



BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of RAC Skills

III Semester, 1st In-Sem. Examination

B. Voc. Program, Summer Semester (2019-20)

Course Code: HVA1301

Time: 1 Hour

Course Name: Refrigerant & Psychrometry

Max. Marks: 20

Instruction:

1. Attempt all Questions.
2. Each question of Section – A carries 01 mark.
3. Each question of Section – B carries 02 mark.
4. Each question of Section – C carries 03 mark.

Section – A

05X01 = 05 Marks

1. The refrigerant R-717 is:
 - a. Air
 - b. Water
 - c. Ammonia
 - d. Carbon dioxide
2. The ozone friendly refrigerant R-134a contains:
 - a. One Chlorine atom
 - b. Two Chlorine atom
 - c. Four Chlorine atom
 - d. No Chlorine atom
3. Which of the following is an azeotrope refrigerant?
 - a. R-11
 - b. R-40
 - c. R-114
 - d. R-502
4. R-410a is a mixture of:
 - a. R-32/R-125 (40%/60%)
 - b. R-32/R-125 (45%/55%)
 - c. R-32/R-125 (50%/50%)
 - d. R-32/R-125 (48%/52%)



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5. What is the refrigerant number for the chemical formula CCl_3F ?

- A. R-12
- B. R-11
- C. R-134a
- D. None

Section – B

03X02 = 06 Marks

1. Why do we use refrigerant in refrigeration system? How it works in the cycle?
2. What is the degree of superheat and sub-cool and where these phenomena take place in a refrigeration cycle?
3. Which component of refrigeration system is of greatest size? Give the explanation.

Section – C

03X03 = 09 Marks

1. Describe VCERS in detail with a neat sketch.
2. Write down the basic properties of an ideal refrigerant.
3. Describe the classification of refrigerant.



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ANSWER SHEET

III Semester, 1st In-Sem. Examination

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4. Each question of Section – C carries 03 mark.

Section – A

05X01 = 05 Marks

1. The refrigerant R-717 is:
c. Ammonia
2. The ozone friendly refrigerant R-134a contains:
d. No Chlorine atom
3. Which of the following is an azeotrope refrigerant?
d. R-502
4. R-410a is a mixture of:
c. R-32/R-125 (50%/50%)
5. What is the refrigerant number for the chemical formula CCL_3F ?
b. R-11

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Section – B

03X02 = 06 Marks

1. Why do we use refrigerant in refrigeration system? How it works inside the cycle?

Answer: Refrigerant- A heat carrier substance.

For working – It undergoes phase changes at suitable pressure and temperature.

2. What is the degree of superheat and sub-cool and where these phenomena take place in a refrigeration cycle?

ANSWER: Degree of superheat= Actual measured temperature of vapor/steam- Saturated temperature of vapor/steam.

Degree of sub-cool= Saturated liquid temperature – Actual measured temperature.

3. Which component of refrigeration system is of greatest size? Give the explanation.

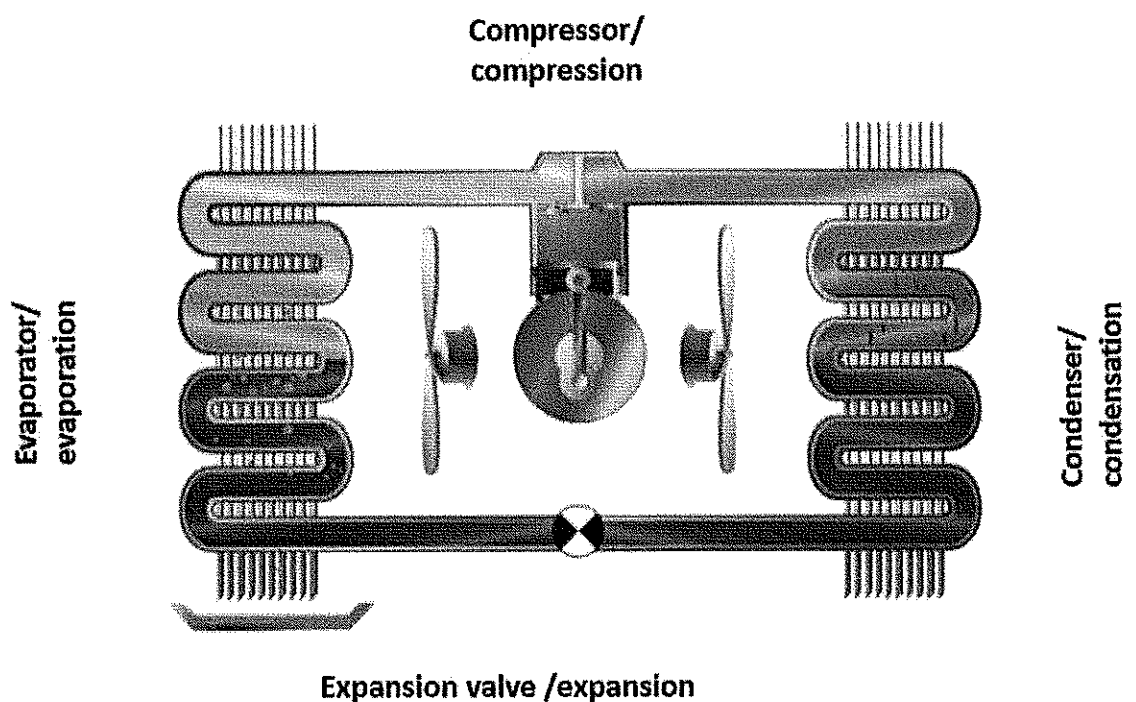
ANSWER: Condenser

Heat rejected by condenser= Heat from evaporator+ Heat from compressor

Section – C

03X03 = 09 Marks

1. Describe VCRS in detail with a neat sketch.





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2. Write down the basic properties of an ideal refrigerant.

ANSWER:

Low boiling and freezing point.

High critical pressure and temperature.

High latent heat of vaporization.

Low specific heat of liquid, and high specific heat of vapor.

Low specific volume of vapor.

High thermal conductivity.

Non- corrosive to metal.

Non flammable and non explosive.

Non toxic.

Low cost.

Easily and regularly available.

Easy of locating leaks by odour or suitable indicator.

Mixes well with oil.

High coefficient of performance.

Environment friendly.

