cImportant 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**
a)	**Define: (i) EMF (ii) Current (iii) Resistance state their units.**
Ans	**(i) EMF:** **(1 Mark)** It is the work done per unit charge which is the potential difference between the electrodes measured in volts. **OR** Mathematically, $V = \frac{W}{Q}$ **(ii) Current:** **(1 Mark)** It is defined as the movement of free electrons or flow of electrons inside a conducting material. It is denoted by I and measured in ampere. **OR** $I = Q/t$ Where, I = Average current in amperes , Q = Total charge flowing T = Time in seconds required for the flow of charge *Units* : – *coulomb* / sec. *or Amperes*. **iii) Resistance with their unit:** **(Definition: 1 Mark & Unit :1 Mark)** It is defined as the opposition offered by a conductor to the flow of current. It is represented by R **OR** The formula for resistance is given by R= $\rho \times (l/a)$ OR R=V/I **Unit** – ohm

b) Why single phase induction motor is not self starting?

Ans **Reason for single phase induction motors are not self starting:** **(4 Mark)**

- When single phase AC supply is given to main winding it produces alternating flux.
- According to double field revolving theory, alternating flux can be represented by two opposite rotating flux of half magnitude.
- These oppositely rotating flux induce current in rotor & there interaction produces two opposite torque hence the net torque is Zero and the rotor remains standstill.
- Hence Single-phase induction motor is not self starting.

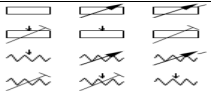
OR

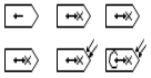
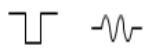
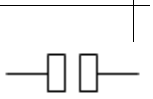
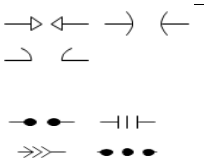
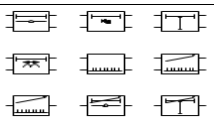
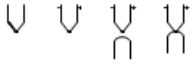
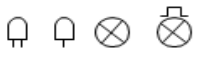
Single phase induction motor has distributed stator winding and a squirrel-cage rotor. When fed from a single-phase supply, its stator winding produces a flux (or field) which is only alternating i.e. one which alternates along one space axis only. It is not a synchronously revolving (or rotating) flux as in the case of a two or a three phase stator winding fed from a 2 of 3 phase supply. Now, alternating or pulsating flux acting on a stationary squirrel-cage rotor cannot produce rotation (only a revolving flux can produce rotation). **That is why a single phase motor is not self-starting.**

c) Name the electrical accessories used in electric circuits and draw their symbols.

