# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

**School of RAC Skills**

**Session: 2019-20 (Summer Semester)**

**B. Voc. Program, 1st Semester,**

**End-Sem. Examination**

**Course Code: HVA-1101** **Time: 2 Hours**

**Course Name: Basic of RAC** **Max. Marks: 50**

## Section – A

10X01 = 10 Marks

1. The ratio of heat extracted in the refrigerator to the workdone on the refrigerant is called:
   a) COP of refrigeration
   b) COP of heat pump
   c) Refrigerating efficiency
   d) Relative coefficient of performance
2. The coefficient of performance is always.....one
   a) Equal to
   b) Less than
   c) Greater than
   d) All of above
3. The efficiency of Carnot heat engine is 80%. The COP of a refrigerator operating on the reversed carnot cycle is equal to:
   a) 0.25
   b) 0.40
   c) 0.60
   d) 0.80
4. During which process does heat transfer occur because of density differences?
   a) conduction
   b) convection
   c) radiation
   d) reflection
5. What method of energy transfer requires no medium for transfer?
   a) conduction
   b) convection
   c) Radiation
   d) All of above
6. At which temperature both degree Celsius and farenhaiet scale are equal:
   a) 100
   b) -40
   c) +40
   d) 0
7. What is the condition for thermodynamic equilibrium?
   a) Thermal equilibrium
   b) Mechanical equilibrium
   c) Chemical equilibrium
   d) All of the above
8. In which direction does heat flow?
   a) From a cold substance to cold substance
   b) Up
   c) Down
   d) From a warm substance to a cold substance

9. Which property remain constant during constant volume process?
   a) Temperature
   b) Pressure
   c) Volume
   d) Enthalpy
10. Different modes of heat transfer are:

a) Conduction
b) Conduction
c) Radiation
d) All of above

## Section – B

04X04 = 16 Marks

1. What are the types of energy used in thermodynamics system? Explain in detail.
2. What is flow work? Derive expression of flow work for an open system also derive expression for displacement work done.
3. Explain different modes of heat transfer in details.
4. What is heat exchanger? Write different types of heat exchanger used in RAC system.

## Section – C

04X06 = 24 Marks

1. What is pressure? Write down different pressure units used in RAC. Explain with neat sketch absolute pressure, gauge pressure, and vacuum pressure.
2. (a) Write down the definition of 1st law of thermodynamics.
   (b) What is Zeroth law of thermodynamics.
3. Differentiate between heat engine, heat pump and refrigeration with neat sketch.
4. A refrigeration cycle absorbs heat at 270 K and rejects it at 300 K
   a) Calculate the COP of this refrigeration cycle
   b) If the cycle is absorbing 1130 kJ/min at 270 K, how many kJ of work is required per second?
   c) If the carnot heat pump operates between the same temperature as the above refrigeration cycle what is the COP?
   d) How many kJ/min will the heat pump deliver at 330 K if it absorbs 1130 kJ/min at 270 K

Answer Key
(A)

# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

**School of RAC Skills**

**1st Semester, End Sem. Examination**

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

**Course Code: HVA-1101** **Time: 1 Hour**

**Course Name: Basic of Refrigeration and Air-Conditioning** **Max. Marks: 20**

**Instruction:** (Attempt all questions.)

Section A

1) a
2) c
3) a
4) b
5) c
6) c
7) d
8) d
9) c
10) d

**Short answer: Section B**

1) Thermodynamics system energy is stored energy (kinetic energy, potential energy and internal energy) and transit energy (work and heat)
   Types of system are: open system, close system and isolated system
2) The energy required to move one molecules of fluid element is called flow work. –vdp and Pdv

3) Conduction, convection and radiation

4. heat exchanger types of heat exchanger are: air cooled, water cooled and evaporative cooling

**Long answer question Section C**

1) Pressure: it is a normal force/unit area
   Different pressure units are: N/m2, Pascal, Bar, atmospheric pressure, torr, PSI, mm of Hg.
   Absolute pressure = atmospheric pressure+ gauge pressure (pressure above atmospheric)
   Absolute pressure = atmospheric pressure- gauge pressure (pressure below atmospheric)

2). Ist law : energy can neither be created nor be destroyed it can transform from one place to another
Zeroth law: when two bodies A and B are in thermal equilibium with another body C, then they are thermal equilibrium with each other.

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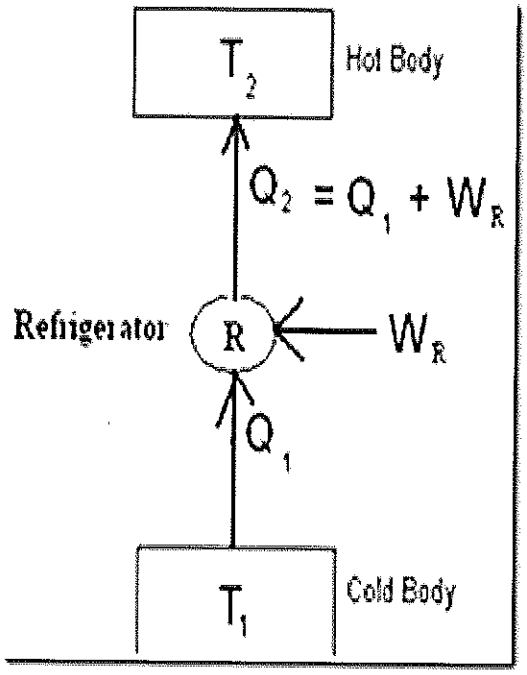
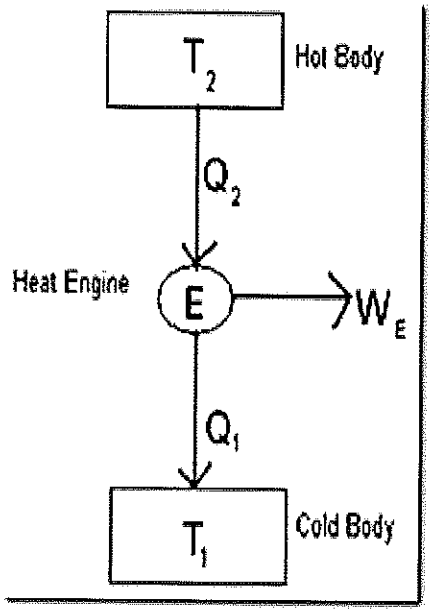



$T_1 < T_a$




$T_1 > T_a$

3).

4. COP = 270/300-270 =9
Cop = Qi/W
9= 18.83/Wr
Wr= 2.1 KJ/s
Heat pump COP= T2/T2-T1= 300/300-270 10
Q2= 1256KJ/min

# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

**School of RAC Skills**

**Session: 2019-20 (Summer Semester)**

**B. Voc. Program 1st Semester,**

**End-Sem. Examination**

**Course Code: HVA1102** **Time: 2 Hours**

**Course Name: Installation and Assembly of Refrigerator** **Max. Marks: 50**

**Instruction:**

## Section – A

10X01 = 10 Marks

1. Which compressor type is most efficient for high load applications?
   a) RSIR
   b) CSIR
   c) CSR
   d) PSC
2. Which device control temperature in a water cooler and refrigerator?
   a) Pressure Switch
   b) Thermostat
   c) Relay
   d) OLP
3. What is full of OLP?
   a) On Load protector
   b) Over Load Protector
   c) Offset Load Protector
   d) Over Line Protector
4. What is main purpose of potential relay?
   a) Provide a smooth starting to compressor.
   b) Provide starting torque
   c) Provide safety against low voltage
   d) Disconnect starting winding after providing starting of motor
5. Which refrigerant is highly flammable?
   a) R290
   b) R134a
   c) R32
   d) R410A
6. Which oil is suitable with R134.
   a) POE
   b) PAE
   c) Glycols

d) Miniral

7. Capillary gauge is made of
   a) Scale
   b) Wires
   c) Holes
   b) blocks
8. What is melting point of copper in centigrade
   a) 1085
   b) 1185
   c) 1285
   d) 1385
9. What is main disadvantage with aluminum heat exchangers?
   a) High Cost
   b) Lower Lifetime
   c) Lower heat transfer
   d) Harmful for environment
10. how many capacitors does a RSIR compressor has?
   a) 0
   b) 1
   c) 2
   d) 3

**Section – B**

04X04 = 16 Marks

1. What are different components of refrigerator and how they work?.
2. Explain working of current relay with suitable sketch?
3. How to charge R134a refrigerant, explain with necessary safety procedures?
4. What are differences between fin-tube and wire tube condenser?

**Section – C**

04X06 = 24 Marks

1. How thermostat control temperature in refrigerator and water cooler?
2. What are basic troubleshooting steps when a fridge is not cooling?
3. Explain working of Refrigerator.
4. How to identify leaks in system and fix it?

# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

(A)

Registration No.: .....

**School of RAC Skills**

**Session: 2019-20 (Summer Semester)**

**B. Voc. Program 3rd Semester,**

**End-Sem. Examination**

**Course Code: HVA1102** **Time: 2 Hours**

**Course Name: Installation and Assembly of Refrigerator** **Max. Marks: 50**

**Instruction:**

## Section – A

10X01 = 10 Marks

1. Which compressor type is most efficient for high loadapplications?
   c) CSR
2. Which device control temperature in a water cooler and refrigerator?
   b) Thermostat
3. What is full form of OLP?
   b) Over Load Protector
4. What is main purpose of potential relay?
   d) Disconnect starting winding after providing starting of motor
5. Which refrigerant is highly flammable?
   a) R290
6. R134 is suitable with which oil.
   a) POE
7. Capillary gauge is made of
   b) Wires
8. What is melting point of copper in centigrade
   a) 1085
9. What is main disadvantage with aluminum heat exchangers
   b) Lower Lifetime
10. how many capacitors does a RSIR compressor has?
    a) 0

## Section – B

04X04 = 16 Marks

1. **What are different components of refrigerator and how they work?.**

**Answer**

These are the part of refrigerator

Metallic body

Insulation layer

Compressor

Cooling coil

Condenser

Thermostat

Shelves

Door

different compartments of fridge.