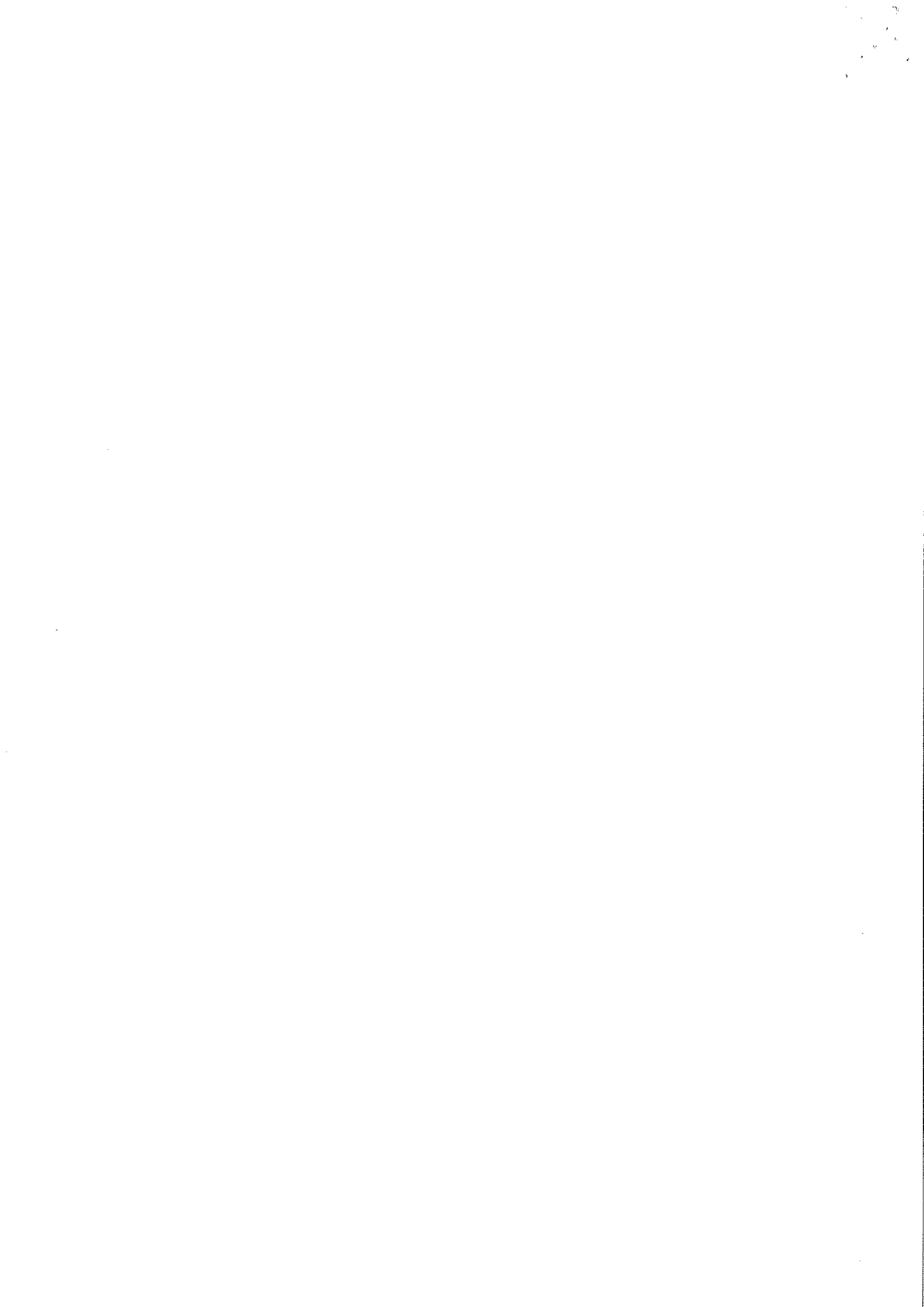
3. Describe the classification of refrigerant.

Chlorofluorocarbons (CFCs)

Hydrochlorofluorocarbons (HCFCs)

Hydrofluorocarbons (HFCs)

Hydrocarbons (HCs)





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School of RAC Skills

3rd Semester, 1st In-Sem. Examination

B. Voc. Program, Summer Semester (2019-20)

Course Code: HVA-1302

Time: 1 Hour

Course Name: Compressor, Condenser and Evaporator

Max. Marks: 20

Instruction: Attempt all questions.

Section – A

05X01 = 05 Marks

1. Which compressor type uses piston to compress the gas?
 - a) Scroll
 - b) Reciprocating
 - c) Screw
 - d) Rotary
2. Which compressor type uses tapered, machined gear components to trap the gas for compression?
 - a) Scroll
 - b) Reciprocating
 - c) Screw
 - d) Rotary
3. Which style of compressor uses belts to operate the compressor?
 - a) Open type
 - b) Closed type
 - c) Chassis type
 - d) Hermetic type
4. What should be done to increase the compressor speed of a belt-driven compressor?
 - a) Decrease drive pulley size
 - b) Increase drive pulley size
 - c) Increase driven pulley size
 - d) Both A and C
5. What lubricates the refrigeration compressor?
 - a) Refrigerants
 - b) Moisture
 - c) Oil
 - d) Desiccants

Section – B

03X02 = 06 Marks

1. Explain with example compression ratio and volumetric efficiency of compressor.
2. Differentiate between positive displacement and roto-dynamics compressor.
3. Differentiate between rotary and swing type compressor with sketch.



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Section – C

03X03 = 09 Marks

1. Write down different types of classifications of compressor.
2. Explain with neat sketch construction and working of reciprocating compressor .
3. Explain with neat sketch construction and working of screw compressor.

Q

Q



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School of RAC Skills

3rd Semester, 1st In-Sem. Examination

B. Voc. Program, Summer Semester (2019-20)

Course Code: HVA-1302

Time: 1 Hour

Course Name: Compressor, Condenser and Evaporator

Max. Marks: 20

Instruction: (Attempt all questions.)

Section A

- 1) b
- 2) c
- 3) a
- 4) d
- 5) c

Short answer: Section B

- 1) It is the ratio of discharge pressure to suction pressure (in absolute pressure), $\frac{169 \text{ Psig} + 14.5 \text{ Psig}}{21 \text{ Psig} + 14.5 \text{ Psig}}$

- 2) **Positive Displacement type:**

Compression is achieved by trapping a refrigerant vapor into an enclosed space and then reducing its volume.