Ans **(Any four symbols are expected- 1 Mark each)**

Note: Student may draw other than these symbols may be accepted

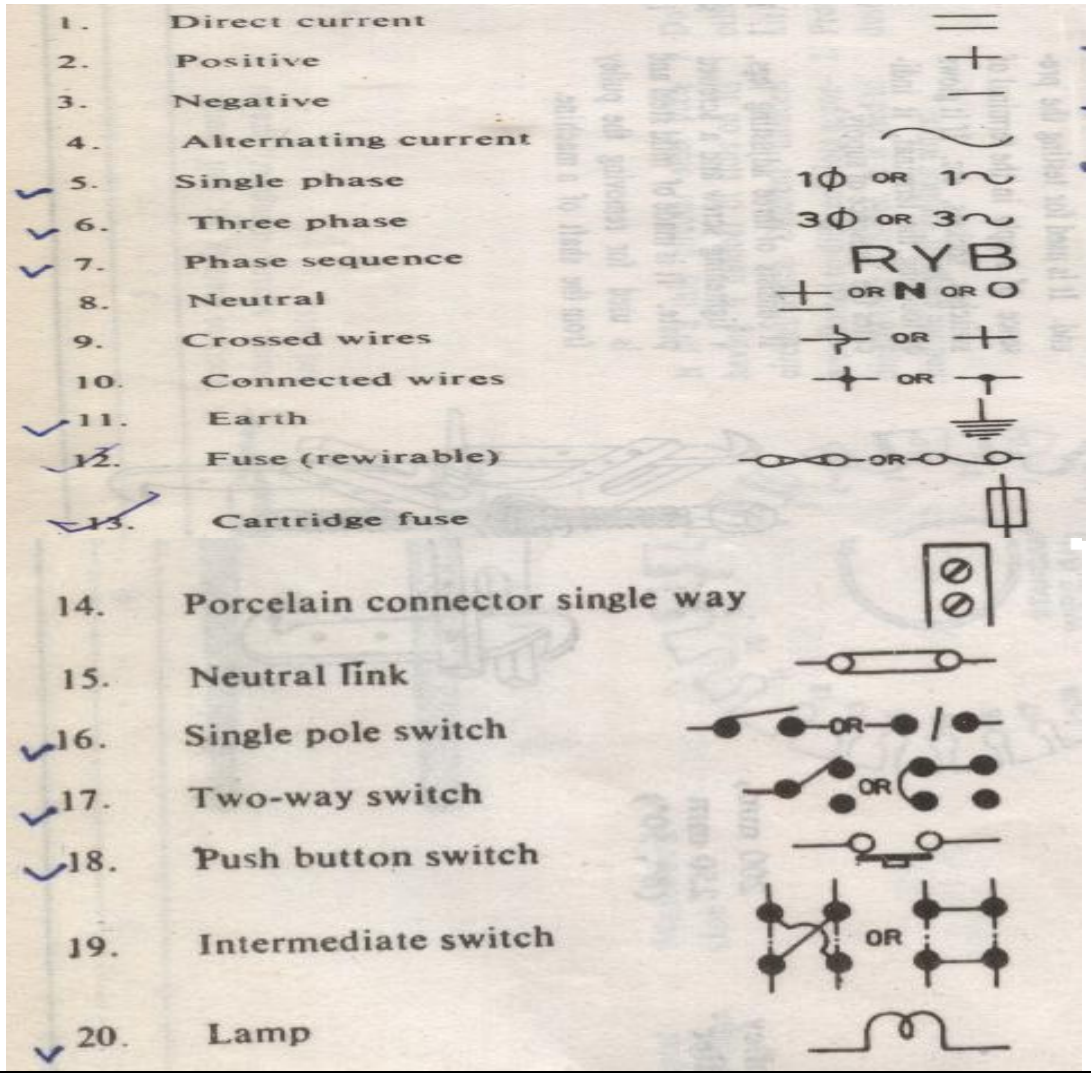
Name	Electrical Symbol	Alternate Symbol	Name	Electrical Symbol	Alternate Symbol
Ground			Attenuator		
Equipotentiality			Capacitor		
Chassis			Accumulator		
Battery			Antenna		
Resister			Loop antenna		
Circuit breaker			Crystal		

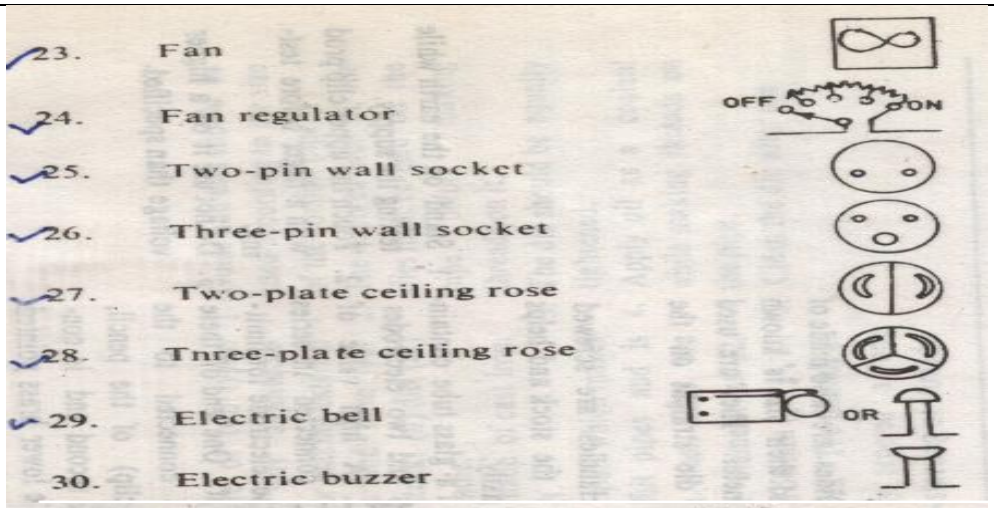
Fuse			Half inductor		
Ideal source			Pickup head		
Generic component			Pulse		
Transducer			Saw tooch		
Inductor			Step function		
Explosive squib			Permanent magnet		
Sensing link squib			Magnet core		
Squib igniter			Ferrite core		
Surge protectors			Igniter plug		
Material			Buzzer		
Delay element			Thermal element		
Thermocouple			Speaker		
Lamp			Microphone		

