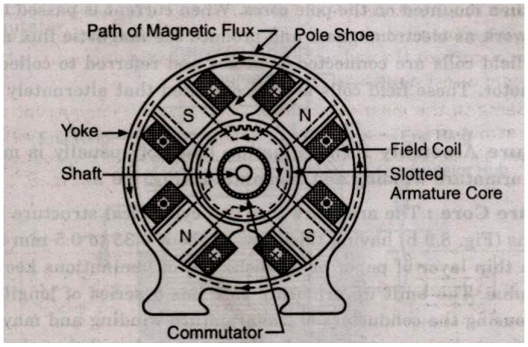
Important suggestions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and communication skills)
4) While assessing figures, examiner may give credit for principle components indicated in a figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case some questions credit may be given by judgment on part of examiner of relevant answer based on candidate understands.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q.1 A)	**Attempt any Three of the following:** **12 Marks**
i)	**Define the term magnetic flux and magnetic flux density. State their units.**
Ans	**i) Magnetic flux (ϕ) :-** **(2 Mark)** The total number of lines of force comprising the magnetic field is called magnetic flux $\varphi = Its\ unit\ is Wb$ **ii) Magnetic flux density:-** **(2 Mark)** Magnetic flux is passing perpendicularly per unit area is called magnetic flux density. $B = \varphi / A\ Wb/m^2$ $B = Magnetic\ density$ $\varphi = flux$ $a = Area$
ii)	**Draw construction diagram of DC motor. State function of any four parts.**
Ans	**(Figure-1, & Function of any three part -1 Mark each part)**  **OR Equivalent Fig**

Function : (Any three part expected)

1) Yoke: The yoke serves the following two purposes.

i) It supports the other components such as poles and provides mechanical protection for whole machine.

ii) It forms a part of the magnetic circuit & provides the path of low reluctance for the magnetic flux.

2) Pole Cores & Pole shoe:

The pole shoe serves two purposes

i) They spread out flux in the air gap & their large cross section reduces the reluctance of the magnetic path

ii) They support the exciting coils or field coils.

3) Armature core:

It serves two purposes

i) Houses the armature conductors or coils and causes them to rotate, hence cut the magnetic flux

ii) Provides a low reluctance path to the flux through armature

4) Armature winding:

The armature winding consists of a large number of coil suitably connected together to form rotor winding.

5) Commutator:

The function of the commutator is to reverse the current in each conductor of the armature as it passes from one pole to another and thus to help the motor to develop a continuous and unidirectional torque

7) Brush:

Brushes are used to pass the current to the commutator from the external circuit.

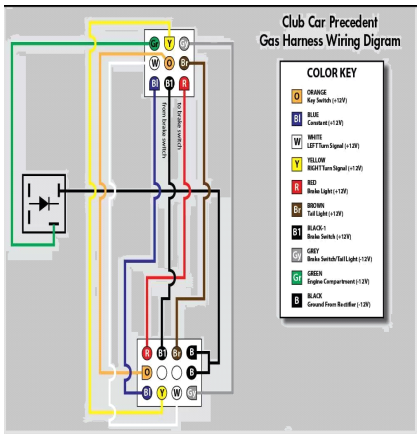
8) Cooling Fan:

A fan is fitted to the shaft for cooling purposes.

9) End covers:

These are attached to the ends of the main frame and contain bearings for the armature. The end cover on the commutator side also supports the brush assemblies.

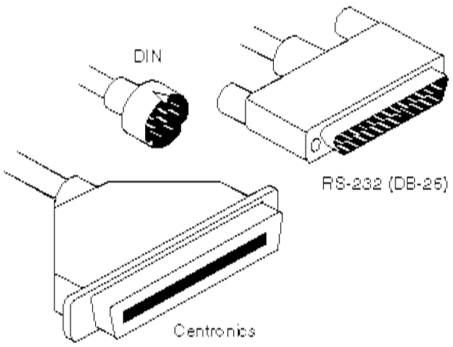
iii)	**Describe function of wiring harness and cable connectors with diagram.**
Ans	**Function of wiring harness:** **(Figure: 1 Mark & Function: 1 Mark)**



or equivalent figure

Automobile wiring is complicated and critical to setup, with the help of harness time required for completion of wiring is less it easy to replace and maintain other accessories like audio, video or mobile can be setup inside the vehicle, with proper instructions it can be easily installed and replace safely.

Cable connectors: **(Figure: 1 Mark & Function: 1 Mark)**



Function of cable connector:

The part of a cable that plugs into a port or interface to connect one device to another. Most connectors are either male *or* female types.

iv) Compare between intrinsic and extrinsic semiconductor.

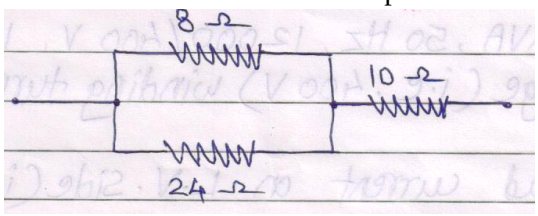
Ans **(Any Two point expected : 1 Mark each)**

Sr.No.	Parameter	Intrinsic Semiconductor	Extrinsic Semiconductor
1	**Purity**	Pure form of Semiconductor	Impure form of Semiconductor
2	**doping**	No doping (pure)	Doped with pentavalent or trivalent impurities
3	**Type**	Silicon & Germanium materials	N type & P type
4	**conductivity**	Conductivity very less	Conductivity increases with addition of impurity.

Q.1 B) Attempt any one of the following: 06 Marks

i) Two resistances of 8 ohm and 24 ohm respectively are connected in parallel. Another resistance of 10 ohm is connected in series with the combination. Calculate respective voltages which should be applied across the whole circuit: (1) To pass 6 A current through 10 ohm resistance. (2) To pass 6 A current through 24 ohm resistance.