Components of refrigerator are mounted on its body made in three layers, first layer is made of metallic sheet inside is there is thick insulation layer theirs layer is made of plastic forming, this layer is molded in different curves and shapes to hold items inside cabinet.

At the bottom of fridge compressor is mounted, compressor push the refrigerant in system and create flow. Heat of perishable foods is aborbed by chilled refrigerant in evaporator or cooling coil. This heat is rejected by condenser, in most of cases this condenser is wire and tube type condenser.

Expansion valve is also a important part of system which lowers the temperature of refrigerant.

Thermostat is a temperature controlling device. It switch on and switch off power supply of system according to the temperature.

There are different compartments in fridge to provide different temperature zones in fridge for different food items.

2. **Explain working of current relay with suitable sketch.**

**Answer: -**

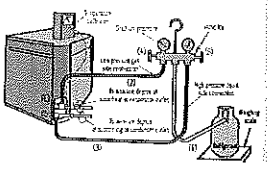
Current Relay: it is one of very common type of relay used with single phase compressors. Current relay operates on current basis as its name indicates. There are two main function of current relay, first one is provide safety against high current condition and second one is switch off starting winding power supply after motor starts properly.

3. **How to charge R134a refrigerant, explain with necessary safety procedures?**

**Non or very less flammable Refrigerant Charging Procedure:-**

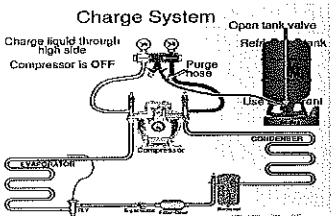
Ensure Vacuuming before charging the system

- Purge the high and low side of system Open.
- Now tight both the low and high-pressure side hose.
- Start charging the gas refrigerant from the refrigerant bottle to the low-pressure side of the HVAC system at connection C by opening the valve A and the refrigerant valve of the charging bottle until the vacuum comes to zero.



- Now start the compressor as the suction pressure goes above zero.
- After about 30 – 40 seconds of charging close the valve A and check the suction gauge pressure for a rise in pressure.

- Keep monitoring the degree of superheat by the temperature calibrator to ensure liquid is not entering into compressor suction also we can calculate how much charge present in the system by the pressure chart.
- If the superheat temperature is high, then it means the system is running low in refrigerant whereas lower superheat temperature than the desired value means the system has overcharged.
- Repeat the procedure 10 to 11 until the suction pressure reaches to 60 psi (as per maker) this avoids the risk of overcharging of the system also keep measuring the refrigerant by the weighing scale.
- Once the refrigerant has charged, close the refrigerant valve, valve A and B and disconnect all the hoses and secure everything.




4. **What are differences between fin-tube and wire tube condenser?**

**Answer**

- Wire and tube condenser are large in size but fin and tube are small in size.
- Wire and tube condenser operates on principle of natural convection but fin and tube condenser operates on forces convection.
- Wire and tube condenser condenser are made of bandi tube on the other hand fin and tube type condenser have tubes of copper with aluminum fins, tubes can also be made of Aluminum.
- Wire and tube type condenser can only used in very low heat load condition, fin and tube type condenser are suitable for almost every load condition.

## Section – C

04X06 = 24 Marks

1. **How thermostat control temperature in refrigerator and water cooler?**

Thermostat in water cooler in gas filled thermostat, these are part of thermostat

feeler bulb

gas pipe comnnected with feeler bulb.

Spring

Bellow

spring

nobe

Electrical terminals

Metals casing.

Working: -

In Metal casing all these componenst except feeler bulb and its pipe are assembled. Feeler bulb sense the temperature and gas which is contact with this bulb expand according to the heat available. This pipe is connected with the bellow, Which is flexible. Expanded gas exert pressure on bellow, on the oppsite of thermostat spring is also apping force. If temperature is high, pressure appied by the gas on the bellow will be more and that push bellow, this movement of bellow connect the interminal terminals and electricity flow through thermostat. If Spring pressure is adjusted in the

manner that it will apply high pressure o bellow than gas pressure, in this condition it will be open circuit inside thermostat and current can't flow through, and compressor will not run.

2. **What are basic troubleshooting steps when a fridge is not cooling?**

**Answer**

Basic steps of trouble shooting of a water cooler when its not working are as follows

Check its condition (visual inspection)

if compressor is in ON condition means cooling system component are working then

check weather compressor is Ground or not

Condenser is hot or not if condenser is not hot means there is less refrigerant in the system or system is chock

check for chock circuit first

if circuit is not chock then check the leak in system, find the leak and remove it. After it vacuum the circuit and charge the refrigerant.

If system in not in ON condition

Check its electrical connections, if there is open circuit, short is by taking required safety procedures

then check condition of relay and capacitor, replace them if they are faulty.

Now check for thermostat, if thermostat is not working replace it.

If after this all system is not working most probably compressor is dead, replace the compressor.

These are basic steps to find faults in water cooler, these steps include many basic operations like

Vacuuming

Refrigerant charging

Leak finding

Brazing etc.

All these operations must perform in a righ

3. **Explain working of Refrigerator.**

**Answer**

Refrigerator a common device used in all scopes of refrigeration to preserve and store perishable food items. It works on VCR cycle. It consists of a heat pump, insulated body and container on which insulation has been applied. VCR cycle work as follows:-

- Compressor compresses refrigerant having low temperature and pressure, after compression refrigerant vapour has a stage of high pressure and pressure

(superheated vapour). This high temperature is not required so we need to reject it, in condenser this temperature(heat) has been rejected into atmosphere. This heat is gained from the evaporator.

- Condenser converts superheated vapour from compressor into subcooled liquid. At the outlet of condenser refrigerant normally has temperature range close to 35-40 degree centigrade. After condenser liquid refrigerant enters into expansion valve, here refrigerant loses its pressure because pipe friction. Pressure and temperature are proportional so sudden large drop in refrigerant creates sudden temperature. Expansion valve almost work opposite of compressor.
- After expansion valve liquid refrigerant having low temperature and pressure enters into a heat exchanger named as evaporator. Here low temperature refrigerant exchanges heat with surrounding (say room), this heat cause evaporation (not boiling) in refrigerant, in this heat exchange process we get cooling on our fridge or cold air through AC.
- At the outlet of evaporator, refrigerant is a mixture of liquid and vapour. It enter into compressor through accumulator and repeat cycle.

4. **How to identify leaks in system and fix it?**

**Answer**

There are many sign that show leak in system, some of them are as follows

Leaking of oil form joints

Low temperature on condenser

Compressor frequent trip

insufficient cooling etc.

leak can be find by following ways

**Leak Testing: -**

Leak testing is one of very critical issue while installing a RAC system. There are many methods to check leak, some of them has discussed below.

1. Leak testing by decay in Vacuum pressure
2. Leak testing by soap solution
3. leak testing by Nitrogen pressure holding
4. Leak testing by UV-rays
5. Leak testing by electronic leak detector.

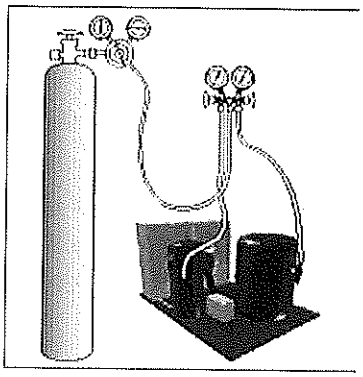
**Decay in vacuum pressure**

This method is also known as vacuum holding, as its name in this method we hold vacuum for some time, if there any decay is showing in vacuum pressure in other words if pressure of system is increasing, this sign show presence of leak in system. This method is not a continent method, because this method is not enough sensitive for small leaks.

**Soap solution: -**

This is a very common and easy method to find leaks. In this method soap solution is applied on leak prone areas. If there is bubble formation in soap solution that indicate leak.
This method is only applicable if system is pressurized.

**Leak detection by Dry Nitrogen pressure holding:-**



In this method nitrogen filled into circuit at high pressure upto 150bars. After it soap solution method is applied that indicate presence of leaks.
In large plants it is not possible to check every single in this condition depression in nitrogen shows presence of leak.

Dry Nitrogen in perfect gas for this operation because it is inert gas.

After Finding leaks in system these leaks can be fix by brazing or make the new flare joints.

# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

**School of Refrigeration & Air Conditioning Skills**

**Session: 2019-20 (Summer Semester)**

**B. Voc. Program, I Semester,**

**End-Sem. Examination**

**Course Code: HVA1103** **Time: 2 Hours**

**Course Name: Assembly & Installation of AC** **Max. Marks: 50**

**Instruction:**

All questions are compulsory.

Section A is objective type.

Section B is short answer type.

Section C is long answer type.

## Section – A

10X01 = 10 Marks

1. What is the measuring unit Temperature?
   a) Watt b) Kelvin c) Bar d) None
2. What is the name of temperature measuring device?
   a) Thermometer b) Micrometer c) Both d) None
3. Which one is more precise, a Vernier caliper with 0.02 mm least count or a micrometer with 0.01 mm least count?
   a) Micrometer b) Vernier Caliper c) Not Comparable d) None
4. How does the power consumption of AC depend upon its star rating?
   a) Directly Proportional b) Inversely Proportional
   c) Equal d) None
5. During the AC installation procedure, nitrogen is hold in copper tubes for---.
   a) Leak testing b) Pressure testing
   c) Temperature testing d) All of the above
6. During the vacuuming of AC, pressure is measured by----.
   a) Compound Gauge b) Thermometer
   c) Sling Psychrometer d) None
7. Flaring tool is used for-----.
   a) Flare making b) Swaging
   c) Both d) None
8. Where does the evaporation of refrigerant take place?
   a) Compressor b) Condenser
   c) Evaporator d) None
9. Where does the condensation of refrigerant take place?
   a) Compressor b) Condenser
   c) Evaporator d) None

10. The feeler bulb of thermostatic expansion valve is placed---.

a) After evaporator b) Before evaporator

c) On evaporator d) None

## Section – B

04X04 = 16 Marks

1. Write down the state of refrigerant inside all the basic components of a VCRS.
2. Define the term condensation and evaporation.
3. The least count of a Vernier caliper is 0.02 mm and minimum measurable value on its main scale is 1mm. Find the total number of divisions on Vernier scale.
4. the least count of a micrometer is 0.02 mm and total number division is 50. Find out minimum measurable value on main scale.