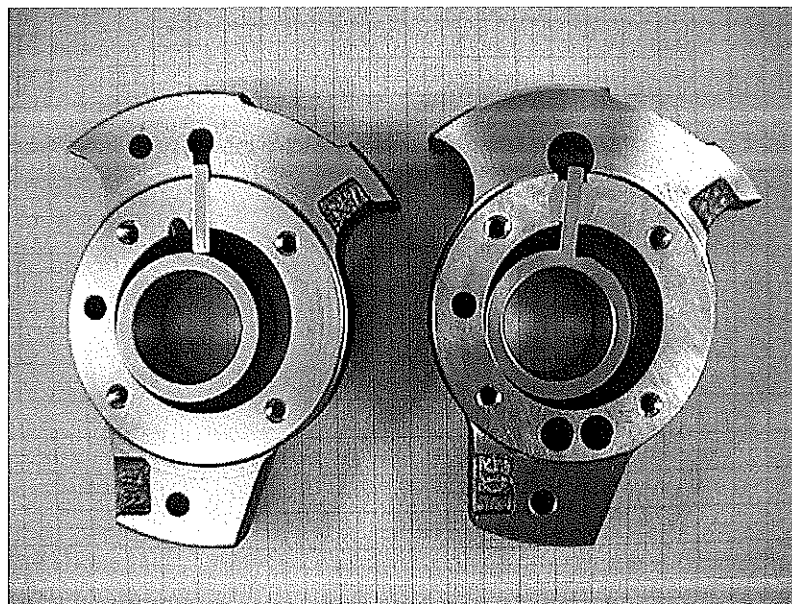
A fixed amount of refrigerant is trapped each time and its pressure raises and its volume is reduced

In positive displacement flow is pulsating/unsteady leads to wear, vibration and noise.

Roto-Dynamics Compressor

The rise in pressure is achieved by imparting kinetic energy (angular momentum) to a refrigerant by a rotating mechanical element (impeller) and then converting the kinetic energy into pressure as refrigerant flow through the diverging passage.

In roto-dynamics flow is not pulsating/steady flow leads to less wear, vibration and noise.



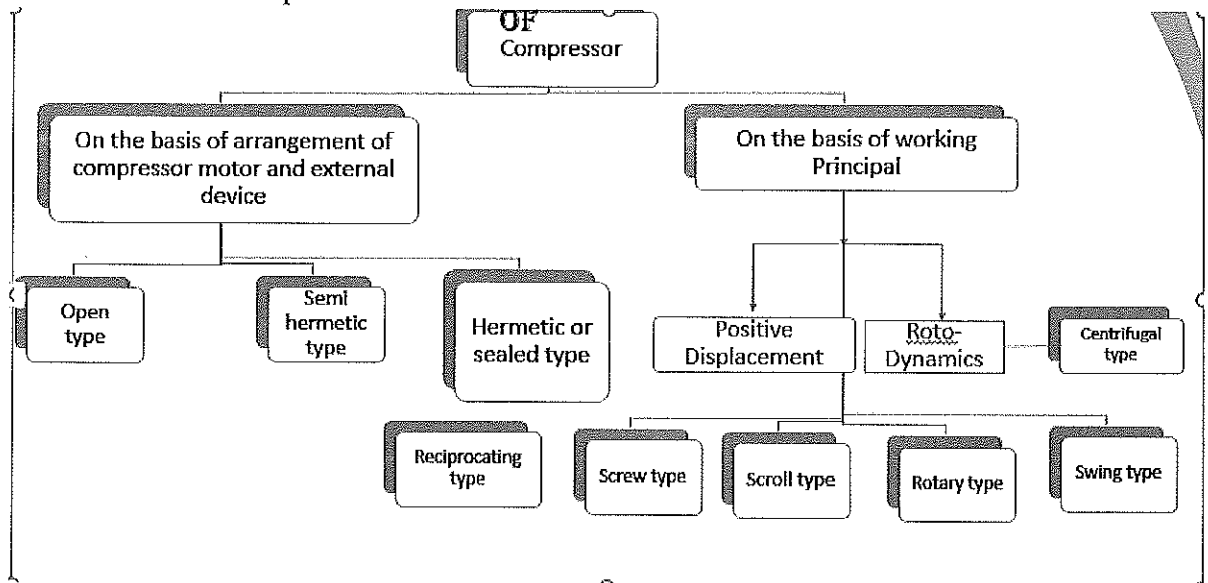
3)

4) Rotary VS Swing Compressor.

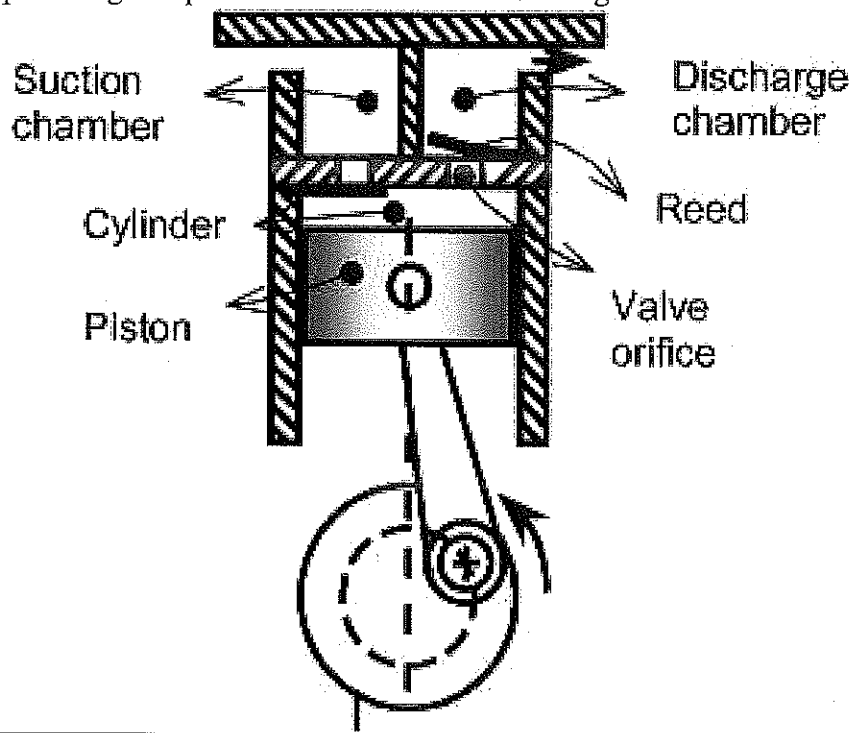
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Long answer question Section C