Ans Resultant of 8 ohm & 24 ohm combination connected in parallel :

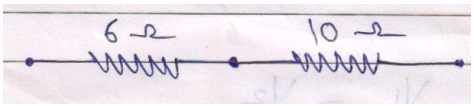


$R_T = \dfrac{R_1 \times R_2}{R_1 + R_2}$ ---------- **(1 Mark)**

$R_T = \dfrac{8 \times 24}{8 + 24} = \dfrac{192}{32}$

$R_T = 6\,\Omega$

---------- **(1 Mark)**



i) To pass 6A current through 10 ohm resistance:

$R = R_1 + R_2 = 6 + 10 = 16\Omega$

$V = I \times R = 6 + 16 = 94$ *volt* ---------- **(1 Mark)**

ii) To pass 6A current through 24 ohm resistance:

The current through 8 ohm resistance will be 18 A as

$I_1 \times R_1 = I_2 \times R_2$ ---------- **(1 Mark)**

$I_1 \times 8 = 6 \times 24$

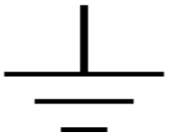
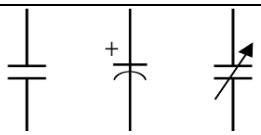
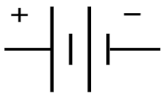
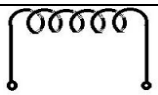
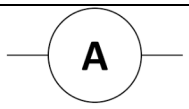
$\therefore Total\ I = I_1 + I_2 = 18 + 6 = 24A$ ---------- **(1 Mark)**

$\therefore Total\ R = 16\ ohm$

$\therefore V = 24 \times 16 = 384\ volt$ ---------- **(1 Mark)**

ii) **(ii) Draw the graphic symbol for following :**
1) Ground 2) Switch 3) Capacitor 4) Battery 5) Induction coil 6) Ammeter

Ans **(Each graphic symbol : 1 Mark)**

S.No	Name	Electrical graphic symbol
1	**Ground**	
2	**Switch**	
3	**Capacitor**	
4	**Battery**	
5	**Induction coil**	
6	**Ammeter**	

Q.2 **Attempt any FOUR of the following:** **16 Marks**

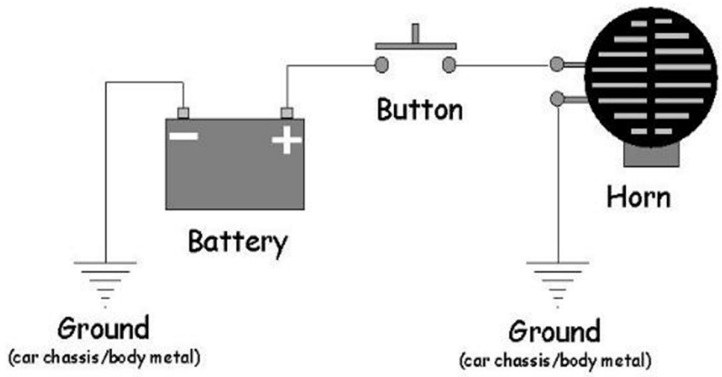
i) Compare between insulator and conductor.

Ans: **Compare between conductor and insulator:** **(Any Two expected: 1 Mark each)**

S.No	Insulator	Conductor
1	The conductivity of insulator is very low.	The conductivity of conductor is very high.
2	It has very high resistivity.	It has very low resistivity.
4	Insulator has negative temperature coefficient of resistance.	Conductor has positive temperature coefficient of resistance.
3	There is small number of electrons available for conduction.	There is large number of electrons available for conduction.
4	**Examples:** Paper, Mica glass.	**Examples:** Aluminum, copper.

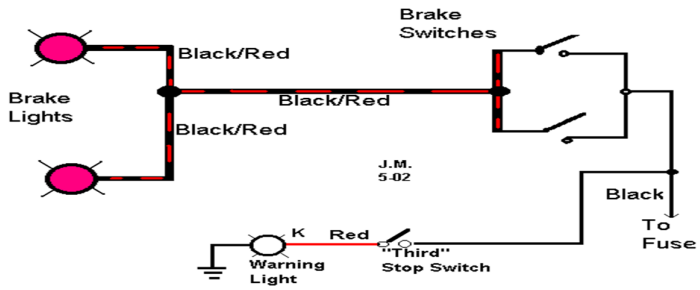
ii) Draw the wiring diagram of Horn and Stop light.

Ans: **i) Horn:** **-------(Diagram 2 Mark)**



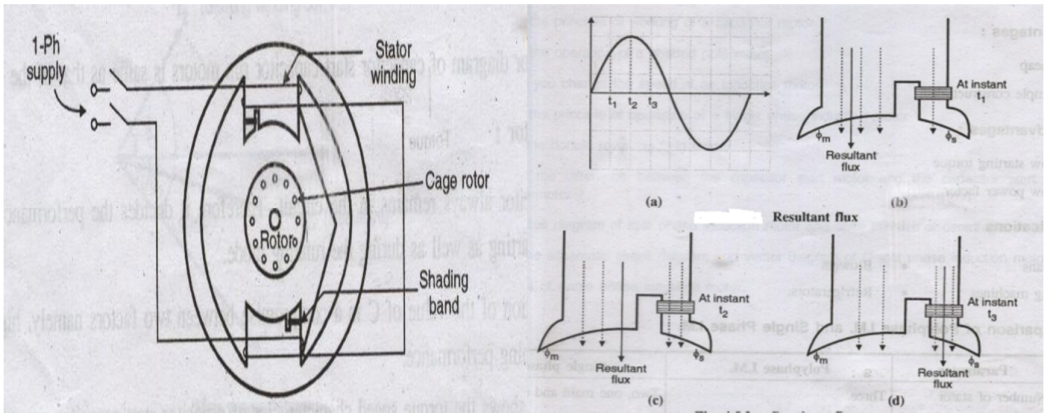
or equivalent figure

ii) STOP light: **-------(Diagram Mark 2)**

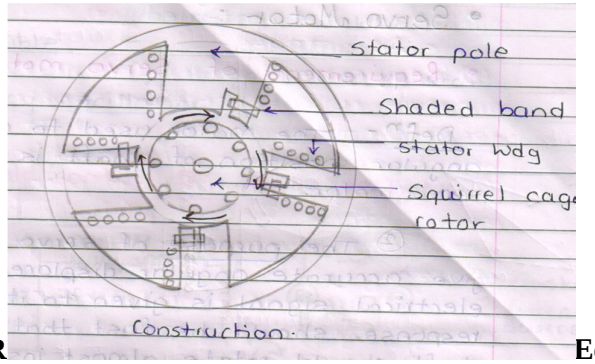


or equivalent figure

iii)	**With the help of diagram, explain working of shaded pole single phase AC motor.**
Ans:	**i) Shaded Pole Induction Motor :** **(Figure-2 Mark & Explanation: 2 Mark)**



or



OR **Equivalent Fig.**

Construction & Working:-

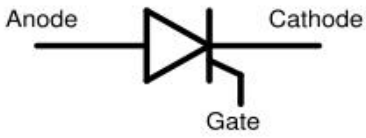
When single phase supply is applied across the stator winding an alternating field is created. The flux distribution is non uniform due to shading coils on the poles.

Now consider three different instants of time t_1, t_2, t_3 of the flux wave to examine the effect of shading coil as shown in the fig above. The magnetic neutral axis shifts from left to right in every half cycle, from non shaded area of pole to the shaded area of the pole. This gives to some extent a rotating field effect which may be sufficient to provide starting torque to squirrel cage rotor.

iv) Draw symbolic representation of SCR. State meaning of following terms related SCR characteristic : (1) holding current (2) breakdown voltage (3) forward current rating.