## Section – C

04X06 = 24 Marks

1. Explain vapour compression refrigeration system in detail with neat sketch.
2. Write down the pumping down process in detail.
3. Write a note on "Importance of tool box".
4. Explain different type of expansion device in detail.

# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

**School of Refrigeration & Air Conditioning Skills**

**Session: 2019-20 (Summer Semester)**

**B. Voc. Program, I Semester,**

**End-Sem. Examination**

**ANSWER KEY**

**Course Code: HVA1103** **Time: 2 Hours**

**Course Name: Assembly & Installation of AC** **Max. Marks: 50**

**Instruction:**

All questions are compulsory.

Section A is objective type.

Section B is short answer type.

Section C is long answer type.

## Section – A

10X01 = 10 Marks

1. What is the measuring unit Temperature?

   b) Kelvin

2. What is the name of temperature measuring device?

   a) Thermometer

3. Which one is more precise, a Vernier caliper with 0.02 mm least count or a micrometer with 0.01 mm least count?

   a) Micrometer

4. How does the power consumption of AC depend upon its star rating?

   b) Inversely Proportional

5. During the AC installation procedure, nitrogen is hold in copper tubes for---.

   a) Leak testing

6. During the vacuuming of AC, pressure is measured by----.

   a) Compound Gauge

7. Flaring tool is used for-----.

   a) Flare making

8. Where does the evaporation of refrigerant take place?

   c) Evaporator

9. Where does the condensation of refrigerant take place?

   b) Condenser

10. The feeler bulb of thermostatic expansion valve is placed---.

    a) After evaporator

## Section – B

04X04 = 16 Marks

1. Write down the state of refrigerant inside all the basic components of a VCRS.

Ans: Compressor = vapour

Condenser = Vapour to liquid

Expansion device = Liquid (Moderate Temperature) to liquid (Low Temperature)

Evaporator = liquid to Vapour

2. Define the term condensation and evaporation.

**Ans: Condensation** is the change from a vapor to a condensed state.

**Evaporation** is the change of a liquid to a gas.

3. The least count of a Vernier caliper is 0.02 mm and minimum measurable value on its main scale is 1mm. Find the total number of divisions on Vernier scale.

Ans: Least count = Minimum value on main scale/ Total no. of division

Therefore, total no. of division = 1/0.02

= 50 ans.

4. the least count of a micrometer is 0.02 mm and total number division is 50. Find out minimum measurable value on main scale.

Ans: Least count = Minimum value on main scale/ Total no. of division

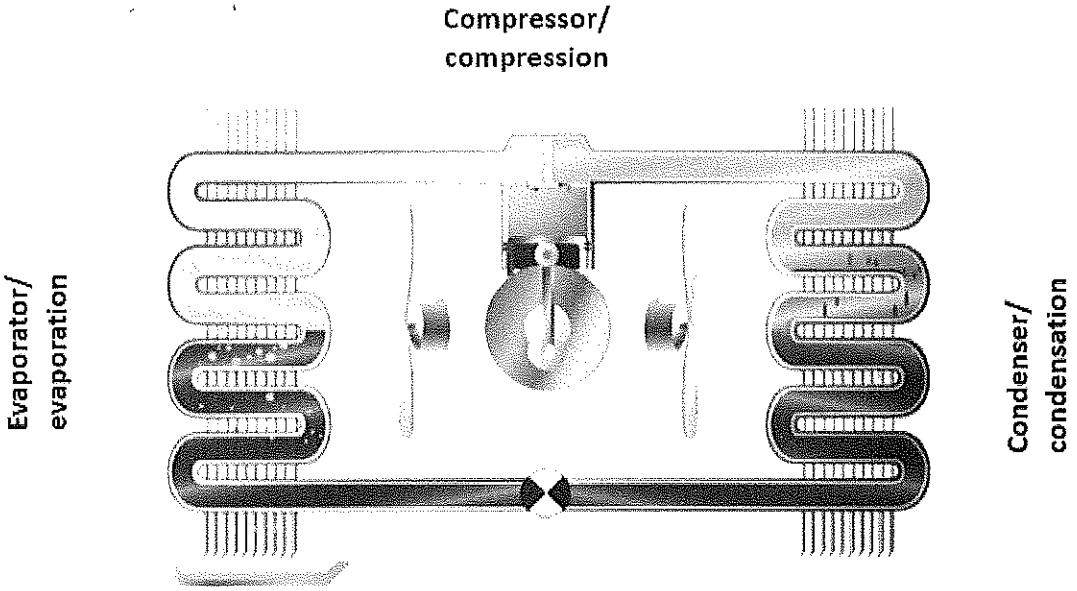
Therefore, Minimum value on main scale = 50* 0.02

= 1 mm ans.

## Section – C

04X06 = 24 Marks

1. Explain vapour compression refrigeration system in detail with neat sketch.




2. Write down the pumping down process in detail.

Ans:

a. Switch off the air conditioning unit.

b. Attach the compound pressure gauge to the vapour line service valve

c. Turn the knob on the service valve, to position it in between fully opened, and fully closed.

d. You will notice that the pressure gauge reading will increase

e. next, operate the air conditioning unit for 3 to 5 minutes,

f. Isolate the liquid line by closing the liquid line service valve.

g. You will start to notice the reducing pressure reading on the compound gauge

h. Isolate the vapour line service valve by closing it, once the pressure reading 0.

3. Write a note on "Importance of tool box".

Sprit level

Bender

Wire cutter

Hammer

Screw driver

Vacuum pump

Etc.

4. Explain different type of expansion device in detail.

Ans:

1. Capillary Tubes
2. Orifice
3. Constant pressure or Automatic Expansion Valve (AEV)
4. Thermostatic Expansion Valve (TEV)
5. Float type Expansion Valve a) High Side Float Valve b) Low Side Float Valve
6. Electronic Expansion Valve

**Capillary Tube**

A capillary tube is a long, narrow tube of constant diameter. The word "capillary" is a misnomer since surface tension is not important in refrigeration application of capillary tubes. Typical tube diameters of refrigerant capillary tubes range from 0.5 mm to 3 mm and the length ranges from 1.0 m to 6 m. The pressure reduction in a capillary tube occurs due to the following two factors:

1. The refrigerant has to overcome the frictional resistance offered by tube walls. This leads to some pressure drop, and
2. The liquid refrigerant flashes (evaporates) into mixture of liquid and vapour as its pressure reduces. The density of vapour is less than that of the liquid. Hence, the average density of refrigerant decreases as it flows in the tube. The mass flow rate and tube diameter (hence area) being constant, the velocity of refrigerant increases since = ρVA. The increase in velocity or acceleration of the refrigerant also requires pressure drop.

**Thermo - static Expansion Valve**

The name 'thermostatic-expansion valve' may give the impression that it is a temperature control device. It is not a temperature control device and it cannot be adjusted and used to vary evaporator temperature. Actually TEV is a throttling device which works automatically, maintaining proper and correct liquid flow as per the dictates of the load on the evaporator. Because of its adaptability to any type of dry expansion application, automatic operation, high efficiency and ability to prevent liquid flood backs, this valve is extensively used.

The functions of the thermostatic-expansion valve are:

(a) To reduce the pressure of the liquid from the condenser pressure to evaporator pressure,

(b) To keep the evaporator fully active and

(c) To modulate the flow of liquid to the evaporator according to the load requirements of the evaporator so as to prevent flood back of liquid refrigerant to the compressor.

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# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

**School of Refrigeration and Air conditioning**

**Session: 2019-20 (Summer / Winter Semester)**

**B. Voc.Semester,1ST Semester,**

**End-Sem. Examination**

**Course Code: HVA1104** **Time: 2 Hours**

**Course Name: Sheet Metal & Welding** **Max. Marks: 50**

**Instruction:** All questions are compulsory

**Section – A**

10X01 = 10 Marks

1.Which among the following electrode works on D.C+_____

a.Basic

b.Rutile

c.Cellulose

d.Special purpose

2.In Oxy-Fuel Process which has high pressure_____

a.Butane

b.Acetylene

c.Oxygen

d.Argon

3.Acetylene Cylinder Line pressure & cylinder pressure are _____

a. 0.25 bar & under19 bar

b. 0.5psi & 200 psi

c. 0.5bar & 200 psi

d. 0.25Psi &19bar

4. Valve on cylinder is also known as ?

a.Bull nose key

b.Square Peg Valve

c.Non return valve

d.Butterfly Valve

5.Welding Electrode 7018?

a. Cellulose Electrode

b. Rutile Electrode

c. Basic Electrode

d. Special Purpose Electrode

6.Primary Classification Types of Joining Process are?
a. Welding and brazing
b.Nut & bold
c.Temporary & Permanent
d.Adhesive

7.Filler rod used with copper during brazing is:

a)Titanium
b)silver
c)Copper
d)Copper phosphorous

8.Oxygen cylinder Line pressure & cylinder pressure are

a)0.5 bar & 200 bar
b) 0.5psi & 200 psi
c)0.5bar & 200 psi
d)0.25Psi &19bar

9. Colour coding for Oxygen & Acetylene

a)Red &Blue

b)Black & white

c)Blue & Red

d)Maroon & Ruby Red

10.Flux used in Brazing is?

a)Boron
b)Borax
c)silver oxide
d) Titanium di oxide and salt of Sodium

**Section – B**

04X04 = 16 Mark

QB.1a) Name and state the tools required by the welders?
b) State the care and maintenance to keep the hand tools in a good working condition?

QB.2 .)what are the safety precautions used in Arc Welding ?