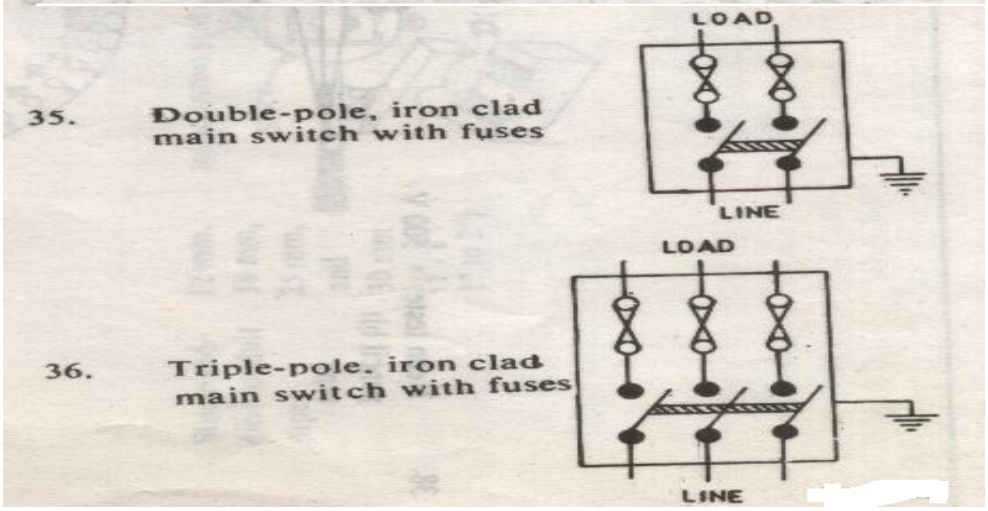
Fluorescent lamp			Oscillator		
AC source			Thermopile		
DC source					

OR

Any four symbols from below or equivalent symbols accepted)







d) **Compare intrinsic and extrinsic semiconductor on : i) Purity ii) doping iii) type iv) conductivity**

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

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
a)	**Derive an emf equation of 1-phase transformer.**	

Ans

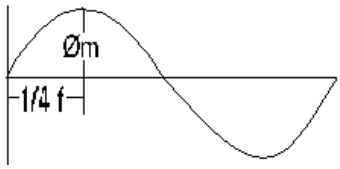
➢ **EMF equation of single phase Transformer:-**

Let, N_1= Number of turns in the primary

N_2= Number of turns in the Secondary

Øm= Maximum flux in core (wb)= BmxA

F= Frequency



(1 Mark)

As shown in figure, flux increases from its zero value to maximum value Øm in one quarter of the cycle (i.e. ¼ f) sec

➢ Average rate of change of flux

➢ $\frac{\phi m}{1/4f} = 4 f\phi m$ (wb/sec) **(1 Mark)**

Rate of Change of flux per turn means induced emf, If flux various sinusoidally then r.m.s value of induced emf is obtained by multiplying the average value with form factor.