1) Classification of compressor



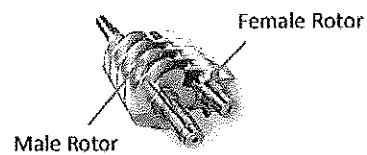
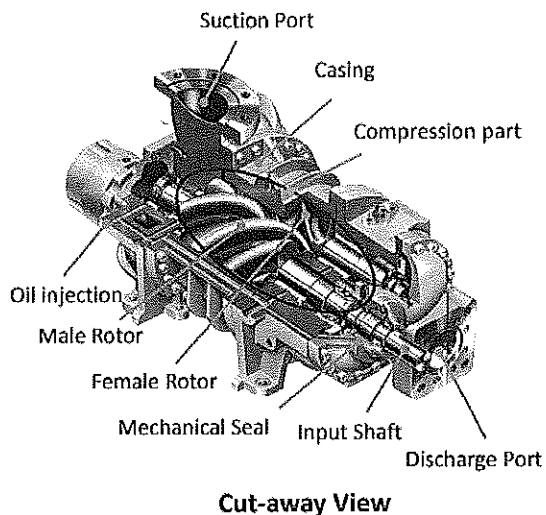
2) Reciprocating compressor construction and working



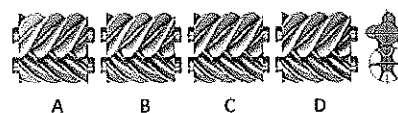
3). Screw Compressor construction and working



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Compression Part



Compression process

Theory of Operation



School of HVAC&R Skills

Session: 2019-20 (Summer / Winter Semester)

B. Voc. 3rd Semester,

1st In-Sem. Examination

Course Code: HVA-1303

Time: 1 Hour

Course Name: Air Distribution

Max. Marks: 20

Instruction: Attempt all questions.

Section – A

05X01 = 05 Marks

1. Which of the following heat transfer mechanisms is used by human body?
a) Radiation b) Convection c) Evaporation d) All of the above

2. What is the acceptable range of temperature and humidity for human comfort in light summer clothing?
a) 72°F, 20% rh b) 70°F, 65% rh c) 80°F, 30% rh d) All of the above

3. When air is heated the relative humidity –
a) Increases
b) Decreases
c) Remains constant
d) may increase or decrease, depending on the air temperature

4. Dry/ Wet Bulb temperatures are measured using:
a) Thermometer
b) Sling psychrometer
c) Dry bulb thermometer
d) Anemometer

5. How the moisture from the air is removed?
a) Condensation.
b) Absorption using desiccants.
c) Both A and B.
d) None of the above.

Section – B

03X02 = 06 Marks

1. State the ways mechanisms of removal of heat of a human body.
2. What is the difference between absolute humidity and relative humidity?
3. What is "clo" and how does it affect thermal comfort?

Section – C

03X03 = 09 Marks

1. Explain comfort conditions for summers and winters with the help of a thermal chart diagram.
2. What are the factors affecting indoor air quality?
3. What is the importance of air & air flow?

Prepared by Shyam Anand Chaturvedi¹⁰

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School of HVAC&R Skills

Session: 2019-20 (Summer / Winter Semester)

B. Voc. 3rd Semester,

1st In-Sem. Examination

Course Code: HVA-1303

Time: 1 Hour

Course Name: Air Distribution

Max. Marks: 20

Answer Key

Section – A

05X01 = 05 Marks

1. D
2. A
3. D
4. B
5. C

Section – B

03X02 = 06 Marks

1. There are four ways the body loses heat to the environment:
 - Conduction
 - Convection
 - Radiation
 - Evaporation

Conduction cools the body by the transfer of heat from the skin to the air surrounding and touching us. Convection accelerates the cooling process by movement of cool air over the body, increasing the transfer of heat from the body to the air. The wind-chill effect often reported in the winter is due to convection. Cooling by radiation occurs when we get close to a large object that is colder than our body temperature. Evaporation is the only body cooling process that does not require cooler surroundings.

Evaporation only requires that the body produce sweat and that the surrounding air be able to absorb water. Rapid evaporation of perspiration produces a cooling effect.

- 2.

Actual amount of water that is contained in the air is called absolute humidity. RH is the relationship between weight of water vapor in a pound of air compared to the weight of water vapor that a pound of air could hold if it was 100% saturated. RH is used to determine air conditions, operating effectiveness and efficiency of a HVAC system

- 3.

Clothing has an insulating value and, in general, the greater the insulating value, the lower the ambient temperature for the same comfort level. Typical indoor winter clothing is 1 clo; a person with shoes, socks, pants/full length skirt, shirt and jacket.