Ans: **(Symbol-1Mark & Each meaning: 1 Mark)**

Symbolic representation of SCR



(1) Holding current : It is the minimum anode current required to maintain SCR in the on state.

(2) Breakdown voltage : The voltage at which breakdown of reverse biased junction occurs and current increases uncontrollably.

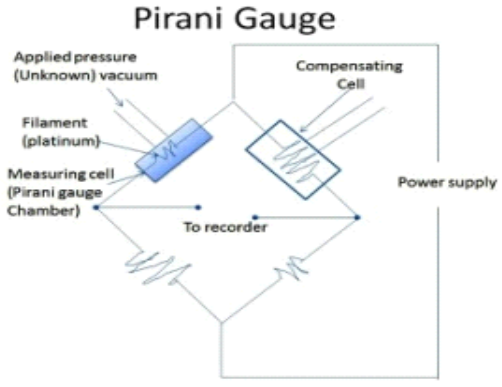
(3) Forward current rating : The maximum value of anode current, that an SCR can handle safely without any damage, is called the forward current rating.

v) State the principle of pirani vacuum gauge. Draw a labelled block diagram of pirani gauge.

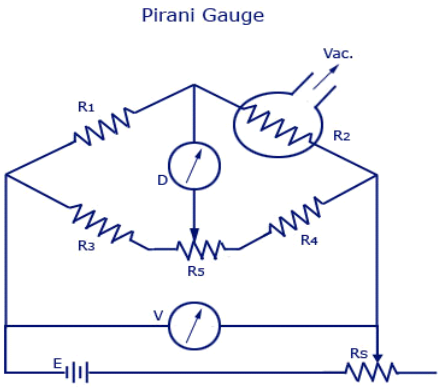
Ans: **Principle of pirani vacuum gauge :** **(Principal: 2 Marks & Diagram: 2 Marks)**

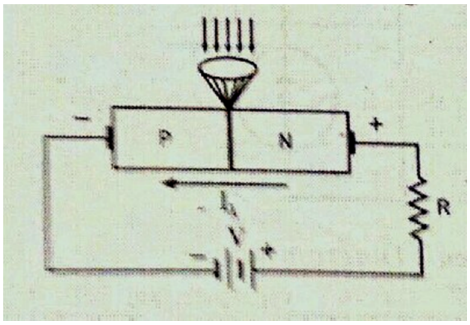
The Pirani gauge consists of a metal filament (usually platinum) suspended in a tube which is connected to the system whose vacuum is to be measured. Connection is usually made either by a ground glass joint or a flanged metal connector, sealed with an o-ring. The filament is connected to an electrical circuit from which, after calibration, a pressure reading may be taken. A conducting wire (platinum filament) gets heated when electric current flows through it. This wire suspended in a gas will lose heat to the gas as its molecules collide with the wire and remove heat. As the gas pressure is reduced (by the vacuum pumps) the number of molecules present will fall proportionately, the conductivity of the surrounding media will fall and the wire will lose heat more slowly. Measuring the heat loss is an indirect indication of pressure.

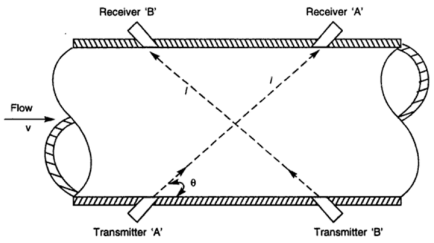
Diagram of pirani vacuum gauge:



OR



vi)	**Draw symbol of photodiode. Explain its working and write its two applications.**
Ans:	**(Symbol : 1 Mark, Working: 1 Mark, Digarm: 1 Mark & Application: 1 Mark)** **Symbol:** **Schematic diagram**   **or equivalent dia.** **Working-** Photodiode is a two terminal semiconductor P-N junction device and is designed to operate with reverse bias. A photodiode is a p-n junction or PIN structure. When a photon of sufficient energy strikes the diode, it excites an electron, thereby creating a free electron (and a positively charged electron hole). When a reverse biased P-N junction is illuminated, the current flowing through it varies almost linearly with light flux. The output voltage is taken from across a series-connected load resistor R as shown in above figure. **Applications of photodiode:** 1. Photo diodes are used in consumer electronics devices such as compact disc players, smoke detectors 2. The receivers for infrared remote control devices used to control equipment from televisions to air conditioners. 3. Light measurement, as in camera light meters, or to respond to light levels, as in switching on street lighting after dark.
Q.3	**Attempt any FOUR of the following:** **16 Marks**
i)	**Describe the working of ultrasonic flow meter using neat diagram.**
Ans:	**(Diagram- 2 Marks & Working Principle-2 Marks)** ➢ **Ultrasonic flow meter Schematic diagram:-** **There are two types based on – 1) Doppler effect 2) Transit time.**



or equivalent dia.

Working- Ultrasonic flow meter based on Doppler effect is explained here.

A and B are piezo-electric devices transmitting the short duration ultrasonic signals through the fluid that is flowing through the pipe at a velocity v. Similar type of crystals are used as receivers to respond to pressure fluctuations.

Due to the fluid velocity v aiding the transmission, the velocity of ultrasonic signal from the transmitter-A to receiver-A is increased to a value c + v cos θ, where c is the velocity of sound through the fluid in the pipe and θ is the angle between the path of sound and the pipe valve. The repetition frequency of the received pulse f_A will be

$$f_A = \frac{c + v\cos\phi}{l}$$

Where l= the distance between the transmitter and receiver. On the other hand, the velocity of the ultrasonic signal transmitted by transmitter B and received by received B will be reduced by the fluid velocity causing a retardation of v cos θ and its pulse repetition frequency f_B will be

$$f_B = \frac{c - v\cos\phi}{l}$$

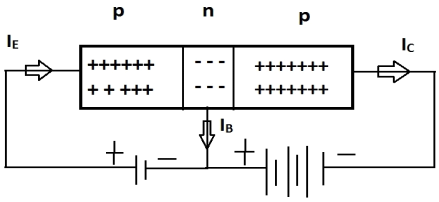
The difference between frequencies is given by

$$\Delta f = f_A - f_B = \frac{2v\cos\phi}{l}$$

By measuring the difference in the repetition frequency Δf and knowing the values of θ and l, the velocity of the fluid can be computed alternatively, the flow velocity can be computed by measuring the transit time difference between the two pulse trains in either direction.

ii) With the help of a neat diagram, explain working of PNP transistor.