From factor = $\frac{R.M.S\ Value}{average\ value} = 1.11$ **(1 Mark)**

R.M.S.value of emf /turn = 1.11 x 4 f m= 4.44 f m **(1 Mark)**

R.M.S value in the whole primary winding

= (induced emf / turn) x No. of primary turns

$E_1 = 4.44\ f\ \phi m N1$

E_1 = 4.44 f BmAN_1

OR **E_1 = 4.44 ϕm f N_1** **(1 Mark)**

R.M.S. value in the whole table secondary winding

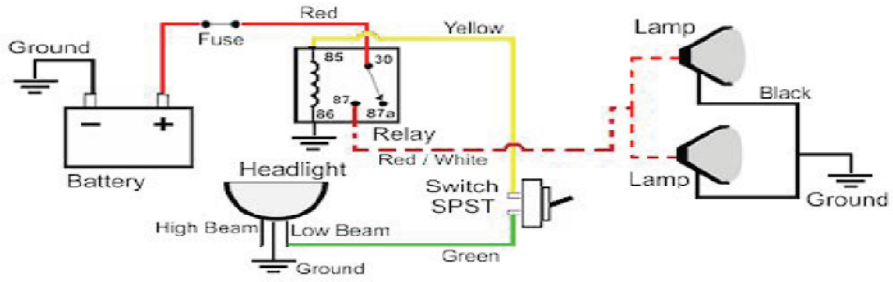
$E_2 = 4.44\ f\ Bm\ A\ N_2$ **(1 Mark)**

OR $E_1 = 4.44\ \phi m\ f\ N_2$

b) Draw and explain in brief the wiring diagram of (i) Head light (ii) Horn (ii) Stop light

Ans

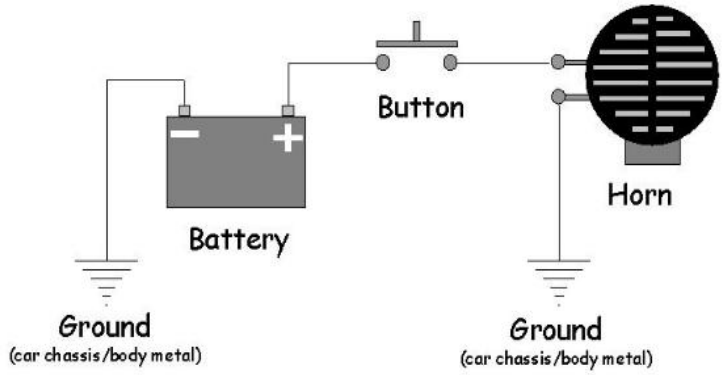
I) Head light **-------(Diagram 1 Mark & Explanation 1Mark)**



or equivalent diagram

For HEAD or Driving Lights: Turn on the high beam headlamps. Connect the end of the circuit tester to ground (-) and use the tester to locate the headlamp high beam lead. Turn off the ignition and the headlamps. Disconnect the battery. Turn on ignition switch and low beam headlamps for Fog Lamps, or high beam headlamps for Driving Lamps

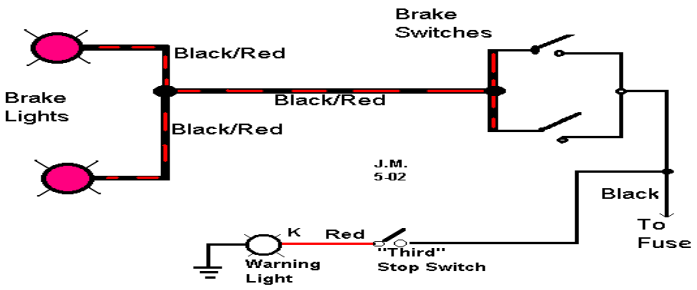
II) Horn: **-------(Diagram 1 Mark & Explanation 1Mark)**



or equivalent figure

This diagram shows the typical “hot side switching” wiring that most people waltz into the world of horn wiring expecting. Battery grounded, hot wire to push button, push button to horn, then ground horn. When horn Butten is pressed horn is blow.