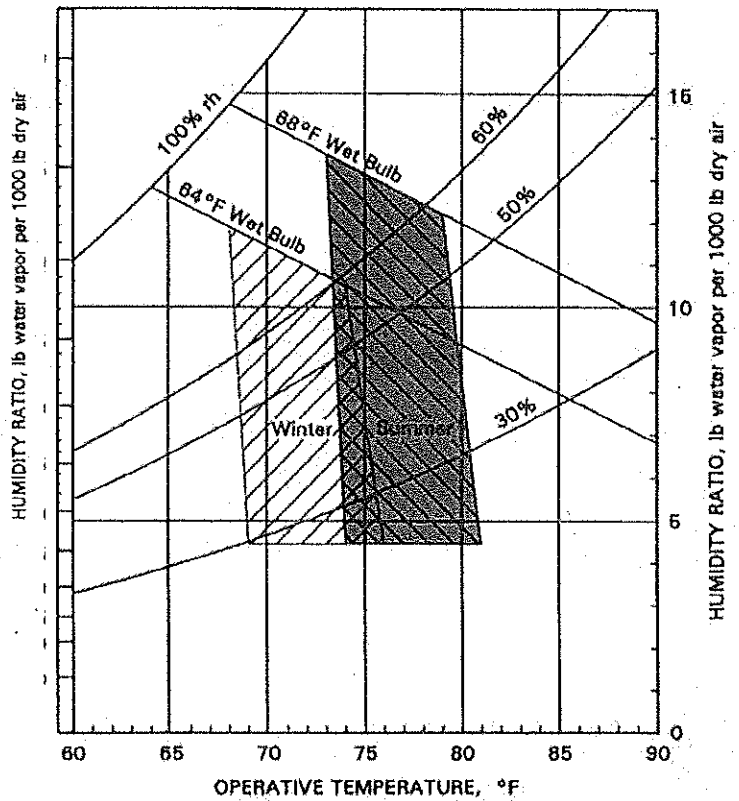
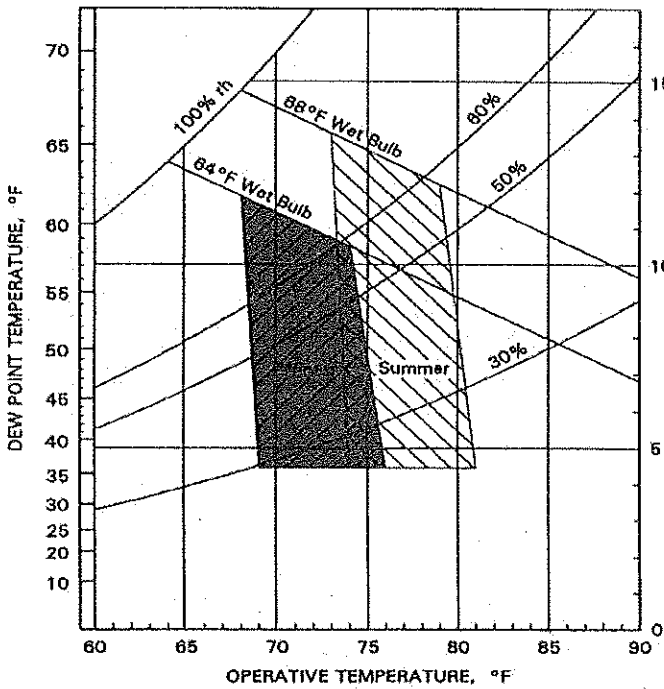
Typical light summer clothing, including shorts/knee-length skirt and short sleeved shirt, is 0.5 clo.

Section – C

03X03 = 09 Marks

1.

From the comfort chart for the summer months, it can be determined that the average individual will be comfortable if the surrounding air is 75°F with a relative humidity of 50%. This is because the 75°F line and the 50% relative-humidity line cross at a point that is located within the “comfort” square. It can also be determined that the average person will not be comfortable if the surrounding air is 85°F



2.

Air contaminants: - Indoor air contaminants can be solid or liquid particles, gases or vapors. Some can be irritants or odiferous, thus affecting occupant comfort. The same contaminants at higher concentrations, as well as others of which occupants may be unaware, can be health risks. People vary in their sensitivity to contaminants. Even very small concentrations of certain fungi and other impurities can cause serious discomfort and impairment of sensitive individuals while not affecting most occupants.

Outdoor air requirements: - It provides designers with a means of determining ventilation rates needed to achieve acceptable indoor air quality, which is defined as: “air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction.”



Exhaust requirements: - Exhaust air systems are either general systems that remove air from large spaces, or local systems that capture aerosols, heat or gases at specific locations within a space and transport them to where they can be collected, filtered, inactivated or safely discharged to the atmosphere.

3.

- Understanding importance of air and airflow is necessary to troubleshoot and maintain an HVACR system.
- Factors affecting airflow will affect system performance.
- Most properties responsible for human comfort are all dependent on air.
- Fresh Air flow is necessary to maintain oxygen level in a space.
- The fresh air mixes with the room air to create comfortable atmosphere in that space.



School of RAC Skills
Session: 2019-20 (Summer Semester)
B. Voc. Program, 3rd Semester,
1st In-Sem. Examination

Course Code: HVA1304

Time: 1 Hour

Course Name: Thermal Insulation

Max. Marks: 20

Section – A

05X01 = 05 Marks

1. Which insulation has highest working temperature?

- a) Rock Wool b) plastic foams
- c) Glass wool d) fiber Glass

2. Perlite is an example of

- a) Stone Wool b) Cellulose
- c) Loose insulation d) ceramic fiber

3. Slag wool is an example of

- a) Plastic Foams b) Natural fibers
- c) Bricklaying insulation d) Loose insulation

4. Working range of PUF Insulation is

- a) -200 to 110 b) 300 – 800
- c) 50 – 450 d) 100- 850

5. Cellulose insulation is made of

- a) Sand b) Stone wool
- c) Dolomite d) Recycled paper and tree fibers

Section – B

03X02 = 06 Marks

1. In ancient time, how did human use natural resources as insulating materials in daily life?
2. Describe characteristics of good thermal insulating material.
3. Write a note on expanded perlite.

Section – C

03X03 = 09 Marks

1. Write a note on history of Artificial insulation.
2. Write a note on importance and advantages of thermal insulating materials.
3. Write a note on classification of thermal insulating materials.

Prepared by
Devendra Pathak

Everdos

G

Answer Sheet

Thermal Insulation

Section A

Answer 1 (a)

Answer 2 (d)

Answer 3 (b)

Answer 4 (a)

Answer 5 (c)

Section B

Answer 1

In Ancient time human was totally depend on natural resources of insulation to protection against wild animals and extreme winter and summer, heavy rain and flood other weather and natural problems.

Here are some examples

Wood: -

Wood was an important part of life, wood is bad conductor of heat so it being used in making shelters and roof and walls. That time wood does not a long life it is a main disadvantage of wood.

Natural fibres: -

Natural fibres are easy to get, cotton, coconut fibre, jute fibre, animal wool are most common fibres. Cotton can be used in clothes to protection against hard weather conditions, Jute and coconut could be used in wall and roof insulation.

Animal wool like sheep and camel wool was main insulating materials in clothing to protection in winters.

Cork: -

Cork and rubber both are tree products use as domestic insulation. Cork had main application in wall insulation.

Sand wood shaving, cellulose were also used as natural insulations.

Answer 2

Characterises of a good thermal insulating material

1. Low thermal conductivity

Lower the thermal conductivity lowers the heat transfer; low heat transfer is the result that we need through thermal insulating materials.