QB.3)Write down the brief steps for setting up Oxy-fuel Welding?

QB.4)Write the difference between Permanent and temporary Joints?

# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

**Section – C**

04X06 = 24 Marks

QC1) What are the types of flames generated in Gas welding /OxyFuel Welding .

Draw the Types of Flame and label it?

QC2) write down the different accessories and gauges used for OxyFuel process?

b)Write down the safety procedures used while working with

1)Oxy fuel

2)Electric arc

QC3)What is brazing ?How it is different from Welding & Mention the temperature difference between these two?

QC.4)Why Metal is shielded by a Gas or a Flux during welding ,

Mention the name of gases used to shield the work piece?

(A)

Registration No.: .....

**School of Refrigeration and Air conditioning**

**Session: 2019-20 (Summer / Winter Semester)**

**B. Voc.Semester,1ST SEM**

**End-Sem. Examination**

**Course Code: HVA1104** **Time: 2 Hours**

**Course Name: Sheet Metal & Welding** **Max. Marks: 50**

**Instruction:** (if any)

**Section – A**

10X01 = 10 Marks

10 objective type questions, each question carries 01 mark.

1.Which among the following electrode works on D.C+_____

a.Basic
b.Rutile
c.Cellulose
d.Special purpose

2.In Oxy-Fuel Process which has high pressure_____

a.Butane

b.Acetylene

c.Oxygen
d.Argon

3.Acetylene Cylinder Line pressure & cylinder pressure are _____

a. 0.25 bar & under19 bar
b. 0.5psi & 200 psi
c. 0.5bar & 200 psi
d. 0.25Psi &19bar

4. Valve on cylinder is also known as ?

a.Bull nose key

b.Square Peg Valve

c.Non return valve

d.Butterfly Valve

5.Welding Electrode 7018?
a. Cellulose Electrode

b. Rutile Electrode

c. Basic Electrode

d. Special Purpose Electrode

6.Primary Classification Types of Joining Process are?
a.Welding and brazing
b.Nut & bold
c.Temporary & Permanent
d.Adhesive

7.Filler rod used with copper during brazing is:

a)Titanium
b)silver
c)Copper
d)Copper phosphorous

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a)0.5 bar & 200 bar
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d)0.25Psi &19bar

9. Colour coding for Oxygen & Acetylene

a)Red &Blue

b)Black & white

c)Blue & Red

d)Maroon & Ruby Red

10.Flux used in Brazing is?

a)Boron
b)Borax
c)silver oxide
d) Titanium di oxide and salt of Sodium

**Section – B**

04X04 = 16 Marks

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

QB.1a) Name and state the tools required by the welders?
b) State the care and maintenance to keep the hand tools in a good working condition?
Answer State the care and maintenance to keep the hand tools in a good working condition?
(a) Double ended spanner -it is used to loosen or tighten nuts ,bolts
(b) Cylinder key – to lossen and allow the gas to flow out
(c) Nozzle & Tip cleaner-In order to direct the flow nozzle is used and tip cleaner allows us to clear the carbon or foreign residue stuck in the passage of the tip of nozzle.
(d) Spark lighter to Ignite the flame

(e) Wire brush used to clean the surface of metal in order to remove the rust or settlement on the base plate

(f) Chipping hammer – to remove slag from the welded or joined surface

(g) Tongs to handle the hot material and place it

to take care of the tool one needs to do the following

Using tip cleaner to remove the carbon select the correct drill and move it, without turning ,through hole in the tip.

Smooth files are used to clean the surface of the tip.

QB.2a)what are the safety precautions used in Arc Welding ?

Answer2a.Safety Precautions used in the arc welding are as follows

Electric shock- Using Personal protective Equipment like non static shoes, proper clamping of earths lugs ,

Pre and Post check for wire wear and tear.

Spark and spatter -Sleeves and leather apron, leather gloves

Smoke and fumes -using nose mask and fume ventilation in the workshop

Heat radiation -use tongs or a long leg lenth material handling equipments to prevent from these

Chipped and hot slag particles ;should be using hard gloves while working

Hot jobs and stub ends using of infrared temperature to read the surface temprature and using tongs to move the heated base plate

QB.3)Write down the brief steps for setting up Oxy-fuel Welding?

Answerb.3)ans3 Steps for setting up Oxy fuel Welding

Preparation step

Step 1-Gas generation or Pressuring the flow.

The Very First step of the gas welding is to get the line pressure to the desired range and required bay.

For this Cylinder Peg valves are open and set to desired pressure

1)Acetylene- cylinder pressure is below 19 bars and line pressure is set to .25bar

2)Oxygen:-Cylinder Pressure is set at 200 bar and .5 line pressure measured with the help of master gauge.

Step2. Connect the hose to the nozzle after cleaning

Inspect for Non return Valve /flash gas arrester

procedure step 1 Open the regulator of the acetylene and with a use of spark lighter enlight the flame

Immediately after lighting up open the oxygen regulator and try to stabilized the flame

heat the metal surface linearly heat the surface

Step 3 Add filler

Addition of filler is done at achieving of desired temperature range.

Step4 Allow to solidifies

QB.4)Write the difference between Permanent and temporary Joints?

Answer B4)

| Temporary Joint | Permanent Joint |
|---|---|
| Temporary joints allow easy dismantling of assembled components without breaking them. | Permanent joints don't allow dismantling of assembled components without rupturing them. |
| Temporary joints are not necessarily leak-proof. | Permanent joints are usually leak-proof. |
| Strength of temporary joint is comparatively less. | Strength of permanent joint is high. Usually joint strength is same with that of the components. |
| It facilitates fast, easy and cost efficient inspection. No destructive testing is required for inspection of joints. | As permanent joints cannot be disassembled easily, so inspection is difficult and costly. Often destructive testing is carried out, which damages the assembled structures. |
| Repair and replacement are also easy. | Repair and replacement are difficult and costly. |
| Temporary joints are suitable where frequent separation of assembled components is required. | Permanent joints are suitable for such applications where separation is usually not desired in the service life. |

**Section – C**

04X06 = 24 Marks

0C long type questions, each question carries 06 marks.

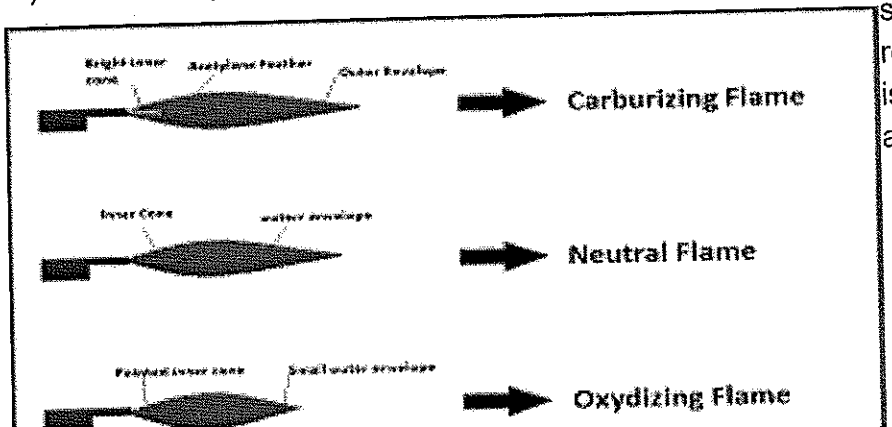
QC1) What are the types of flames generated in Gas welding /OxyFuel Welding . Draw the Types of Flame and label it?

Answer C1

There are **three** basic **flame types**:

Neutral (balanced), A neutral **flame** is named neutral since in most cases will have no chemical effect on the metal being welded.

2)Excess acetylene (carburizing), will produce iron carbide, causing a chemical change in steel and iron. For this reason a carburizing flame is not used on metals that absorb carbon



3)Excess oxygen (oxidizing) is hotter than a neutral flame and is often used on copper and zinc.

QC2) write down the different accessories and guages used for OxyFuel process?
Answer Regulators To control the mass flow rate ogf the gases ,
2acetylene hose:hose for flow of gas from regulator to nozzle
3Oxygen hose for flow of gas from regulator to nozzle
4)Oxygen control valve to control The oxygen gas
acetylene control valve to control the actelyne gas
5)Torch :-To direct the flame
6Bull nose key:-to open square peg valve of the cylinder
b)Write down the safety procedures used while working with
1)Oxy fuel
2)Electric arc
QC3)What is brazing ?How it is different from Welding & Mention the temperature difference between these two?
Answer QC3)**Brazing** is a metal-joining process in which two or more metal items are joined together by melting and flowing a filler metal into the joint, the filler metal having a lower melting point than the adjoining metal filler is filled by capillary action.

In welding the base metal is heated to molten temperature at the pool side while in brazing only the filler rod(lower temperature than base metal) is heated to melting temperature and allows to solidify.
Temprature range for brazing is above 450-970degree celcius
QC.4)Why Metal is shielded by a Gas or a Flux during welding ,
Mention the name of gases used to shield the work piece?
Answerc.4 )The primary purpose of **shielding gas** is to prevent exposure of the molten weld pool to oxygen, nitrogen and hydrogen contained in the air atmosphere. The reaction of these elements with the weld pool can create a variety of problems, including porosity (holes within the weld bead) and excessive spatter.
Gases used to shield the work piece are
Argon
argon+co2 20% is used for short arc welding

Depending upon the Arc length the pressure of Argon and co2 is controlled as it provides best penetration power to protect the metal beads so formed

Registration No.: .....

# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

**School of Electrical Skills**
**Session: 2019-20 (Summer Semester)**
**B. Voc. Program, 1st Semester,**
**End – Sem. Examination**

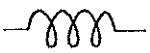
**Course Code: HVA1105** **Time: 2 Hours**
**Course Name: RAC Electricals** **Max. Marks: 50**

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

**Section – A**

10x01 = 10 Marks

1. The symbol of resistor is:

   (a)  (b)  (c)  (d) None of these

2. The unit of power is:

   (a) W (b) Wh (c) A (d) V

3. Rate of flow of electric charge in an electric circuit is known as:

   (a) Voltage (b) Current (c) power (d) Energy

4. The mass of neutron is:

   (a) less than (b) greater than (c) equal to (d) None of these

5. In an atom particles having positive charge is called:

   (a) Proton (b) Neutron (c) Electron (d) None of these

6. Two resisters of resistance R1 and R2 are connected in parallel the equivalent resistance (R) is:

   (a) R= R1+R2 (b) R=(R1R2)/(R1+R2)

   (c) R=(R1+R2)/(R1R2) (d) None of these

7. Given, V=10sin100 $\pi$ t find the frequency f:

   (a) 50Hz (b) 100Hz (c) 60 Hz (d) None of these

8. The unit of magnetic flux is:

   (a) Henry (b) Weber
   (c) ampere turn/ weber (d) ampere/meter

9. A current is said to be direct current when its:
   (a) Magnitude remains constant with time
   (b) Magnitude changes with time
   (c) Direction changes with time
   (d) Magnitude and direction changes with time

10. The property of a material which opposes the creation of magnetic flux in it is known as:

    (a) Reluctivity (b) magneto motive force (c) permeance (d) reluctance



A

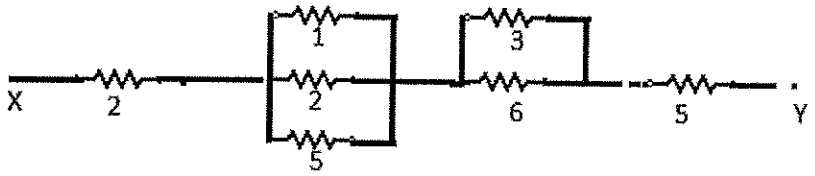
Registration No.: .....

# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

## Section – B

04x04 = 16 Marks

1. What do you mean by Electric Power?
2. What do you mean by a resistance?
3. Find the equivalent resistance between X and Y (Given all the resistances are in ohms).




4. Explain the properties of magnetic lines of force.

## Section – C

04x06 = 24 marks

1. State and explain Kirchhoff's Voltage Law with suitable example.
2. State and explain Ohms law.
3. Complete the following table for a circuit consisting of a voltage source connected in series with a resistance.

| | Voltage (V) | Current (A) | Power (w) | Resistance (ohm) |
|---|---|---|---|---|
| 1. | 100 | | | 1000 |
| 2. | 500 | 20 | | |
| 3. | | 10 | 1000 | |

4. Draw a sine wave and explain following:
   a. Cycle
   b. Time period
   c. Frequency
   d. Amplitude.

# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

**School of Electrical Skills**

**1st Semester, End-Sem. Examination**

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

**Course Code: HVA1105** **Time: 2 Hours**

**Course Name: RAC Electricals** **Max. Marks: 50**

## Section – A

10X01 = 10 Marks

1. (a) 
2. (a) W
3. (b) Current
4. (b) greater than
5. (a) Proton
6. (b) R=(R1R2)/(R1+R2)
7. (a) 50Hz
8. (b) Weber
9. (a) Magnitude remains constant with time
10. (d) reluctance

## Section – B

04X04 = 16 Marks

1. What do you mean by Electric Power?

   Electric power is the rate of energy consumption in an electrical circuit.

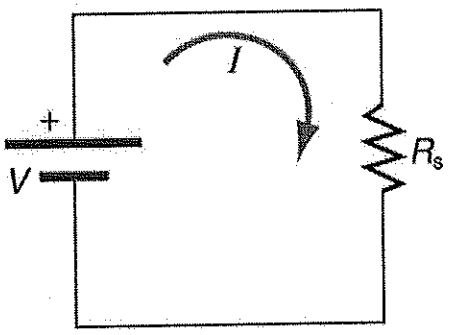
   Electric power is the rate at which energy is transferred to or from a part of an electric circuit

   The electric power is measured in units of watts.

   General form:

   electric power = Potential difference x current

   P = VI




2. What do you mean by a resistance?

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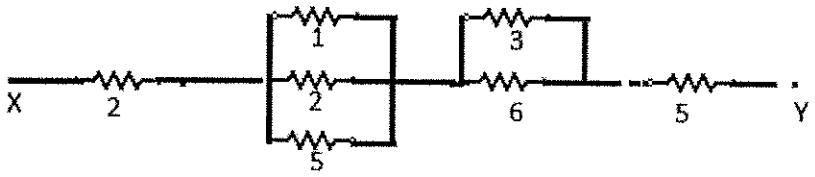
- Resistance is the 'opposition' to the current flow measured in ohms (Ω)
- Conductors have a low value of resistance
- Insulators have a very high resistance
- Load in DC/AC circuits

3. Find the equivalent resistance between X and Y (Given all the resistances are in ohms).




REq= [1||2||5]+[3||6]+5+2

REq=({[10/17]+[2]+5+2

REq=10/17+9

REq=9.58

4. Explain the properties of magnetic lines of force.

- Magnetic flux of a filed is considered as the total number of magnetic lines of force in the field. These are also called magnetic flux lines.
- Each magnetic flux line is closed loop.
- Each magnetic flux line starts from north pole of a magnet and comes to the south pole through the field and continues from south pole to north pole in the body of the magnet.
- No two flux lines cross each other.
- Two similar lines of force travel side by side but repeal each other.
- The lines of force are stretched like elastic cord.

**Section – C**

04X06 = 24 Marks

1. State and explain Krichhoff's Voltage Law with suitable example.

KVL states that the algebraic sum of the voltages between successive nodes in a closed path in a circuit is equal to zero

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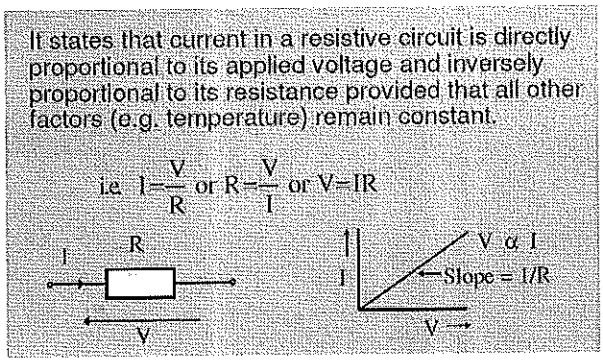
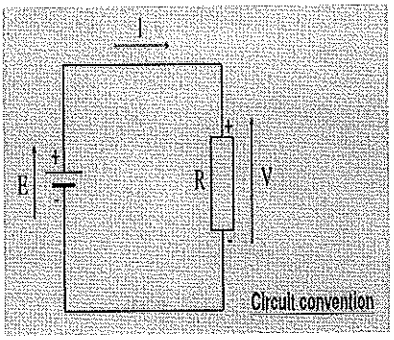
Or

Algebraic sum of all the voltages in a closed electrical circuit is equal to zero.

2. State and explain Ohms law.




3. Complete the following table for a circuit consisting of a voltage source connected in series with resistance.

| | Voltage (V) | Current (A) | Power (w) | Resistance (ohm) |
|---|---|---|---|---|
| 1. | 100 | | | 1000 |
| 2. | 500 | 20 | | |
| 3. | | 10 | 1000 | |

Ans

1. V=100

   R=100

   Then I= 100/1000

   0.1

   P=V*I=.1*100=10

2. P=500*20=10000

   R=V/I=500/20=25

3. P=1000

   I=10

   1000=10^2*R

   R=1000/100=10

   V=I*R

   V=10*10

| | Voltage (V) | Current (A) | Power (w) | Resistance (ohm) |
|---|---|---|---|---|
| 1. | 100 | 0.1 | 10 | 1000 |
| 2. | 500 | 20 | 1000 | 25 |
| 3. | 100 | 10 | 1000 | 10 |

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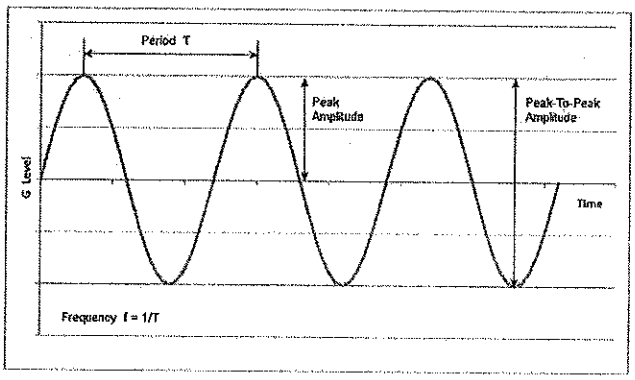
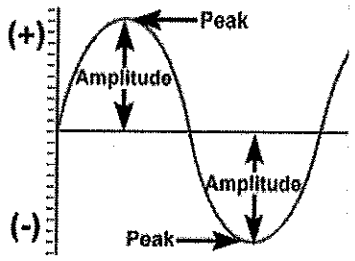
4. Draw a sine wave and explain following
   a. Cycle
   b. Time period
   c. Frequency
   d. Amplitude.




Cycle: One complete wave of alternating current or voltage.

Time Period (T): The time required to produce one complete cycle of a waveform

Frequency (f): is equal to number of cycles per second.

f=1/T

Amplitude: is the magnitude or intensity of the signal waveform measured in volts or amps.

# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

**School of HVAC Skills**

**Session: 2019-20 (Summer Semester)**

**B. Voc. Program, 1st Semester,**

**End-Sem. Examination**

**Course Code:** HVAC1106 **Time: 2 Hours**

**Course Name:** Electronics and Instrumentation **Max. Marks: 50**

## Section – A

10X01 = 10 Marks

1. Select the equation below that represents the relationship between charge, capacitance, and voltage for a capacitor
   a) Q = CV
   b) C = QV
   c) $X_c = 1/2\pi fC$
   d) V = IR

2. In a PN junction with no external voltage, the electric field between acceptor and donor ions is called a
   a) Peak
   b) Barrier
   c)Threshold
   d) Path

3. How is a 3.9 kΩ resistor color-coded?
   a) Red, white, red, gold
   b) Red, green, orange, silver
   c) Orange, white, red, gold
   d) Orange, green, orange, silver

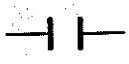
4. In a semiconductor, the energy gap between the valence band and conduction band is about -
   a) 5 eV
   b) 10 eV
   c) 15 eV
   d) 1 eV

5. When transistors are used in digital circuits they usually operate in the-
   a) Active region
   b) Breakdown region
   c) Saturation and cutoff regions
   d) Linear region

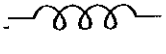
6. In a LED, the light is produced by a solid state process called as
   (a) Light radiation
   (b) Electroluminescence
   (c) Light multiplication
   (d) Phosphorescence

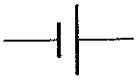
7. If at one end, the two wires made of different metals are joined together then a voltage will get produced between the two wires due to difference of temp between the two ends of wires. This effect is observed in
   a) Thermocouples
   b) Thermistors
   c) RTD
   d) Ultrasonics

8. The symbol used for inductance is-

   a) 

   b) 

   b) 

   d) 

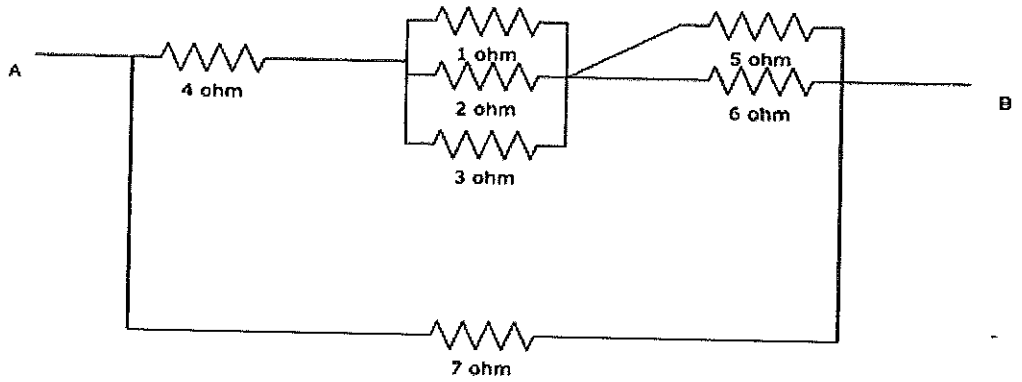
9. A capacitor consists of two
   a) Conductors only
   b) Dielectric only
   c) Conductors separated by a dielectric
   d) Dielectric separated by a conductor

10. The purpose of using flux in soldering is to-
   a) Increase fluidity of solder metal
   b) Fill up gaps left in a bad joint
   c) Prevent oxides forming
   d) Wash away surplus solder

## Section – B

04X04 = 16 Marks

1. Calculate the resistance between A and B.




2. What is the function of transistor? Explain its Common Collector configuration.
3. What is the effect of temperature on insulator, semiconductor and conductor.
4. What is a full-wave rectifier? Explain its working.

## Section – C

04X06 = 24 Marks

1. What are the basic components in electronics? Draw symbols with explanation.
2. What is a transducer? Is a speaker a transducer? Why transducers are required?
3. What is the working principle of photovoltaic cell?
4. What is thermistor and how it works? Write its applications.

# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

**School of HVAC Skills**

**Session: 2019-20 (Summer Semester)**

**B. Voc. Program, 1st Semester,**

**End-Sem. Examination**

**Course Code:** HVAC1106 **Time: 2 Hours**

**Course Name:** Electronics and Instrumentation **Max. Marks: 50**

## Section – A

10X01 = 10 Marks

1. Select the equation below that represents the relationship between charge, capacitance, and voltage for a capacitor
   a) Q = CV b) C = QV
   c) $X_c = 1/2\pi fC$ d) V = IR

a) Q = CV

2. In a PN junction with no external voltage, the electric field between acceptor and donor ions is called a
   a) Peak b) Barrier
   c)Threshold d) Path

b) Barrier

3. How is a 3.9 kΩ resistor color-coded?
   a) Red, white, red, gold b) Red, green, orange, silver
   c) Orange, white, red, gold d) Orange, green, orange, silver

c) Orange, white, red, gold

4. In a semiconductor, the energy gap between the valence band and conduction band is about -
   a) 5 eV b) 10 eV
   c) 15 eV d) 1 eV

d) 1 eV

5. When transistors are used in digital circuits they usually operate in the-
   a) Active region b) Breakdown region
   c) Saturation and cutoff regions d) Linear region

c) Saturation and cutoff regions

6. In a LED, the light is produced by a solid state process called as
   (a) Light radiation (b) Electroluminescence
   (c) Light multiplication (d) Phosphorescence

(b) Electroluminescence

7. If at one end, the two wires made of different metals are joined together then a voltage will get produced between the two wires due to difference of temp between the two ends of wires. This effect is observed in
   a) Thermocouples b) Thermistors
   c) RTD d) Ultrasonics

a) Thermocouples

8. The symbol used for inductance is-

a) 

b) 

b) 

d) 

b)

9. A capacitor consists of two
   a) Conductors only
   b) Dielectric only
   c) Conductors separated by a dielectric
   d) Dielectric separated by a conductor

c) Conductors separated by a dielectric

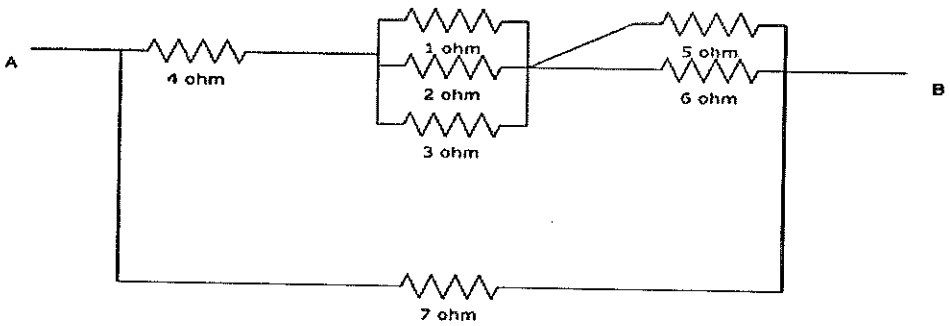
10. The purpose of using flux in soldering is to-
   a) Increase fluidity of solder metal
   b) Fill up gaps left in a bad joint
   c) Prevent oxides forming
   d) Wash away surplus solder

c) Prevent oxides forming

**Section – B**

04X04 = 16 Marks

**1. Calculate the resistance between A and B.**




**Ans.** The 1 ohm, 2 ohms and 3 ohm resistors are connected in parallel.

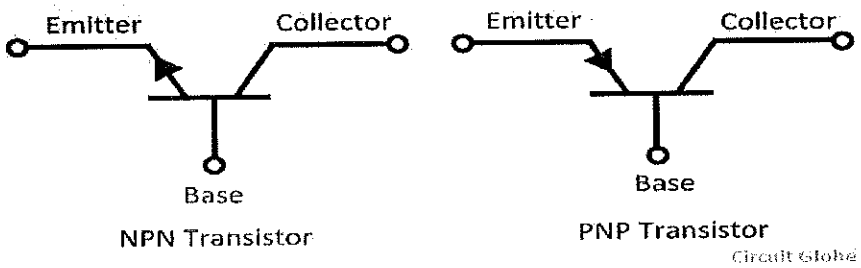
Its equivalent resistance is in series with the 4 ohms resistor and the parallel connection of the 5 ohms and 6 ohms resistor.

The equivalent resistance of this combination is 80/11 ohm.

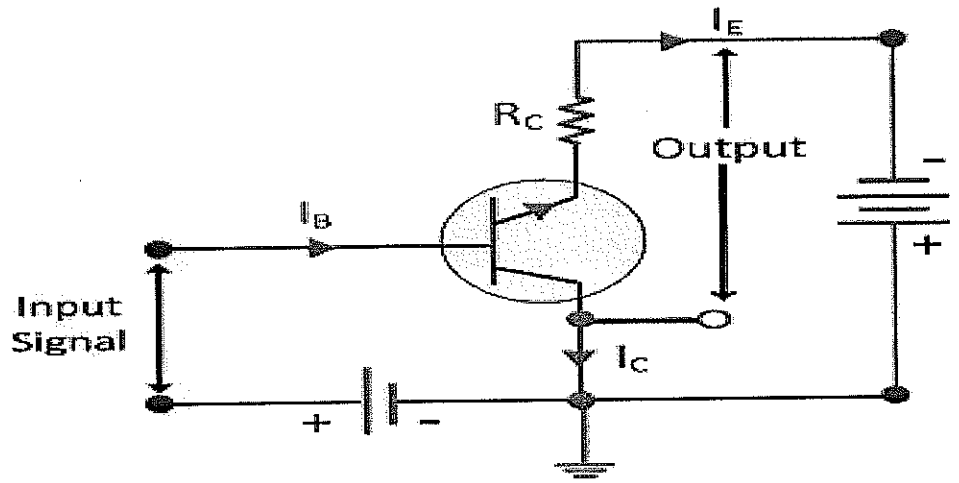
This is in parallel with 7 ohms to give equivalent resistance between A and B is 3.56 ohm.

**2. What is the function of transistor? Explain its Common Collector configuration.**

**Ans.** The transistor is a semiconductor device which transfers a weak signal from low resistance circuit to high resistance circuit. The words **trans** mean transfer property and **istor** mean resistance property offered to the junctions. In other words, it is a switching device which regulates and amplify the electrical signals like voltage or current. The transistor consists two PN diode connected back to back. It has three terminals namely emitter, base and collector.