III) STOP light: **-------(Diagram 1 Mark & Explanation 1Mark)**



or equivalent figure

When breaks are applied in a vehicle, break switches are put in close or ON position. the break lights get supply from battery and blow out

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

a) **State Faraday's laws of electromagnetic induction.**

Ans: **Faraday's law of electromagnetic induction:**

i) First Law: - Whenever change in the magnetic flux linked with a coil or conductor , an emf is induced in it. **OR** Whenever a conductor cuts magnetic flux, an emf is induced in conductor. ----------**(02Marks)**

ii) Second Law :- The Magnitude of induced emf is directly proportional to (equal to) the rate of change of flux linkages.

$$e = \frac{-Ndt}{dt} d\phi$$

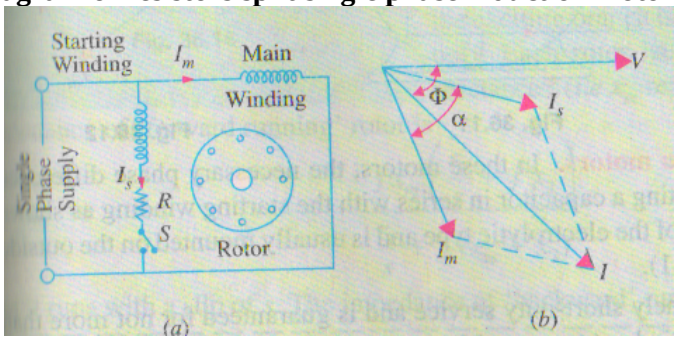
Where, N= Number of turn

$\frac{d\phi}{}$ = Rate of Change of flux ----------**(02Marks)**

b) **Explain in brief the construction and working of resistance split phase induction motor.**

Ans: **(Diagram: 2 Mark & Working: 2 Mark)**

Circuit diagram of resistors split single phase induction motor:



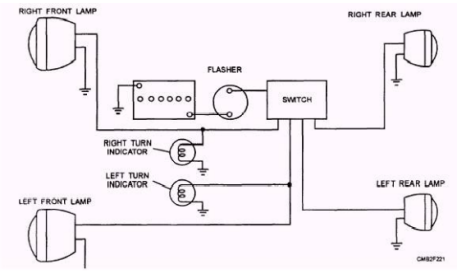
or equivalent figure

Construction and Working of resistance split phase induction motor:

- In resistors split phase I.M. shown in above figure 'a', the main winding has low resistance but high reactance whereas the starting winding has a high resistance, but low reactance.
- The resistance of the starting winding may be increased either by connecting a high resistance 'R' in series with it or by choosing a high-resistance fine copper wire for winding purpose**.**
- Hence as shown in fig. 'b' , the current I_S drawn by the starting winding lags behind the applied voltage V by a small angle whereas current I_m taken by the main winding lags behind V by a very large angle.
- Phase angle between I_S and Im is made as large as possible because the starting torque of a split-phase motor is proportional to sin α .
- A centrifugal switch S is connected in series with the starting winding and is located inside the motor.
- Its function is to automatically disconnected the starting winding from the supply when the motor has reached 70 to 80 per cent of its full load speed.

c) Explain in brief with suitable wiring diagram. i) Turn indicator ii) Wind shield wiper

Ans: **i) Diagram of Turn on indicator :** **(1 Marks)**



or equivalent dia.