2. Uniform viscosity—it gives uniform thermal properties, that make uniform temperature distribution.

3. Least thermal expansion.

Least thermal expansion makes insulating material easy to handle and safe to use. Thermal expansion makes contraction and elongation in materials that should always avoid.

4. High fire resistance

This property is required because of safety reasons; low fire resistance can make accidents very frequently.

5. Highly Inert

It Should be resistance to oils or liquids, gas fumes, acids and alkalis. Inertness increase its life and fire and other accidents proof.

Answer 3

In 1938 perlite was invented from volcanic products, it has some impurities that absorb water. Rapid heating of perlite on 800-1200 degree Celsius, vaporise the bonded water and resultantly expanded perlite foamed.

However, despite its good insulating efficiency, this is only effective when it is dry or in a loose granular state. As these granules tend to absorb moisture and settle after installation, it becomes less effective as an insulation material with time. It can fill small spaces more completely than fibrous insulation materials. Loose-fill insulation, such as expanded perlite.

Caution is needed during handling and installation of expanded perlite, as perlite dust can cause chronic poisoning

Section C

Answer 1

History of Artificial Insulation

- 1. Mineral wool products
- 2. Foam glass
- 3. Bricklaying elements
- 4. Loose insulations
- 5. Plastic foams
- I. Polystyrene foam
- II. Polyurethane foam

- Mineral Glass Wool

Natural asbestos is the first fibrous mineral in natural wool insulating product category, extensively used by roman on their clothing and roof. It had been used for a long time but after knew it disadvantages it has been abandoned.

First natural wool was formed when steam of volcano turns lava into a fluffy fibre, first it was used only by people who lived nearby volcano's, later it was used commercially

Manufacturing of slag wool began in UK in 1885.

Rock wool was first prepared from in 1897. The commercial production of rock wool started in USA in his factory called the Crystal Chemical Works. It was a very popular in-fill insulation in light frame structures.

Foam Glass

The mass production of foam glass started in 1943 in USA.

This foam glass product was lightweight, rigid, fire, water, so it introduced as a new insulation material.

Very first method of making it was invented in 1931 using silica with 20% combustible material (lignite, coal, wood) and foaming agents (hydrochloric acid, sodium hydroxide solution). This mixture was heated to 1500°C resulting in a porous product.

Bricking Layer Insulation

In 1870s and 1880s main concern was making brick insulation lighter. These projects were started with a series of fail experiments. In 20th century first hollow brick was invented. After it pores bricks were invented, these bricks were baked in fire.

In 1998 aerated autoclaved concrete (AAC) was invented, it is made of lime, metal powder and oil. Today the technology uses ground calcined lime, gypsum and quartz sand, water and aluminium powder as a gas-forming agent

Loose Insulation

Slag was first loose insulation, slabs of slag were being used as roof insulation, it became so popular because it was so cheap. But main disadvantage was its high weight that accumulate water inside. After perlite was discovered

Main breakthrough came in 1938s when expanded perlite was invented by heating perlite around 850 degrees Celsius. In 1950 it became worldwide popular because its high thermal resistance and light weight.

In 1917 expanded clay was invented expanded clay is also a popular insulating material, it is made of special raw material used to make brick (crumbled shale), when this material was heated up to high temperature, grain becomes soft and material expands and forms expanded clay. It can be made by other similar ways.

Plastic foam insulation

1. Polystyrene Foam

In second world war there is need to invent plastic foam insulation because of natural insulation crises.

Polystyrene was first invented as plastic insulation; it is a polymer its monomer is gotten from a tree named as Styra. First experiment was made by Swedish scientist in 1929. There is also another product that is expanded polystyrene. First polystyrene foam was invented in 1931 in USA, it was extruded polystyrene (XPS), it was made with the help of a foaming agent chloromethane.

2. Polyurethane Foam

Polyurethane were invented accidentally in UK in 1933, it was made of ethylene (C_2H_4) with benzaldehyde (C_6H_5CHO) in 1937 it was successfully made in laboratory in Germany. In second world war it was used in aircrafts as insulation. First commercially insulated panels were made in 1950. Then it became a popular building material. After 1950 many other insulating were invented like Polyester foam(PES), Polyethylene foam(PE), Phenolic foam(PF), Formaldehyde foam(UF) etc.

Answer 2

- Reduce the amount of energy required for heating or cooling.
Thermal insulation reduces flow of heat from inside to outside and outside to inside, in summer thermal insulation retard heat flow inside building and reduce heat load of building, reduction in heat load reduce energy requirement to cool building.
This situation in winters, thermal insulation retard flow of heat from inside to outside, so we have higher temperature inside building than outer atmosphere. At the same time our cooling load reduces, so it also reduces power consumption to heat building.
On small building we can't see large reduction in energy consumption but in large commercial building we can see a significant reduction in energy requirement.
- Make a stable temperature inside building.
Thermal insulation makes a stable temperature inside building by retarding flow of heat, thermal insulated homes don't become so cold in night and don't become so hot in day. Regulation on heat flow provide stability in temperature. It is main advantage of thermal insulation.
- Reduce the fuel consumption in power plants.
By maintaining a stable temperature thermal insulation lower power consumption that reduce load on power stations, major portion of electricity is by thermal power plants, when these power stations operate on low load that lowers the consumption of fuel/coal.
- Reduce the emission of harmful gases
There is reduction in emission of harmful gases by thermal insulation, burning of coal in thermal power plants emit harmful gases, thermal insulation reduces consumption of fuel which is directly related with emission of harmful gases.
- Improve the quality of living.
Thermal insulation allows Air Conditioner Refrigerator and other comfort equipment's work efficiently that Improve quality of living. Thermal significantly decrease heating and cooling load that decrease in energy bills. With help of thermal insulation, we can easily control temperature and humidity inside working space with less power that improve quality of living.

Answer 3

According to Shapes

1. Rolls vary in the degree of flexibility and the ability to bend or pressure. They could be fastened by nails like glass wool, rock wool, polyethylene and foil-ceramic rolls
2. Sheets There are specific dimensions and thicknesses such as polyethylene layers, polystyrene, cork and cellulose.

3. Grains a powder or granules are usually placed in the spaces between the walls and it can also be mixed with some other materials. Examples of such materials granulated cork and polymers.