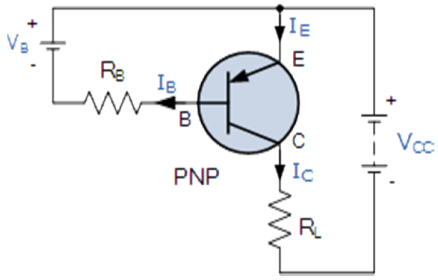
Ans: Diagram : **(Diagram- 1 Mark & Working -3 Marks)**



p-n-p transistor

Working :

The **PNP Transistor** has very similar characteristics to their NPN bipolar cousins, except that the polarities (or biasing) of the current and voltage directions are reversed for any one of the possible three configurations.



PNP Transistor Connection

The voltage between the Base and Emitter (V_{BE}), is now negative at the Base and positive at the Emitter because for a PNP transistor, the Base terminal is always biased negative with respect to the Emitter.

Also the Emitter supply voltage is positive with respect to the Collector (V_{CE}). So for a PNP transistor to conduct the Emitter is always more positive with respect to both the Base and the Collector.

The voltage sources are connected to a PNP transistor are as shown. This time the Emitter is connected to the supply voltage V_{CC} with the load resistor, RL which limits the maximum current flowing through the device connected to the Collector terminal. The Base voltage V_B which is biased negative with respect to the Emitter and is connected to the Base resistor R_B, which again is used to limit the maximum Base current.

To cause the Base current to flow in a PNP transistor the Base needs to be more negative than the Emitter (current must leave the base) by approx 0.7 volts for a silicon device or 0.3 volts for a germanium device with the formulas used to calculate the Base resistor, Base current or Collector current are the same as those used for an equivalent NPN transistor and is given as.

iii) Draw symbol and truth table of NAND and NOR logic gate.

Ans: **(Symbols- 2 Marks & Truth Tables -2 Marks)**

NAND gate

A	B	Output
0	0	1
0	1	1
1	0	1
1	1	0

NOR gate

A	B	Output
0	0	1
0	1	0
1	0	0
1	1	0

iv) Define active, reactive, apparent power and form factor.

Ans:

i) Active Power (P):- **(1 Mark)**

The active power is defined as the average power P_{avg} taken by or consumed by the given circuit.

$P = V.I.Cos\phi$ **Unit: -** Watt **OR** Kilowatt

ii) Reactive Power (Q):- **(1 Mark)**

The reactive power is defined as the product of voltage and current (V, I) and sine of angle between voltage (V) and current (I) i.e. ϕ

Q= V.I. sin ϕ

Units: - VAR **OR** KVAR

iii) Apparent power (s):- **(1 Mark)**

Apparent power is defined as the product of rms values of voltage (v) and current (I) it is given by

S=V.I **Units: -** VA **OR** KVA

iv) Form factor- **(1 Mark)**

It is defined as the ratio of its RMS value to its Average value.

v) Explain the working of stroboscope.

Ans:

Diagram of stroboscope :

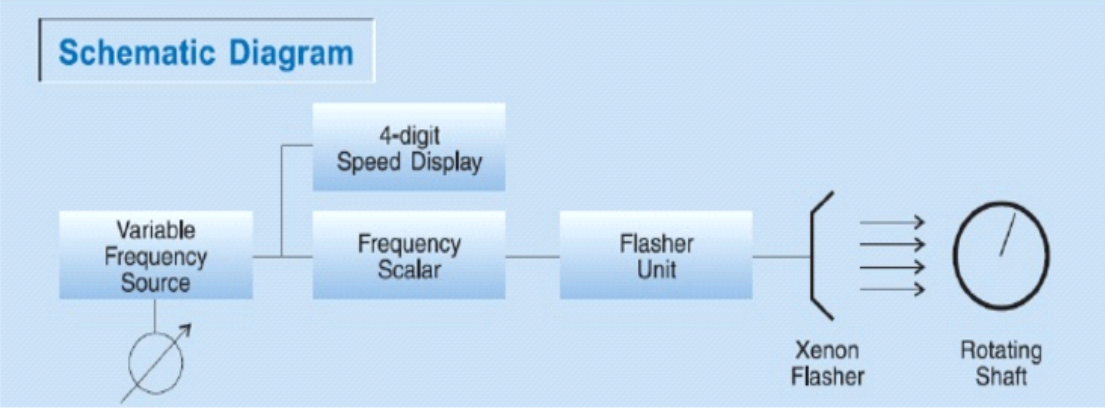


Fig. Schematic diagram of stroboscope

Working of stroboscope :

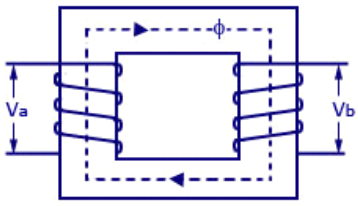
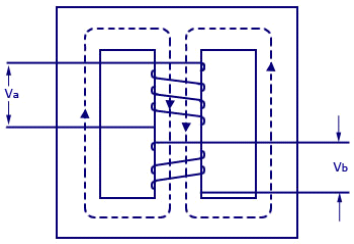
The principle of operation of stroboscopic instruments is as follows: the object performing periodic motion is illuminated and made visible in separate time intervals that are very small by comparison with the period of the object's motion. If the frequency fstr of the light pulses is the same as the frequency f obj of the period of the object's motion, then the object appears stationary.

When these two frequencies are somewhat different, the object appears to be executing a motion that is slower than the actual motion. The frequency F of the slowed motion is the difference between the two frequencies — that is, F = f obj – f str.

Q.4 A) Attempt any Three of the following: 12 Marks

i) Compare between core and shell transformer.

Ans: **(Any Four points expected each:1 Marks)**

S.No	Core Type Transformer	Shell Type Transformer
1.		
2.	The Winding surround the core	The core surround the windings
3.	Magnetic Flux has only one continuous path	Magnetic Flux is distributed into 2 paths
4.	Suitable for high voltage & less output	Suitable for less voltage & high output
5.	Easy for repairs	Difficult for repairs
6.	Less in Weight	More in Weight
7.	Leakage flux are more	Leakage flux are less

ii) What are advantages of positive return system over negative return system '?