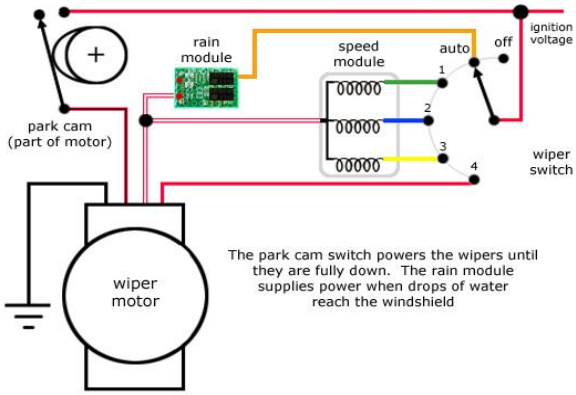
Explanation: **(1 Marks)**

The turn indicator is a gyroscopic instrument that works on the principle of precession. The gyro is mounted in a gimbal. The gyro's rotational axis is in-line with the lateral (pitch) axis of the aircraft, while the gimbal has limited freedom around the longitudinal (roll) axis of the aircraft. **OR**

It is a device consisting of a wheel or disc mounted so that it can spin rapidly about an axis which is itself free to alter in direction. The orientation of the axis

is not affected by tilting of the mounting, so gyroscopes can be used to provide stability or maintain a reference direction in navigation systems, automatic pilots, and stabilizers.

ii) Diagram of Windshield wiper:- **(1 Marks)**



or any equivalent

Explanation:- **(1 Marks)**

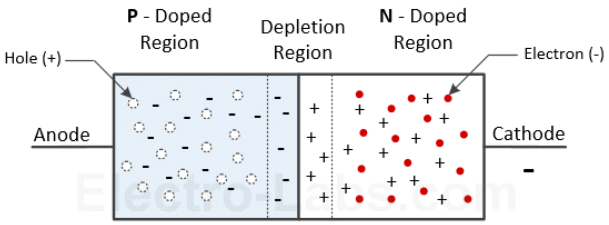
The ignition switch supplies electrical power for the wiper motor. Current passes through the wiper control switch and then to the wiper motor. A speed control module may vary the voltage that reaches the motor on some models. Other types use different windings in the motor to control speed.

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.

d) Draw and explain the construction of P-N junction diode.

Ans: **(2 Mark for construction , 2 Marks explanation)**

Construction of PN junction diode: -



or equivalent figure

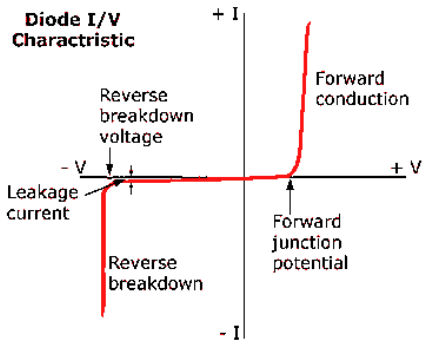
A P-N junction is formed at the boundary between a p-type and n-type semiconductor created in a single crystal of semiconductor by doping.

Working- **(2 Marks)**

In forward bias, the p-type is connected with the positive terminal and the n-type is connected with the negative terminal. With a battery connected this way, the holes in the P-type region and the electrons in the N-type region are pushed toward the junction. This reduces the width of the depletion zone. The positive charge applied to the P-type material repels the holes, while the negative charge applied to the N-type material repels the electrons. As electrons and holes are pushed toward the junction, the distance between them decreases. This lowers the barrier in potential. With increasing forward-bias voltage, the depletion zone eventually becomes thin enough that the zone's electric field cannot counteract charge carrier motion across the p–n junction, as a consequence reducing electrical resistance. The electrons that cross the p–n junction into the P-type material (or holes that cross into the N-type material) will diffuse in the near-neutral region. Therefore, the amount of minority diffusion in the near-neutral zones determines the amount of current that may flow through the diode.