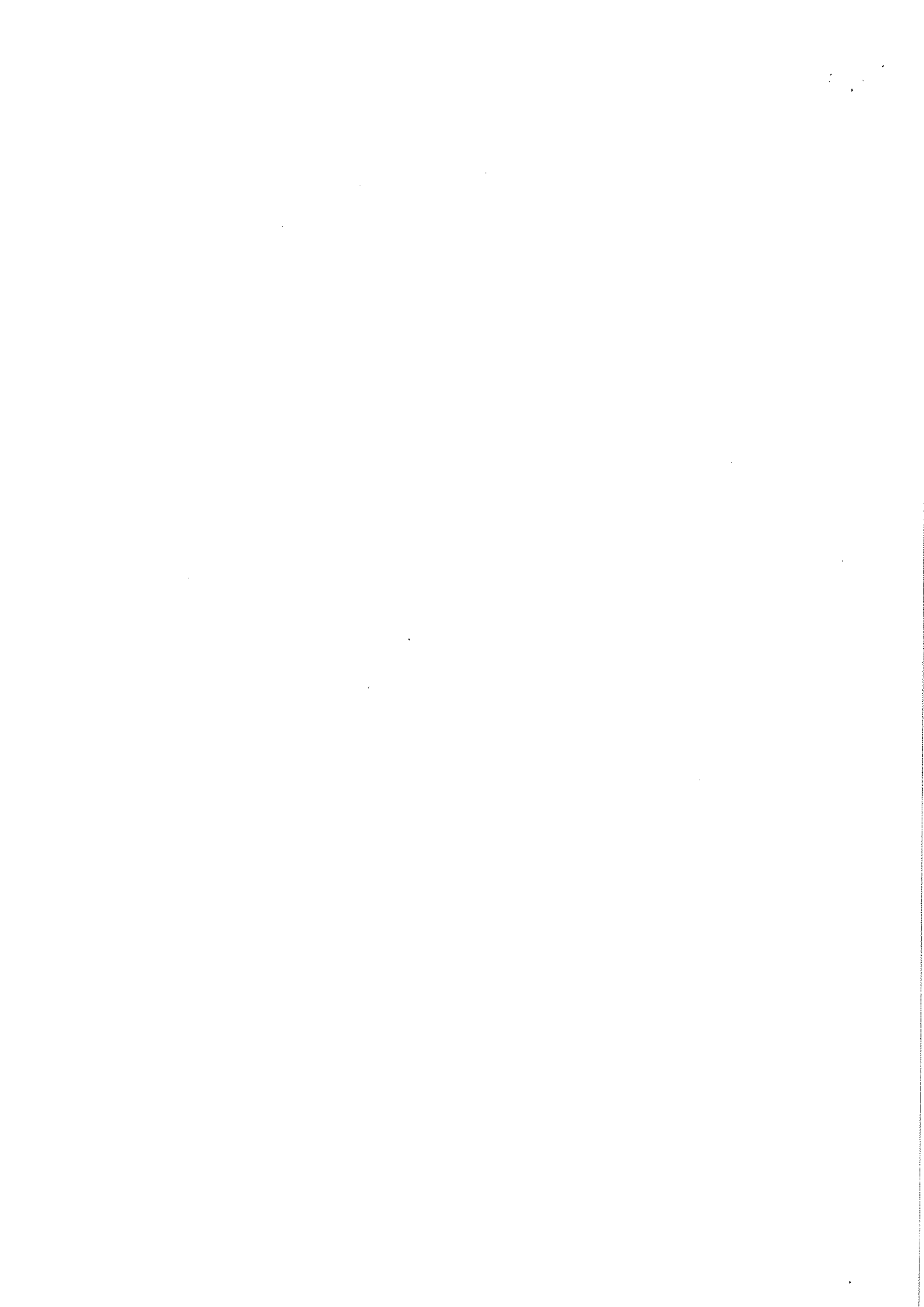
4. Liquid or gaseous form poured or sprayed on to form the desired dielectric layer, such as polyurethane foam and epoxy.

According to Structure

1. Organic such as cotton, wool, cork, rubber and cellulose.
2. Inorganic such as glass, asbestos, Rockwool, perlite, vermiculite and calcium silicate.
3. Metallic: such as aluminium foils and tin reflectors

According to Structure

1. Organic such as cotton, wool, cork, rubber and cellulose.
2. Inorganic such as glass, asbestos, Rockwool, perlite, vermiculite and calcium silicate.
3. Metallic: such as aluminium foils and tin reflectors



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School of HVAC & R Skills
Session: 2019-20 (Summer Semester)
B. Voc. Program, 3rd Semester,
1st In-Sem. Examination

Course Code: HVA 1305**Time: 1 Hour****Course Name: Electrical and Electronics Safety Testing****Max. Marks: 20**

Instruction: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries two marks. Answer all questions from section C, each question carries three marks. Scientific calculator is allowed.

Section – A

05X01 = 05 Marks

- Q.1. Human body can withstand electrical shock up to:
(a) 100 Amps (b) 1 Amp (c) 30 mA (d) Few micro amps
- Q.2. Arc flash tested panels will blow the fault:
(a) Upwards (b) Sideways (c) both A and B (d) None of the above
- Q.3. Which agents are used for electrical fire quenching?
(a) CO₂ (b) FM 200 (c) Inert Gases (d) All of above
- Q.4. For the electronic circuits the value of earth resistance should be less than:
(a) 1 Ω (b) 2 Ω (c) 10 Ω (d) 1000 Ω
- Q.5. As per new requirements, having an electrical safety officer is compulsory for all the projects with _____ kW or more load.
(a) 250 kW (b) 10 kW (c) 1000 kW (d) 5000 kW

Section – B

03X02 = 06 Marks

- Q.1. Why is it essential to provide earthing in electrical systems?
- Q.2. What are the benefits of regular visual inspection of electrical equipment?
- Q.3. Describe the hazards from electrical equipment.

Section – C

03X03 = 09 Marks

- Q.1. What safety precautions to be taken when you are carrying out the work in existing electrical installation?
- Q.2. What precautions to be taken for avoiding any electrical fire?
- Q.3. In new projects which pre-commissioning tests to be carried out.



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School of HVAC & R Skills
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Course Code: HVA 1305

Time: 1 Hour

Course Name: Electrical and Electronics Safety Testing

Max. Marks: 20

Instruction: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries two marks. Answer all questions from section C, each question carries three marks. Scientific calculator is allowed.