Ans: **Advantages of positive return system over negative return system in automotive wiring:**

Positive return system: ---------- (2 Marks)

1. Tends to generate excessive system gain, noise, narrows bandwidth, and can cause oscillation.

2. Creates instability and tends to drive a system into its nonlinear region of operation.
3. Whereas negative feedback reduces system gain and increases bandwidth. Positive feedback increases system gain, narrows bandwidth, and becomes unstable. However, a system operating with positive feedback that hasn't gone into complete instability (oscillation), can be a very sensitive device with very high-gain amplifiers and sharp selectivity--super-regenerative radio receiver is a good example

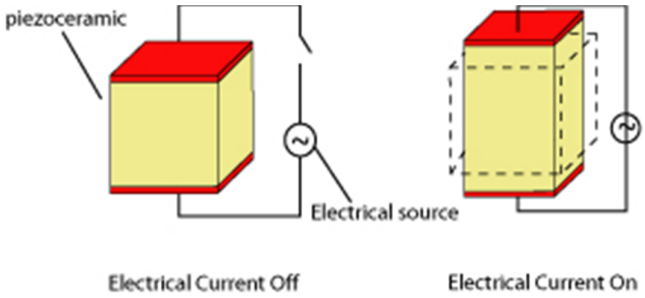
Negative return system: ---------- **(2 Marks)**

1. Tends to opposite excessive change (large amplitude) and wants to hold a system within a limited operating range.
2. In the case of an amplifier, it tends to reduce circuit gain and increase device operating bandwidth.
3. Tends to create system stability by ensuring linear operation.

iii) Explain the working of piezoelectric transducer. State its application.

Ans: **Figure & Working of piezoelectric transducer :**

(Figure: 2 Mark & Explanation: 2 Mark)



A **piezoelectric transducer / sensor** is a device that uses the piezoelectric effect, to measure changes in pressure, acceleration, strain or force by converting them to an electrical charge.

There are certain materials that generate electric potential or voltage when mechanical strain is applied to them or conversely when the voltage is applied to them, they tend to change the dimensions along certain plane. This effect is called as the piezoelectric effect. Some of the materials that exhibit piezoelectric effect are quartz, Rochelle salt,

polarized barium titanate, ammonium dihydrogen, ordinary sugar etc.

OR

The piezoelectric transducers work on the principle of piezoelectric effect. When mechanical stress or forces are applied to some materials along certain planes, they produce electric voltage. This electric voltage can be measured easily by the voltage measuring instruments, which can be used to measure the stress or force.

The physical quantities like stress and force cannot be measured directly. In such cases the material exhibiting piezoelectric transducers can be used. The stress or the force that has to be measured is applied along certain planes to these materials. The voltage output obtained from these materials due to piezoelectric effect is proportional to the applied stress or force. The output voltage can be calibrated against the applied stress or the force so that the measured value of the output voltage directly gives the value of the applied stress or force. In fact the scale can be marked directly in terms of stress or force to give the values directly.

Application piezoelectric transducer:

1) It is used in measurement of pressure.
2) In microphones, the sound pressure is converted into electric signal and this signal is ultimately amplified to produce louder sound.
3) Automobile seat belts lock system.
4) It is also used in medical diagnostics.
5) It is used in electric lighter used in kitchens. Pressure made on piezoelectric sensor creates an electric signal which ultimately causes flash to fire up.
6) They are used for studying high speed shock waves and blast waves.
7) Used in Inkjet printers

iv) A 200 kVA, 50 Hz, 12000/400 V single phase transformer has low voltage winding turns 25. Calculate (1) Full load current on L.V. side (2) Number of turns of high voltage side.

Ans: $V_1 = 12000\,V$ $V_2 = 12000\,V$ $N_1 = ?$ $N_2 = 25$ $I_2 = ?$

ii) To Find full load Primary current I_2:-

$$I_2 = \frac{200 \times 10^3}{V_2\ volt}$$ ---------- **(1 Mark)**

$$I_2 = \frac{200 \times 10^3}{400}$$

$$I_2 = 500\ Amp$$ ---------- **(1 Mark)**

iii) Number of primary winding turns N_1:

$$\frac{V_2}{V_1}=\frac{N_2}{N_1} \quad \text{OR} \quad \frac{V_1}{V_2}=\frac{N_1}{N_2} \ ,$$

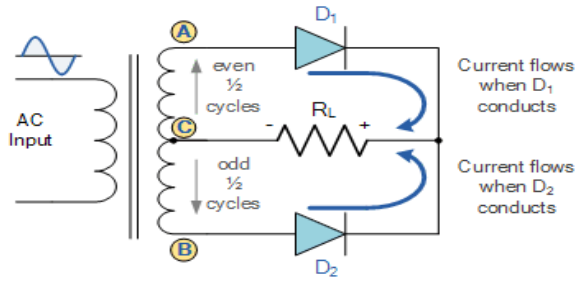
$$N_1=\frac{V_1}{V_2}\times N_2$$ ---------- **(1 Mark)**

$$N_1=\frac{12000}{400}\times 25$$

$$N_1=750 \ \ turns$$ ---------- **(1 Mark)**

Q.4 B)	**Attempt any ONE of the following: 06 Marks**
i)	**Draw neat circuit diagram of full wave rectifier. Describe how current flow in both half cycles. Draw input output voltage waveform.**

Ans: **(Any one diagram 2 marks ,explanation 2 Marks & Waveforms 2 Marks)**

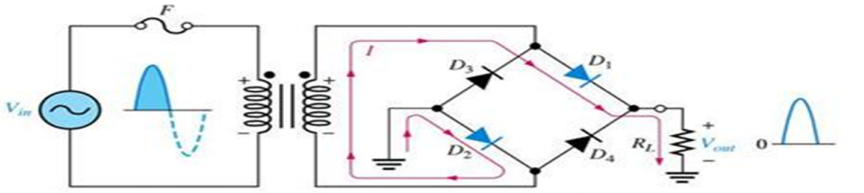


Resultant Output Waveform

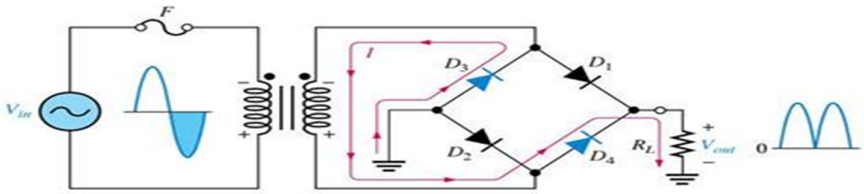
When point A of the transformer is positive with respect to point C, diode D_1 conducts in the forward direction as indicated by the arrows.

When point B is positive (in the negative half of the cycle) with respect to point C, diode D_2 conducts in the forward direction and the current flowing through resistor R is in the same direction for both half-cycles. As the output voltage across the resistor R is the phasor sum of the two waveforms combined.

OR



(a) During positive half-cycle of the input, D_1 and D_2 are forward-biased and conduct current. D_3 and D_4 are reverse-biased.



(b) During negative half-cycle of the input, D_3 and D_4 are forward-biased and conduct current. D_1 and D_2 are reverse-biased.