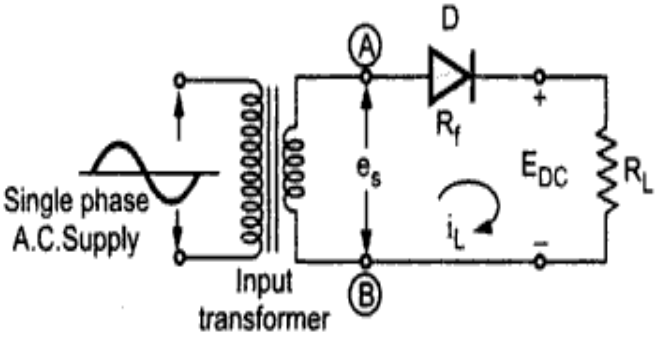
Reverse-bias usually refers to how a diode is used in a circuit. If a diode is reverse-biased, the voltage at the cathode is higher than that at the anode. Therefore, no current will flow until the diode breaks down. Connecting the P-type region to the negative terminal of the battery and the N-type region to the positive terminal corresponds to reverse bias. Because the p-type material is now connected to the negative terminal of the power supply, the 'holes' in the P-type material are pulled away from the junction, causing the width of the depletion zone to increase. Likewise, because the N-type region is connected to the positive terminal, the electrons will also be pulled away from the junction. Therefore, the depletion region widens, and does so increasingly with increasing reverse-bias voltage. This increases the voltage barrier causing a high resistance to the flow of charge carriers, thus allowing minimal electric current to cross the p–n junction. The increase in resistance of the p–n junction results in the junction behaving as an insulator.

VI Characteristics:



or equivalent figure

e)	**Explain the working of half wave rectifier with suitable circuit diagram. Also draw the waveforms of half wave rectifier.**
Ans:	**Half wave rectifier Circuit diagram::** **(1 Mark)**



or equivalent figure

Waveform: **(1 Mark)**

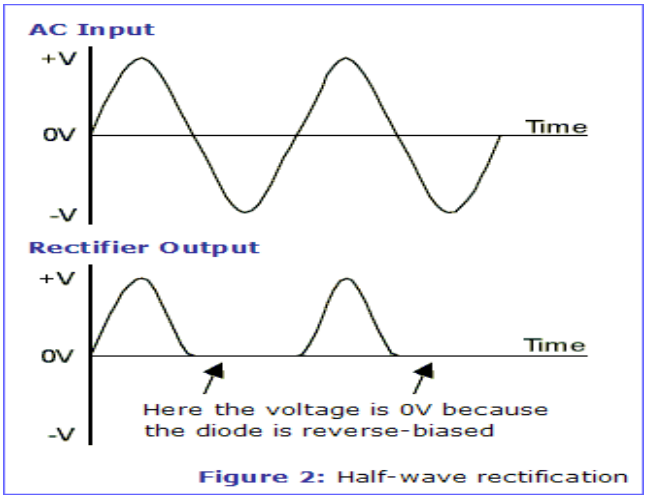


Figure 2: Half-wave rectification

Working : **(2 Marks)**

During positive half cycle of an AC supply, Diode D will forward biased and current starts flowing through load. The output voltage is equal to +Vs.

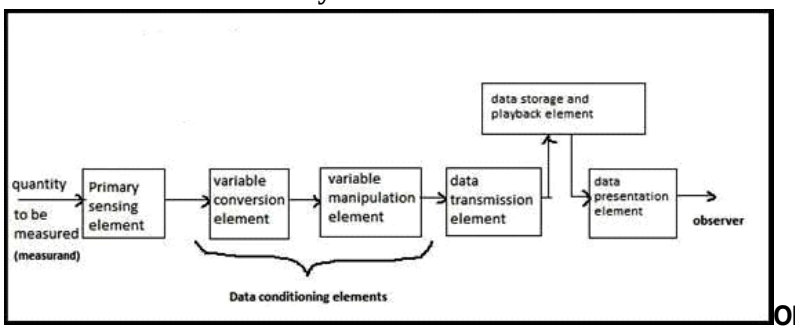
During negative half cycle of an AC supply, Diode D will reverse biased and source is disconnected from load. Therefore output voltage is equal to 0V.

In this pulsating DC waveform will be obtained at the load.