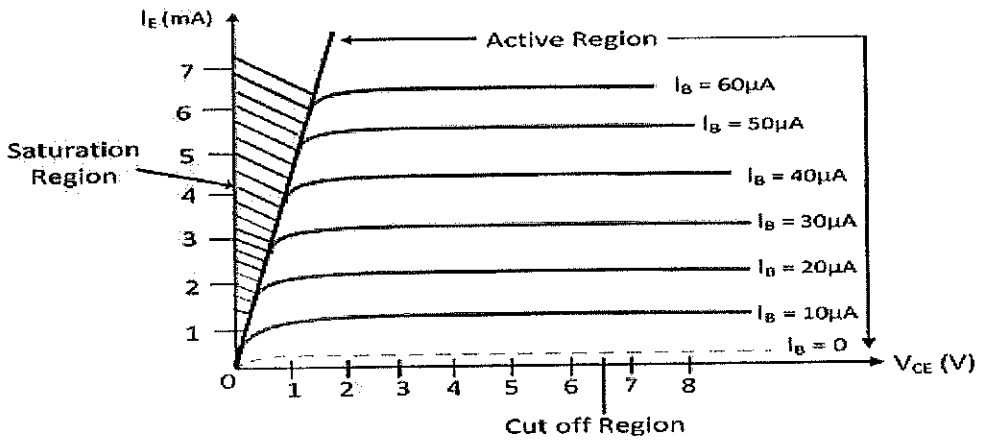



**Common Collector (CC) Configuration:** The configuration in which the collector is common between emitter and base is known as CC configuration. In CC configuration, the input circuit is connected between emitter and base and the output is taken from the collector and emitter. The collector is common to both the input and output circuit and hence the name common collector connection or common collector configuration.




**Output Characteristic Curve**

The output characteristic of the common emitter circuit is drawn between the emitter-collector voltage $V_{EC}$ and output current $I_E$ at constant input current $I_B$. If the input current $I_B$ is zero, then the collector current also becomes zero, and no current flows through the transistor.



The transistor operates in active region when the base current increases and reaches to saturation region. The graph is plotted by keeping the base current $I_B$ constant and varying the emitter-collector voltage $V_{CE}$, the values of output current $I_E$ are noticed with respect to $V_{CE}$. By using the $V_{CE}$ and $I_E$ at constant $I_B$ the output characteristic curve is drawn.

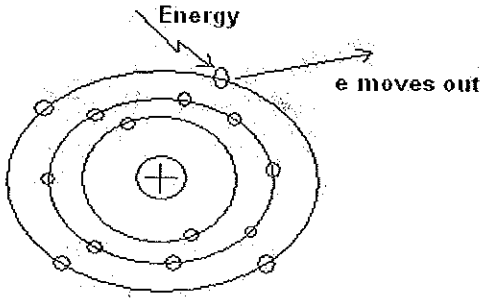
**3. What is the effect of temperature on insulator, semiconductor and conductor.**

**Ans.** Effect of temperature on different materials are as follows:

**Insulators:** With increase in temperature, the conducting property increases. So we call the insulator material have negative temperature coefficient i.e. with increase in temperature, resistance decreases.

$T \uparrow \qquad R \downarrow$

**Semiconductors:** With increase in temperature, the conductivity of the semi-conductor material increases. As with increase in temperature, outermost electrons acquire energy and hence by acquiring energy, the outermost electrons leave the shell of the atom.




Hence with increase in temperature, number of carriers in the semiconductor material increases and which leads to increase in conductivity of the material. So we call the semi-conductor material have negative temperature coefficient i.e. with increase in temperature, resistance decreases.

$T \uparrow \qquad R \downarrow$

**Conductors:** The outermost shell of conductors is mostly free at room temperature and hence due to the fact that conducting materials leave the outermost electrons, the nucleus of the atom of conducting material is more positive as it is a positive ion.

$$Cu \qquad Cu^{+} + e$$

Hence taking out more electrons from the penultimate shell of the atom is very difficult and when the temperature is increased, the energy supplied is not enough to take out-more electrons but due to the energy because of increase in temperature, the nucleus of the atoms starts vibrating and hence obstruct the flow of electrons already in the free space. So with increase in temperature, conductivity of the conductors decreases and resistance increases. Hence we say conductors have positive temperature coefficient.

$T \uparrow \qquad R \uparrow$

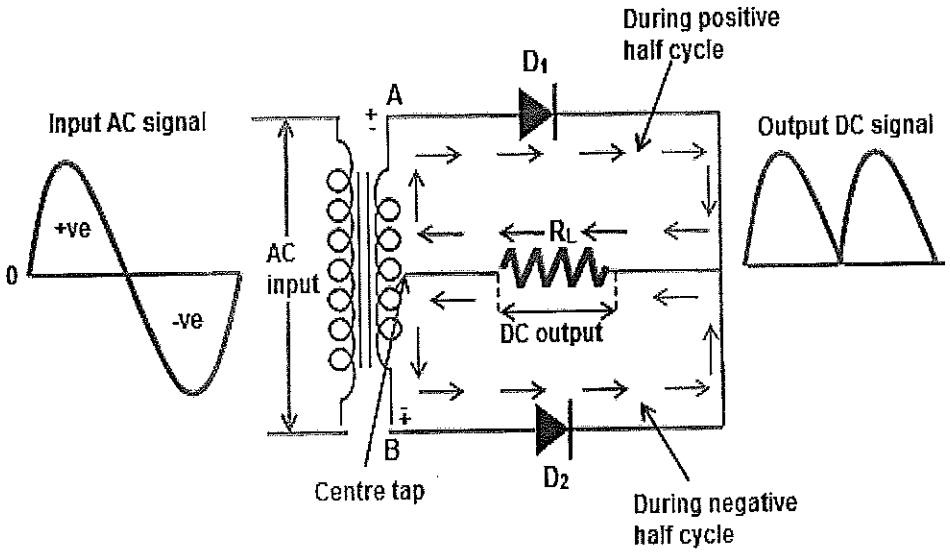
**4. What is a full-wave rectifier? Explain its working.**

**Ans.** The process of converting the AC current into DC current is called rectification. Rectification can be achieved by using a single diode or group of diodes. These diodes which convert the AC current into DC current are called rectifiers. Rectifiers are generally classified into two types:

- half wave rectifier
- full wave rectifier

A half wave rectifier uses only a single diode to convert AC to DC. So it is very easy to construct the half wave rectifier. However, a single diode in half wave rectifier only allows either a positive half cycle or a negative half cycle of the input AC signal and the remaining half cycle of the input AC signal is blocked. As a result, a large amount of power is wasted. Furthermore, the half wave rectifiers are not suitable in the applications which need a steady and smooth DC voltage. So the half wave rectifiers are not efficient AC to DC converters.

We can easily overcome this drawback by using another type of rectifier known as a full wave rectifier. The full wave rectifier has some basic advantages over the half wave rectifier. The average DC output voltage produced by the full wave rectifier is higher than the half wave rectifier. Furthermore, the DC output signal of the full wave rectifier has fewer ripples than the half wave rectifier. As a result, we get a smoother output DC voltage. A full wave rectifier is a type of rectifier which converts both half cycles of the AC signal into pulsating DC signal.




As shown in the above figure, the full wave rectifier converts both positive and negative half cycles of the input AC signal into output pulsating DC signal.

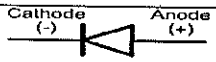
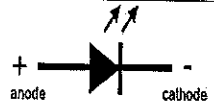
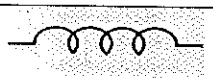
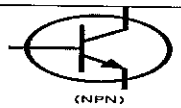
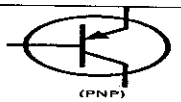
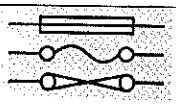
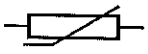
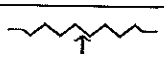
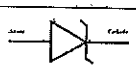
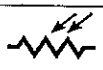
# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

**Section – C**

04X06 = 24 Marks

**1. What are the basic components in electronics? Draw symbols with explanation.**

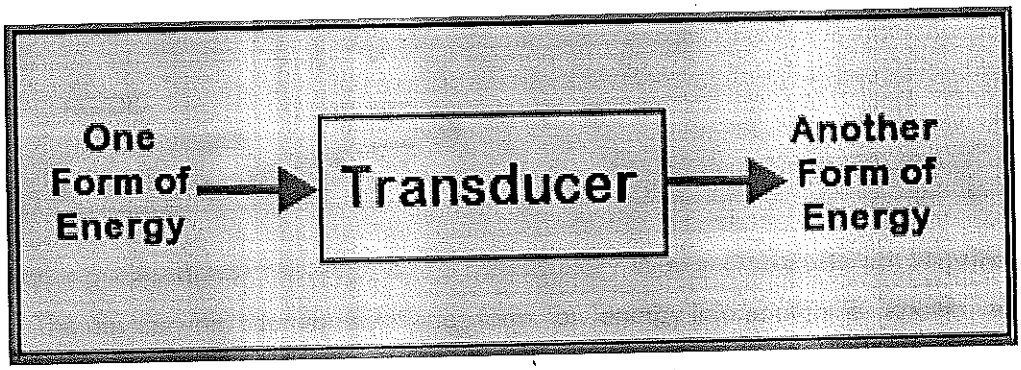
**Ans.** Basic electronic components are as follows:

| S.No. | Name | Symbol | Function |
|---|---|---|---|
| 1 | Resistor |  | Control flow of current. |
| 2 | Capacitor |  | Stores electrical energy in an electric field. |
| 3 | Diode |  | Allow the flow of current in one direction only. |
| 4 | LED |  | A Light-Emitting Diode is a semiconductor light source that emits light when current flows through it. |
| 5 | Inductor |  | Stores energy in a magnetic field when electric current flows through it. |
| 6 | Transistor NPN |  | A semiconductor device used to amplify or switch electronic signals and electrical power, preferred for low current applications, current controlled device |
| 7 | Transistor PNP |  | |
| 8 | MOSFET-NMOS |  | Switching and amplifying electronic signals, used for high power functions, voltage controlled device |
| 9 | MOSFET-PMOS |  | |
| 10 | Fuse |  | Electrical safety device that operates to provide overcurrent protection of an electrical circuit. |
| 11 | Thermistor |  | A type of resistor whose resistance is dependent on temperature |
| 12 | Potentiometer |  | Variable resistor, adjustable voltage divider |
| 13 | Crystal oscillator |  | An electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a precise frequency |
| 14 | Zener diode |  | Current will flow in the reverse direction |
| 15 | LDR |  | Light Dependent Resistor: resistance, decrease when light falls and increased in the dark. |
| 16 | Ground |  | |