Working :

The four diodes labelled D_1 to D_4 are arranged in "series pairs" with only two diodes conducting current during each half cycle.

During the positive half cycle of the supply, diodes D1 and D2 conduct in series while diodes D3 and D4 are reverse biased and the current flows through the load as shown below.

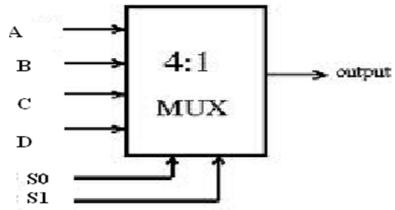
During the negative half cycle of the supply, diodes D3 and D4 conduct in series, but diodes D1 and D2 switch "OFF" as they are now reverse biased. The current flowing through the load is the same direction as before.

ii) Explain multiplexer and demultiplexer. Draw schematic of 4:1 multiplexer.

Ans: **Block/logic diagram of multiplexer (4:1)**

(Figure-1 Mark, Truth Table-1 Mark & Operation- Mark)

Schematic Figure-



or equivalent dia.

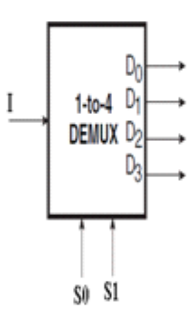
Truth Table:

S_0	S_1	Out
0	0	A
0	1	B
1	0	C
1	1	D

Operation of multiplexer (4:1):

Multiplexer has multiple inputs and one output. i.e. it accepts several data inputs and allows only one of them at a time. The routing of desired data input to output is controlled by select lines.

Block/logic diagram of demultiplexer (1 :4): **(1 Mark)**



I	Select		O/P			
	S0	S1	D0	D1	D2	D3
1	0	0	1	0	0	0
1	0	1	0	1	0	0
1	1	0	0	0	1	0
1	1	1	0	0	0	1

or equivalent dia.

Working- **(2 Mark)**

It accepts single input and distributes it over several outputs. The single input should appear over which output line is decided by select lines.

The relationship between select lines and output lines can be given by $2^m = n$

Where m = No. of select lines and n = No. of output lines.

Q.5 **Attempt any Four of the following:** **16 Marks**

i) Compare electrical and mechanical instrument.

Ans: **(Any four point expected- 1 Mark each point)**

S.No.	Electrical Instrument	Mechanical Instruments
1	These instruments are used for rapid changes. Or sensitivity of the electrical instrument is more	These instruments are used for static & stable condition. Or sensitivity of the electrical instrument is less
2	They are able to record dynamic & transient condition.	They are unable to respond rapidly to measurement of dynamic & transient condition.
3	Instruments are consists of moving parts that are light in weight.	Instruments are consists of moving parts that are rigid, heavy & bulky.
4	Weight is less.	Weight is more.
5	It doesn't produce noise during measurement.	It produce noise & causes air pollution.
6	Rapidly indicates output.	Slowly indicates output.
7	Life of the electrical instrument is less	Life of the mechanical instrument is more

`

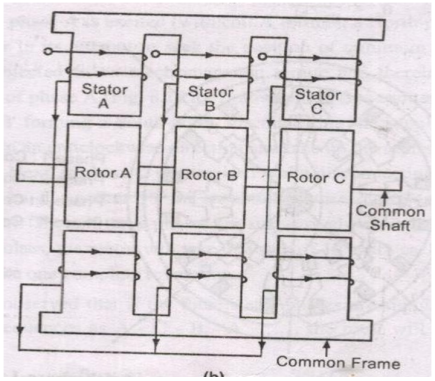
ii)	**Describe working of any one type of stepper motor. State its application.**

Ans:

Types of Stepper Motor :- **(1 Marks)**

1) Variable Reluctance Motor
2) Permanent Magnet Motor

1) Variable Reluctance Motors:- **(Any one types of Explanation - 2 Mark)**



or equivalent dia.

Working:-

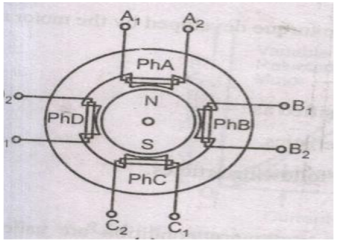
When phase A is excited rotor attempts minimum reluctance between stator and rotor and is subjected to an electromagnetic torque and there by rotor rotates until its axis coincides with the axis of phase A.

Then phase 'B' is excited disconnecting supply of phase 'A' then rotor will move 30 anticlockwise directions. The Same process is repeated for phase 'C'

In this way chain of signals can be passed to get one revolution and direction can be also changed.

OR

2) Permanent Magnet Motor:-



or equivalent dia.

Working :-

If the phase is excited in ABCD, due to electromagnetic torque is developed by interaction between the magnetic field set up by exciting winding and permanent magnet.

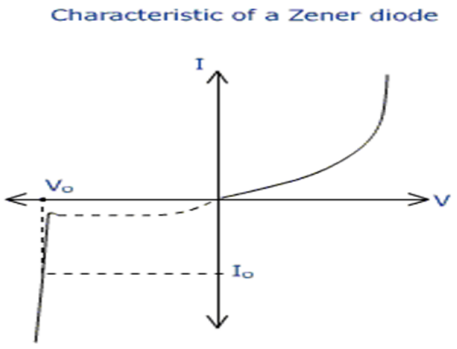
Rotor will be driven in clockwise direction.

Applications of stepper motor- **(Two application expected-1 Mark each)**

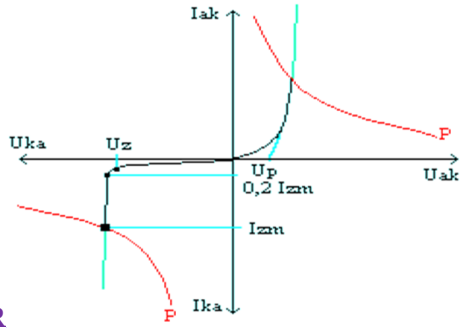
1.Suitable for use with computer controlled system
2. Widely used in numerical control of machine tools.
3. Tape drives
4. Floppy disc drives
5. Computer printers
6. X-Y plotters
7. Robotics
8. Textile industries
9. Integrated circuit fabrication
10. Electric watches
11. In space craft's launched for scientific explorations of planets.
12. In the production of science friction movies
13 Automotive
14. Food processing
15. Packaging

iii) Draw V-I characteristic of zener diode and state its applications.

