time: **2 Hours**

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

ANSWER KEY -A

Section – A

10X01 = 10 Marks

1. Fats in frozen fish tissue tend to become rancid quicker than fats in frozen animal tissues.
   a. True
2. Pork has a higher shelf life than beef.
   b. False
3. Which of the following nutrients are lost in all steps of food engineering (including packaging and freezing)?
   b. Vitamins
4. Evaporation, desiccation and dehydration all mean the same thing.
   b. False
5. At 100% relative humidity, the wet bulb temperature is-
   c. equal to the dew point temperature
6. Which of the following is true about fruits and vegetable processing?
   a. d. All of the mentioned
7. Which of the following are Milk Processing Operations?
   d. All of the mentioned
8. The horizontal line in psychrometric chart joining the change of state of air represents
   b. sensible cooling or heating
9. Psychrometry is the study of-
   a. moist air
10. The length of storage of fruits and vegetables is a function of _____
    a. d. All of the mentioned

Section – B

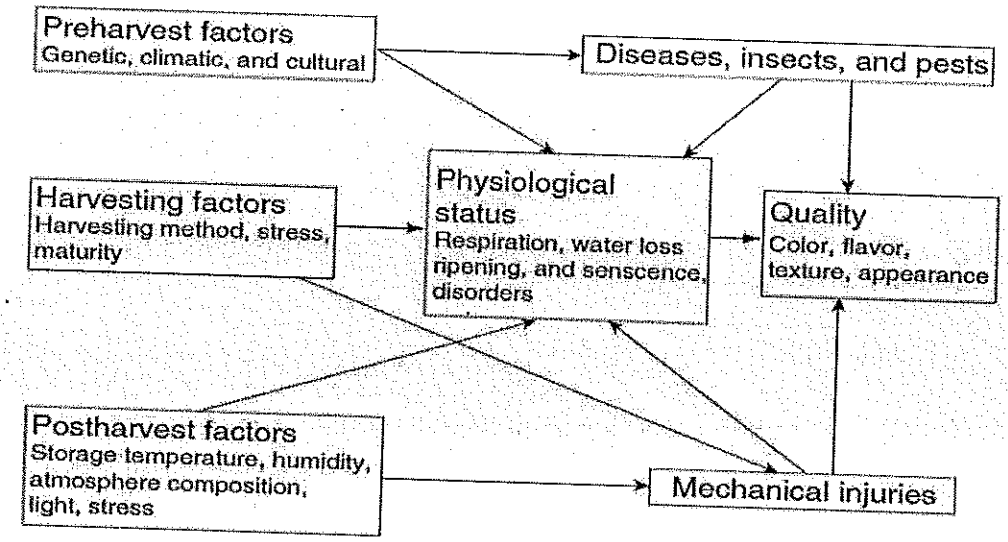
04X04 = 16 Marks

1. 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).

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



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. 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

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. 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.

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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School of Refrigeration & Air Conditioning Skills

Session: 2021-22 (Winter Semester)

B. Voc. Program, III Semester,

End-Sem. Examination

Course Code: RAC1304 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. What is the size of condenser, compare to an Evaporator in a standard Refrigeration system?
   a) Larger
   b) Smaller
   c) Equal
   d) All of the above
2. The amount of starting current over running current for a Compressor is;
   a) Larger
   b) Smaller
   c) Equal
   d) All of the above
3. Which of the following tool is used to open the Refrigerant port?
   a) Adjustable Wrench
   b) Screw driver
   c) Spanner
   d) None
4. The size of liquid line tube compare to vapour line tube is;
   a) Larger
   b) Smaller
   c) Equal
   d) All of the above
5. Which of the following statement is correct?
   a) In Vapour absorption refrigeration system, the compression of refrigerant is avoided.
   b) Sub-cooling can be achieved by circulating more quantity of cooling water through the condenser.
   c) In vapour compression refrigeration, vapour is drawn in the compressor cylinder during its suction stroke and is compressed during compression stroke.
   d) All of the above.
6. Where does the lowest temperature occurs in a vapour compression cycle?
   a) Compressor

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b) Condenser
c) Expansion Valve
d) Evaporator

7. The COP of a vapour compression plant in comparison to vapour absorption plant is;
   a) More
   b) Less
   c) Same
   d) Depends upon the size of plant
8. Domestic refrigerator working on vapour compression cycle uses the following type of expansion device;
   a) Electronic Expansion device
   b) Thermostatic Expansion device
   c) Automatic Expansion device
   d) Capillary Tube

9. The moisture in a refrigerant is removed by;
   a) Evaporator
   b) Safety relief valve
   c) Dehumidifier
   d) Driers
10. The COP of a refrigeration cycle with increase in evaporator temperature, keeping condenser temperature constant, will;
   a) Increase
   b) Decrease
   c) Unchanged
   d) Depends upon the refrigerant used

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 causes of food deterioration.
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

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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 main purposes of a cold room?

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School of Refrigeration & Air Conditioning Skills

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Course Code: RAC1304 Time: **2 Hours**

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

ANSWER KEY-B

Section – A

10X01 = 10 Marks

1. What is the size of condenser, compare to an Evaporator in a standard Refrigeration system?
   a) Larger
2. The amount of starting current over running current for a Compressor is;
   a) Larger
3. Which of the following tool is used to open the Refrigerant port?
   a) Adjustable Wrench
4. The size of liquid line tube compare to vapour line tube is;

   b) Smaller

5. Which of the following statement is correct?

   d) All of the above.