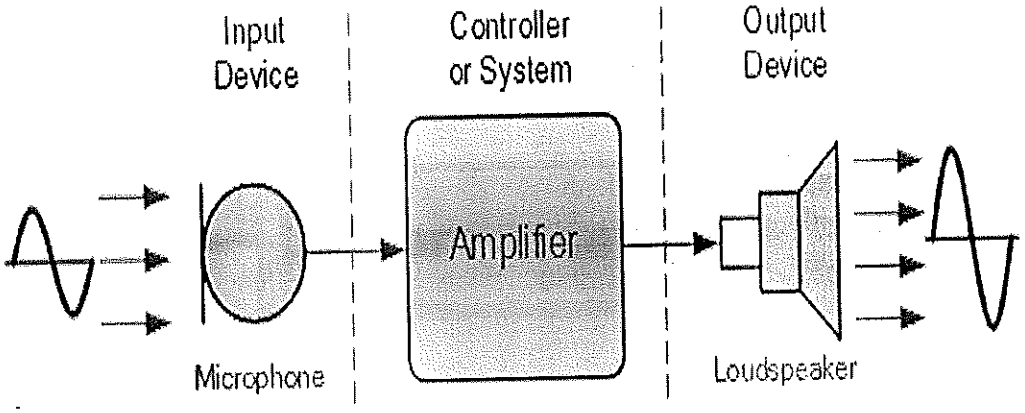
| | | | |
|---|---|---|---|
| 17 | | | Reference point for all signals or a common path in an electrical circuit where all of the voltages can be measured from |
| 18 | | | |
| 19 | Battery source | | |
| 20 | | | |
| 21 | DC source | | |
| 22 | AC source | | |
| 23 | AC/DC | DC<br>AC | |

**2. What is a transducer? Is a speaker a transducer? Why transducers are required?**

**Ans.** The device which converts the one form of energy into another is known as the transducer. The process of conversion is known as transduction. The conversion is done by sensing and transducing the physical quantities like temperature, pressure, sound, etc. The electrical transducer converts the mechanical energy into an electric signal. The electrical signal may be voltage, current and frequency.




A speaker is an electroacoustic transducer; a device which converts an electrical audio signal into a corresponding sound.



**Needs of Transducer**

- It is quite difficult to determine the exact magnitude of the physical forces like temperature, pressure, etc. But if the physical force is converted into an electrical signal, then their value is easily measured with the help of the meter.
- The transducers convert the physical forces into an electrical signal which can easily be handled and transmitted for measurement.

**3. What is the working principle of photovoltaic cell?**

**Ans.** Conversion of light energy in electrical energy is based on a phenomenon called photovoltaic effect. When semiconductor materials are exposed to light, the some of the photons of light ray are absorbed by the semiconductor crystal which causes a significant number of free electrons in the crystal. This is the basic reason for producing electricity due to photovoltaic effect. Photovoltaic cell is the basic unit of the system where the photovoltaic effect is utilized to produce electricity from light energy. Silicon is the most widely used semiconductor material for constructing the photovoltaic cell. The silicon atom has four valence electrons.

In a solid crystal, each silicon atom shares each of its four valence electrons with another nearest silicon atom hence creating covalent bonds between them. In this way, silicon crystal gets a tetrahedral lattice structure. While light ray strikes on any materials some portion of the light is reflected, some portion is transmitted through the materials and rest is absorbed by the materials. The same thing happens when light falls on a silicon crystal. If the intensity of incident light is high enough, sufficient numbers of photons are absorbed by the crystal and these photons, in turn, excite some of the electrons of covalent bonds. These excited electrons then get sufficient energy to migrate from valence band to conduction band.

As the energy level of these electrons is in the conduction band, they leave from the covalent bond leaving a hole in the bond behind each removed electron. These are called free electrons move randomly inside the crystal structure of the silicon. These free electrons and holes have a vital role in creating electricity in photovoltaic cell. These electrons and holes are hence called light-generated electrons and holes respectively. These light generated electrons and holes cannot produce electricity in the silicon crystal alone. There is always a potential barrier between n-type and p-type material. This potential barrier is essential for working of a photovoltaic or solar cell. While n-type semiconductor and p-type semiconductor contact each other, the free electrons near to the contact surface of n-type semiconductor get plenty of adjacent holes of p-type material. Hence free electrons in n-type semiconductor near to its contact surface jump to the adjacent holes of p-type material to recombine.

In other words, negative charge layer in the p-type side and positive charge layer in n-type side together form a barrier which opposes migration of charge carriers from its one side to other. Similarly, holes in the p-type region are held back from entering the n-type region.

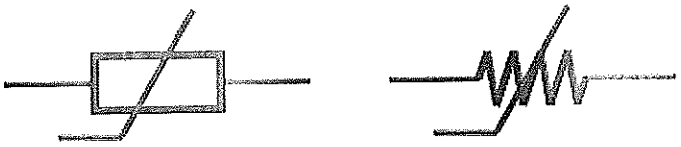
Due to positive and negative charged layer, there will be an electric field across the region and this region is called depletion layer. Now let us come to the silicon crystal. When light ray strikes on the crystal, some portion of the light is absorbed by the crystal, and consequently, some of the valence electrons are excited and come out from the covalent bond resulting free electron-hole pairs. If light strikes on n-type semiconductor the electrons from such light-generated electron-hole pairs are unable to migrate to the p-region since they are not able to cross the potential barrier due to the repulsion of an electric field across depletion layer. At the same time, the light-generated holes cross the depletion region due to the attraction of electric field of depletion layer where they recombine with electrons, and then the lack of electrons here is compensated by valence electrons of p-region, and this makes as many numbers of holes in the p-region.

As such light generated holes are shifted to the p-region where they are trapped because once they come to the p-region cannot be able to come back to n-type region due to the repulsion of potential barrier. As the negative charge (light generated electrons) is trapped in one side and positive charge (light generated holes) is trapped in opposite side of a cell, there will be a potential difference between these two sides of the cell. This potential difference is typically 0.5 V. This is how a photovoltaic cells or solar cells produce potential difference.

**4. What is thermistor and how it works? Write its applications.**

**Ans.** A thermistor is a temperature sensor constructed of semiconductor material that exhibits a large modification in resistance in proportion to a tiny low modification in temperature. Thermistors are inexpensive, rugged, reliable and responds quickly. Because of these qualities thermistors are used to measure simple temperature measurements, but not for high temperatures. Thermistor is easy to use, cheap, durable and respond predictably to a change in temperature. Thermistors are mostly used in digital thermometers and home appliances such as refrigerator, ovens, and so on. Stability, sensitivity and time constant are the final properties of thermistor that create these thermistors sturdy, portable, cost-efficient, sensitive and best to measure single-point temperature. Thermistors are available in different shapes like rod, disc, bead, washer, etc. This article gives an overview of thermistor working principle and applications.

Thermistor symbol



International standard symbol  American standard symbol

**How thermistor Works?** A thermistor is an inexpensive and easily obtainable temperature sensitive resistor, thermistor working principle is, it's resistance depends upon the temperature. When temperature changes, the resistance of the thermistor changes in a predictable way. The benefits of using a thermistor is accuracy and stability.

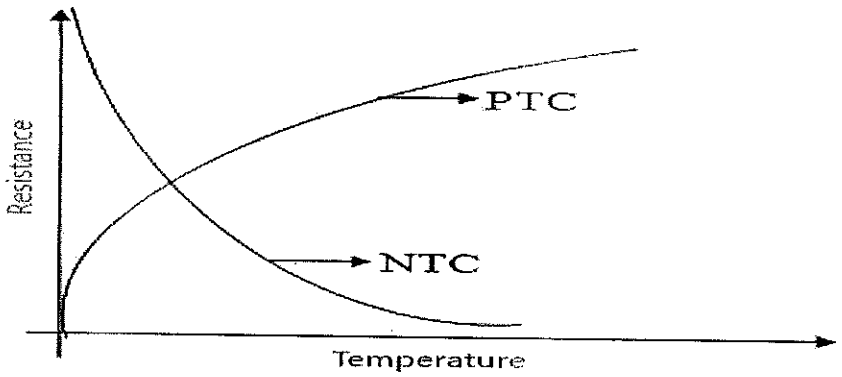
**Types of Thermistors**

- NTC (Negative Temperature Coefficient)
- PTC (Positive temperature coefficient)

The main two types of thermistors are NTC (Negative Temperature Coefficient) and PTC (Positive temperature coefficient). Thermistors measure temperature by using resistance. With an NTC thermistor, as the temperature increases the resistance decreases, and when the temperature decreases, the resistance increases. NTC thermistors are the most common types of thermistors. With a PTC thermistor; the temperature will increase and decrease with the resistance.

**Thermistor Elements**

Thermistor elements are the simplest form of thermistor; it is commonly used when space is very limited. OMEGA offers a wide variety of thermistor elements which vary not only in form factor, but also in their resistance Vs temperature characteristics. Since thermistors are non-linear, the device used to read the temperature must linearize the reading.




**Thermistor Probes**

The standalone thermistor element is comparatively delicate and cannot be located in a rugged environment. OMEGA offers thermistor probes that are thermistor elements fixed in metal tubes. Thermistor probes are much more suitable for industrial environments than thermistor elements.

**Applications of thermistors**

- A Thermistor is used to measure the temperature.
- The thermistor is used as an electrical circuit component
- For temperature compensation
- Circuit protection

- Voltage regulation
- Time delay, and Volume control.
- Thermistors are used in an automotive application
- Instrumentation and Communication
- Consumer electronics
- Food handling and processing
- Industrial electronics
- Medical electronics
- Military and aerospace