Ans: **Characteristics of zener diode:** **(2 Mark)**



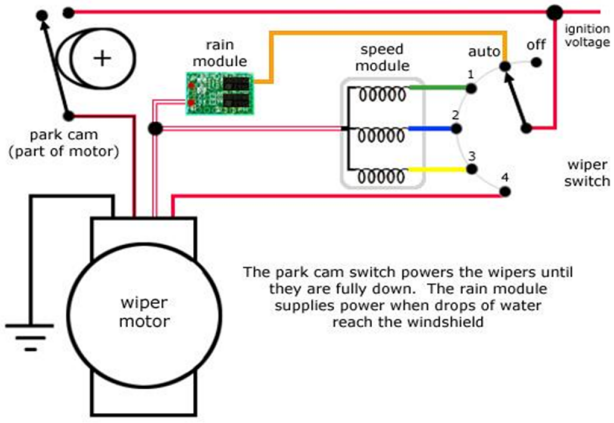
OR



Applications of the zener diode (any two):- **(2Mark)**

1. Voltage regulator
2. Regulated power supply
3. In protection circuits of MOSFETs
4. In the clipping circuits
5. In the pulse amplifier

iv)	**Draw the wiring diagram of windshield wiper. State how speed is controlled in wiper.**
Ans:	**ii) Diagram of Windshield wiper:-** **(2 Marks)**



or any equivalent

Reason speed is controlled in wiper:- **(2 Marks)**

The ignition switch supplies electrical power for the wiper motor. Current passes through the wiper control switch and then to the wiper motor. A speed control module may vary the voltage that reaches the motor on some models. Other types use different windings in the motor to control speed.

Within the wiper-motor is another switch, with voltage that bypasses the off-switch. The motor times this device with the full down position. Many use a cam to open the circuit when the motor achieves wiper parking. Turn off the wiper switch and current continues to flow through the park-switch, until the wipers are fully down.

v)	**State Fleming Right hand and Left hand rules and their use.**
Ans:	**1) Fleming's Right Hand Rule:** **(2 Mark)**

Arrange three fingers of right hand mutually perpendicular to each other, if the first figure indicates the direction of flux, thumb indicates the direction of motion of the conductor, and then the middle finger will point out the direction of induced current.

Use: Generator. current & EMF

2) Left hand rules: **(2 Mark)**

According to Fleming's left hand rule if we stretch the thumb, the center finger and the middle finger of our left hand such that they are mutually perpendicular to each other. If the center finger gives the direction of current and middle finger points in the direction of magnetic field then the thumb points towards the direction of the force or motion of the conductor.

Use: Electric Motor

vi) Define the term gate and flip-flop. Draw symbol of R-S and D Flip-flop.

Ans: **(Definitions 2 Marks & Symbols 2 Marks)**

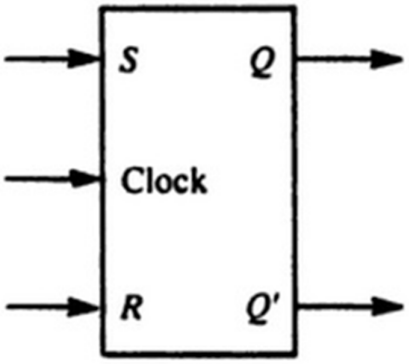
Gate :

Logic gates are the basic building blocks of any digital system. It is an electronic circuit having one or more than one input and only one output. The relationship between the input and the output is based on a certain logic. Based on this, logic gates are named as AND gate, OR gate, NOT gate etc.

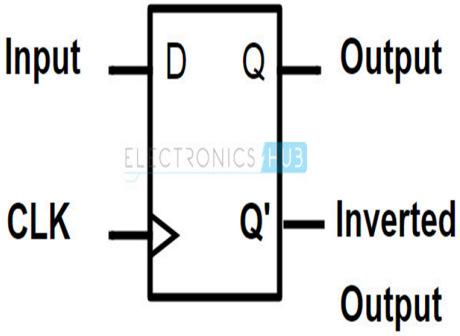
Flip-Flop :

Flip-flops, also called bistable gates, are digital logic circuits that can be in one of two states. Flip-flops maintain their state indefinitely until an input pulse called a trigger is received

RS Flip flop Symbol



D Flip Flop Symbol

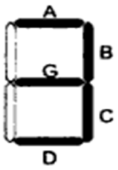


Q.6	Attempt any Four of the following: 16 Marks
i)	**Describe the working of seven segment LED display.**

Ans:

➢ **Working of seven-segment LED display:-** **(4 Marks)**

Seven segment displays consists of Eight LEDs. Depending on the various digits and letters to be displayed, the combinations of LEDs are forward biased.

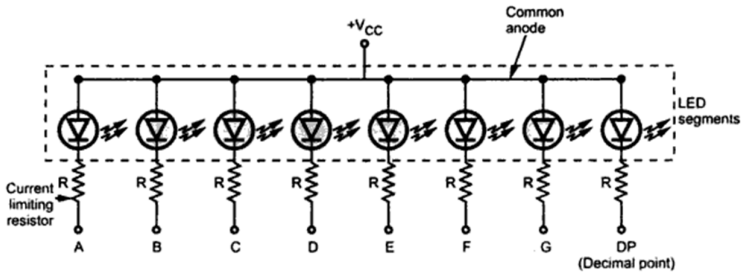


e.g. suppose we want to display the digit 3, then LED a,b,g.c,d should only be forward biased.

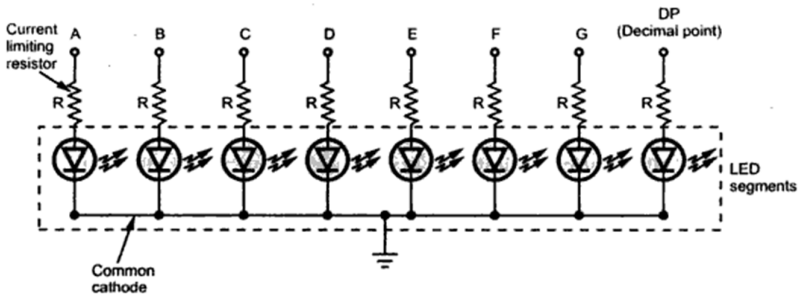
The two types of seven segment display are available-

1. Common anode type
2. Common cathode type

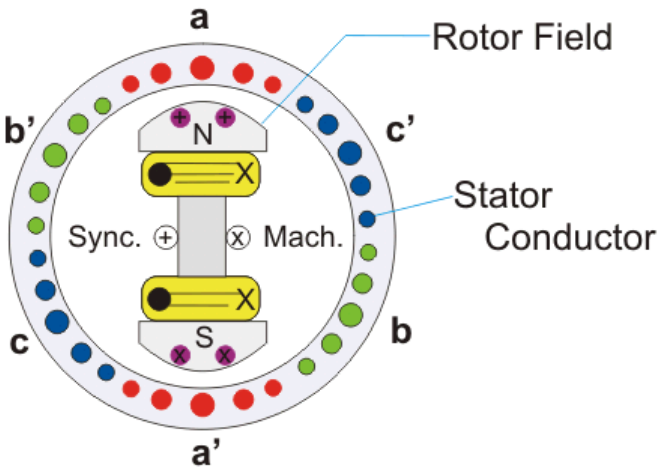
In common anode type, all anodes of LEDs are connected together and common point is connected to +Vcc.