6. Where does the lowest temperature occurs in a vapour compression cycle?

   c) Expansion Valve

7. The COP of a vapour compression plant in comparison to vapour absorption plant is;
   a) More
8. Domestic refrigerator working on vapour compression cycle uses the following type of expansion device;

   d) Capillary Tube

9. The moisture in a refrigerant is removed by;

   d) Driers

10. The COP of a refrigeration cycle with increase in evaporator temperature, keeping condenser temperature constant, will;

    a) Increase

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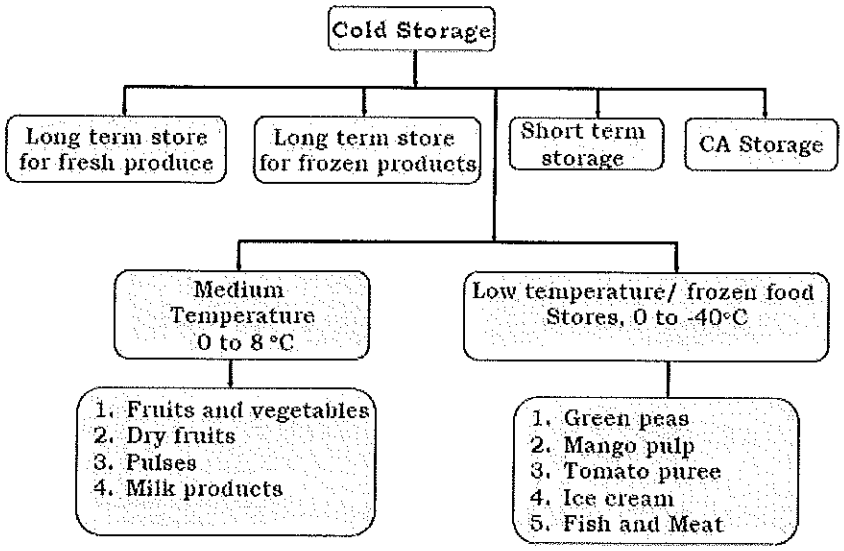
Section – B

04X04 = 16 Marks

11. Write down the different types of cold storages.



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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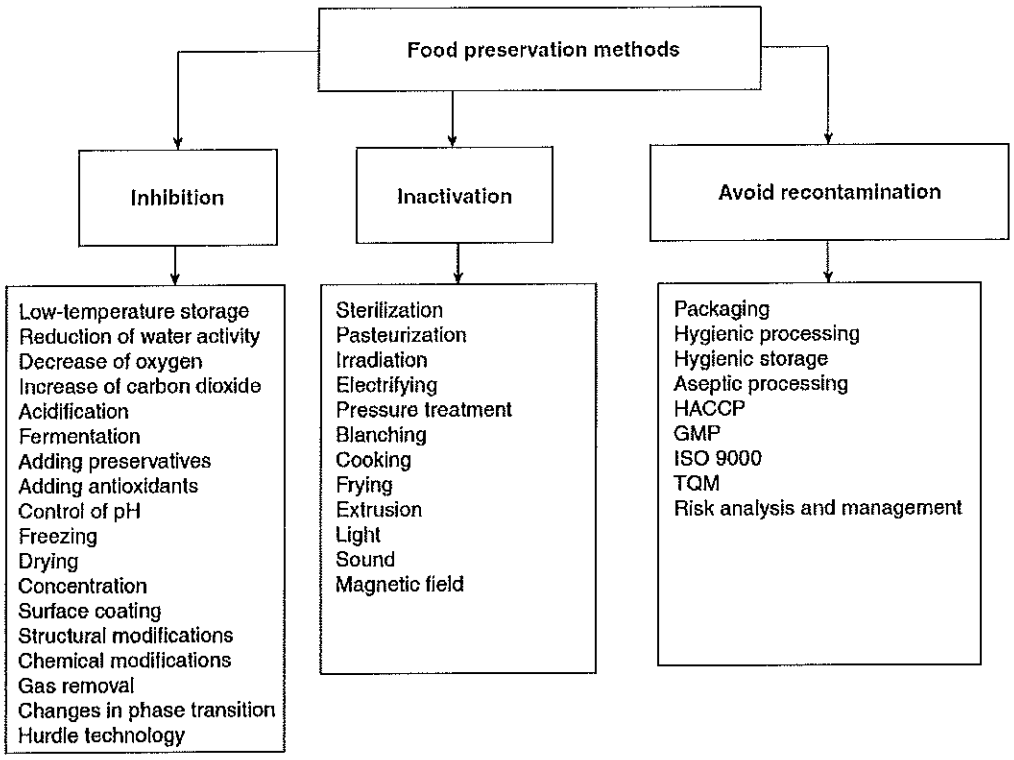

Section – C

04X06 = 24 Marks

15. Write down the causes of food deterioration.

Mechanical, physical, chemical, and microbial effects are the leading causes of food deterioration and spoilage. Damage can start at the initial point by mishandling of foods during harvesting, processing, and distribution; this may lead to ultimate reduction of shelf life.

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 main purposes of a cold room?

The main goals of storage include the following:

1. Slow the biological activity of fruits and vegetables without chilling injury.

2. Slow the growth of microorganisms.

3. Reduce transpirational losses to avoid the following undesirable processes that may occur in certain fruits and vegetables:

a. *Sprouting*: potatoes, onions, ginger, garlic

b. *Elongation*: asparagus, carrots, beets, kohlrabi

c. *Rotting*: due to increased humidity that may result in rapid decay, shriveling, and exhaustion of food reserves

d. *Greening*: exposure of potatoes to light during storage may produce green tissue and

synthesis of toxic glycoalkaloids such as solanine and chaconine

e. *Toughening*: green beans and sweet corn due to prolonged storage at relatively high

temperatures