Section – A

05X01 = 05 Marks

Q.1. Human body can withstand electrical shock up to:

- (a) 100 Amps (b) 1 Amp (c) 30 mA (d) Few micro amps

Ans. (c)

Q.2. Arc flash tested panels will blow the fault:

- (a) Upwards (b) Sideways (c) both A and B (d) None of these

Ans. (a)

Q.3. Which agents are used for electrical fire quenching?

- (a) CO₂ (b) FM 200 (c) Inert Gases (d) All of these

Ans. (a)

Q.4. For the electronic circuits the value of earth resistance should be less than:

- (a) 1 Ω (b) 2 Ω (c) 10 Ω (d) 1000 Ω

Ans. (a)

Q.5. As per new requirements, having an electrical safety officer is compulsory for all the projects with _____ kW or more load.

- (a) 250 kW (b) 10 kW (c) 1000 kW (d) 5000 kW

Ans. (a)

Section – B

03X02 = 06 Marks

Q.1. Why is it essential to provide earthing in electrical systems?

Ans. Electrical earthing is essential for the safety of human being, machines and material. Proper earthing not only provides safety from shocks, it also provides stability to voltages, does not allow voltages to vary beyond certain limit, and aids protection provisions in solidly earthed system. Hence it is essential to provide proper earthing system.

Q.2. What are the benefits of regular visual inspection of electrical equipment?

Ans. Regular visual inspection of electrical equipment will assist in determining whether it is electrically safe. Visual inspection of electrical equipment may help for knowing the obvious damage, defects or modifications to the electrical equipment, including accessories, connectors, plugs or cord extension sockets, looking for discoloration that may indicate exposure to excessive heat, chemicals or moisture.



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Q.3. Describe the hazards from electrical equipment.

Ans. Hazards from electrical equipment or installations may arise from:

1. The design, construction, installation, maintenance and testing of electrical equipment or electrical installations
2. Inadequate or inactive electrical protection
3. Electrical equipment being used in an area in which the atmosphere presents a risk to health and safety from fire or explosion, for example confined spaces
4. The age of electrical equipment and electrical installations
5. Work carried out on or near electrical equipment or electrical installations, including electric overhead lines or underground electric services, for example work carried out in a confined space connected to plant or services.
6. Exposure to high electromagnetic fields may also present a potential hazard for workers with some medical conditions, for example pace makers.

Section – C

03X03 = 09 Marks

Q.1. What safety precautions to be taken when you are carrying out the work in existing electrical installation?

Ans. To carry out work in the existing installation requires more attention and precautions to ensure safety. The work can be normal maintenance, repairs or expansion/ upgrading projects. No shortcuts should be taken to save time.

1. In case of such work, permit system or similar system must be established to inform all the stake holders. In case work is to be done in live installation, hot permit should be given to only the trained and authorized technical persons.
2. Use correct drawings
3. Ensure Proper Earthing
4. Disconnect supply to the work area and lock all the handles in 'off' position.
5. Display of proper instruction boards
6. Inform all the stake holders
7. Check all the back feeding possibilities
8. Switch off mode for all switchgears
9. Allow only authorized personnel
10. Avoid working in live installation as far as Possible.
11. Use of proper safety equipment

Once all work is completed; Make sure all the power and control connections are place and are tightened properly. Check disconnected cables in particular.

Remove all the tools, unused material, scrap, nut bolts etc. from the work area particularly from the panels, DB's and transformer cable boxes. May accidents happen due to tools left on bus bars.

Check the earthing connections. Remove the phase neutral earthing if done.

Take all the basic tests required for the installation health check. Do not avoid testing even if the installation was working prior to carrying out the work.



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Q.2. What precautions to be taken for avoiding any electrical fire?

Ans. Any fire causes immense loss of property and life. Hence, due care should be taken to minimize the risk of fire so that fire does not start. Same is true in case of electrical fire.

If due care is taken while selecting equipment and installation methods, the possibility of electrical fire can be reduced to a very large extent.

Proper Material

Selection of Good Quality and proper material is essential as cheap and low quality material may not have good electrical & mechanical properties.

These can lead to faults. Also, new fire retardant, fire retardant low smoke or Halogen free fire resistant cables, wires are available. These can be used in high density areas. These materials emit lower smoke and also resist the propagation of fire.

Proper Installation Method

All openings in walls, beams, slabs used for carrying electrical systems/ cables/ wires etc. form one area to another must be sealed by fire retardant/ fire resistant material.

This can stop propagation of fire from one area to another. Vertical shafts in buildings must also be sealed at every level.

This stops the smoke from moving up as smoke is a major reason for fatalities in any fire.

Electrical Protection

Restrict electrical faults in the form of over load, short circuit protection, gas operated relays, over voltage protection, proper earthing and surge arrestors, earth leakage relays.

Necessary protections as demanded by IS standards need to be employed at every level right from substation.

Proper selection of switch gear, EF and OC relays, relay settings, proper rating in terms of current carrying capacities & breaking capacities of MCCB's & MCB's exact OC relay ranges for motor feeders, Earth leakage detection devices where ever required should be employed.

All these protections either preempt the tripping before actual disastrous faults or restrict the electrical faults there by restricting damage to equipment and avoid fire.

Elaborate Pre-Commissioning testes of Pre-commissioning testing of entire electrical installation including continuity, insulation resistance.

Insulation strength, physical and functional checks, earthing resistance need to be done properly and as recommended.

Faulty material and installation can be detected prior to commissioning in most cases if proper testing is done. This avoids accidents both electrical & fire.

Q.3. In new projects which pre-commissioning tests to be carried out.

Ans. Pre-commissioning tests as per standards and manufacturers recommendations have to be done to ensure correctness of installation and health of equipment after installation.

These tests help identifying flaws/ problems in the installation if present, that can lead to a faults and consequent accidents, fire during commissioning or operations.



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These tests are particularly important for HT equipment and installation and once successful, indicate healthiness of system.

These tests will generally include.

- Insulation resistance for all equipment & cables
- Pressure testing of HT cables
- Earth resistance
- Functional tests including interlocks
- Relay setting & testing
- Phase sequence.
- Continuity of phases, neutral & earth.
- HV test.

It will be advisable if testing of HT installation including relay testing is carried out by independent testing agency.

Do not avoid proper testing to save time. This can lead to much larger time wastage and monetary losses along with increased possibility of fatal accidents.