In common cathode type, all cathodes of LEDs are connected together and the common point is connected to the ground.



ii)	**Explain working principle of alternator with neat diagram.**
Ans:	**Diagram:** **(1 Marks)**



Construction of three phase alternator: **(1 Marks)**

Construction wise, an alternator generally consists of field poles placed on the rotating fixture of the machine i.e. rotor as shown in the figure above. In most practical construction of alternator, it is installed with a stationary armature winding. There are mainly two types of rotor used in construction of alternator,

1. Salient pole type.
2. Cylindrical rotor type.

The* working principle of alternator *: **(2 Marks)**

Principle of alternator depends upon Faraday's law of electromagnetic induction. When the field winding gets excited field current flows through the field winding which produces magnetic flux in the air gap. As the prime mover rotates, the field winding also rotates and hence the magnetic flux also rotates.

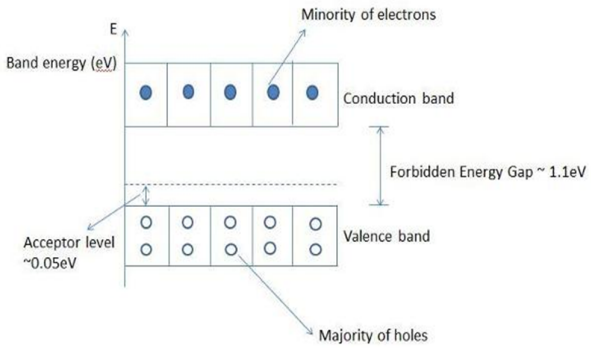
This rotating magnetic field is cut by the stationary armature conductors. So according to Faraday's law of electromagnetic induction , an EMF is induced in the armature conductors.

iii)	**What is mean by doping'' Draw energy band diagram for p-type semiconductor.**
Ans:	**(Definitions 2 Marks & Diagram 2 Marks)**

Doping :

Doping is the process of adding impurities to intrinsic semiconductors to alter their properties. Normally Trivalent and Pentavalent elements are used to dope Silicon and Germanium

Energy band diagram for p-type semiconductor



or equivalent figure

iv) Define accuracy, sensitivity, precision and speed of response.

Ans: **(Each Defamation: 1 Mark)**

i) Accuracy –

It is defined as the difference between the indicated value and the actual value.

OR

It is the closeness which an instrument reading approaches the true value of the quantity being measured.

OR

The degree of exactness of a measurement compared to the expected value.

ii) Sensitivity is an absolute quantity, the smallest absolute amount of change that can be detected by a measurement. **OR**

Sensitivity is the ratio of change in output of an instrument to the change in input.

iii) Precision describes the reproducibility of the measurement.

OR

It is a measure of the reproducibility of the measurements that is given a fixed value of a quantity, precision of measure of the degree of agreement within a group of measurements.

OR

A measure of the consistency of measurements, i.e successive readings do not defer.

iv) Speed of response:

It is defined as the rapidity with which an instrument, responds to the changes in the measured quantity.

v)	**List the transducers which are used for temperature measurement. Explain working of any one.**
Ans:	**(List of Transducer-2 Mark, Figure-1 Mark & Explanation-1 Mark)**

Different temperature transducers-

1. Thermostat
2. Thermistor
3. Resistance Temperature Detector (RTD)
4. Thermocouple
5. Pyrometer

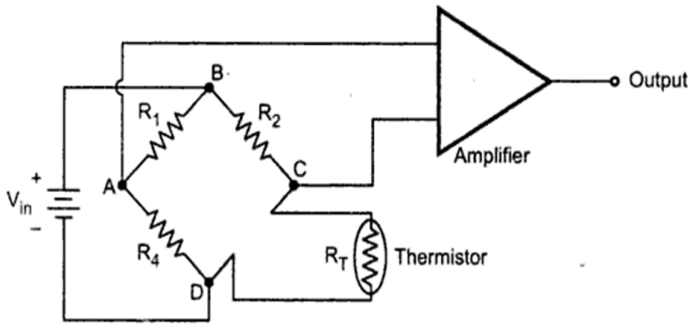
Working:-

1. Thermocouple working principle-

Thermocouple principle is based on the see beck effect which states that if the two dissimilar metals having different work functions are joined together to form a junction (hot junction)and if the junction is subjected to change in temperature then the voltage is generated at the another junction (cold junction). The E.M.F. generated is proportional to the temperature difference.

OR

2. Working principle of Thermistor:-



Thermistors are one of the most commonly used devices for the measurement of temperature. The thermistors are resistors whose resistance changes with the temperature. The thermistors are made up of ceramic like semiconducting materials. They are mostly composed of oxides of manganese, nickel and cobalt having the resistivities if about 100 to 450,000 ohm-cm. Since the resistivity of the thermistors is very high the resistance of the circuit in which they are connected for measurement of temperature can

be measured easily. As mentioned earlier the resistance of the thermistors decreases with the increase its temperature. The resistance of thermistor is given by:

$R = R_o e^k$

$K = \beta(1/T - 1/T_o)$

Where, R is the resistance of the thermistor at any temperature T in ^oK (degree Kelvin)

R_o is the resistance of the thermistors at particular reference temperature $T_o$in ^oKe is the base of the Naperian logarithms β is a constant whose value ranges from 3400 to 3900 depending on the material used for the thermistors and its composition.

The thermistor acts as the temperature sensor and it is placed on the body whose temperature is to be measured. It is also connected in the electric circuit. When the temperature of the body changes, the resistance of the thermistor also changes, which is indicated by the circuit directly as the temperature since resistance is calibrated against the temperature. The thermistor can also be used for some control which is dependent on the temperature.

OR

3. Working principle of RTD:-

The resistance of the material used to manufacture RTD depends upon temperature. As temperature changes resistance of RTD gets changed, the main principle of operation of an RTD is that when the temperature of an object increases or decreases, the resistance also increases or decreases proportionally (RTDs are normally PTC type).

$$R = Ro\ (1+\alpha\ t)$$

The main difference between a RTD and a **Thermistor** is that the sensing element used in a RTD is a metal and a thermistor uses ceramic or polymer material. As platinum is the most commonly used metal for making RTD's, the device can also be called Platinum Resistance Thermometers (PRT's).

---------- **END**----------