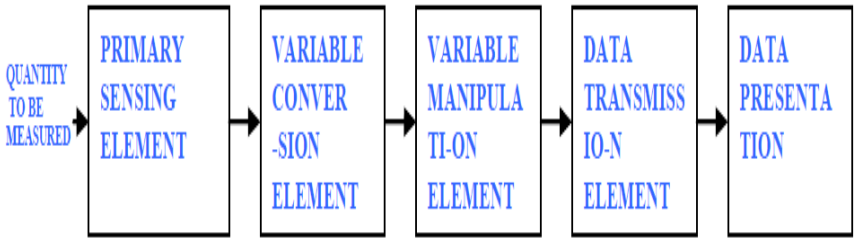
f)	**Draw and explain the block diagram of general measurement system.**

Ans: **(Figure-2 Mark & Explanation-2 Mark)**

Diagram of General measurement system:-



OR



OR Equivalent Fig

Explanation of general measurement system:-:-

A generalized measurement system consists of the following components:

1. Primary Sensing Element
2. Variable Conversion Element
3. Variable Manipulation Element
4. Data Processing Element
5. Data Transmission System
6. Data Presentation Element

In addition to the above components, a measurement system may also have a data storage element to store measured data for future use. As the above six components are the most common ones used in many measurement systems, they are discussed in detail below:

1. Primary Sensing Element:

The primary sensing element receives signal of the physical quantity to be measured as input. It converts the signal to a suitable form (electrical, mechanical or other form), so that it becomes easier for other elements of the measurement system, to either convert or manipulate it.

2. Variable Conversion Element:

Variable conversion element converts the output of the primary sensing element to a more suitable form. It is used only if necessary.

3. Variable Manipulation Element:

Variable manipulation element manipulates and amplifies the output of the variable conversion element. It also removes noise (if present) in the signal.

4. Data Processing Element:

Data processing element is an important element used in many measurement systems. It processes the data signal received from the variable manipulation element and produces suitable output.

Data processing element may also be used to compare the measured value with a standard value to produce required output.

5. Data Transmission System:

Data Transmission System is simply used for transmitting data from one element to another. It acts as a communication link between different elements of the measurement system. Some of the data transmission elements used are cables, wireless antennae, transducers, telemetry systems etc.

6. Data Presentation Element:

It is used to present the measured physical quantity in a human readable form to the observer. It receives processed signal from data processing element and presents the data in a human readable form. LED displays are most commonly used as data presentation elements in many measurement systems.

Q.3	**Attempt any FOUR of the following:**	**16 Marks**
a)	**Define: (i) Active power (ii) Reactive power (iii) Apparent power. Draw power triangle.**	
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

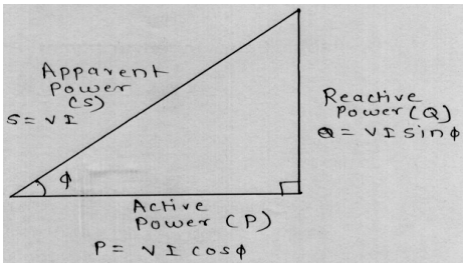
Units: - VAR **OR** KVAR

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) Power Triangle: **(1 Mark)**



OR Equivalent Fig.

b) i) i) State the working principle of D.C. motor

Ans: **Working Principle of D.C Motor :-** **(02 Marks)**

It works on Faradays law of electromagnetic induction , When current carrying conductor is placed in magnetic field force will be exerted on the conductor & motor start rotating and rotor direction is decided by Flemings left hand rule.

b) ii) ii) State the necessity of filter.

Ans: **Necessity of Filter:-** **(2 Marks)**

Filters are circuits which are used to remove unwanted AC components ie. Ripples from the output of rectifier. **OR**

The output of rectifier circuit consists of a.c. ripples. The rectifier gives the output as d.c. + a.c. and not pure d.c (i.e. pulsating DC voltage). So as to get pure d.c. output, filter is necessary at the output side of rectifier.

c)	**Define : (i) Accuracy (ii) Precision (iii) Sensitivity (iv) Reliability**
Ans:	**(Each Definition : 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) 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. **iii) 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. **OR** **(iv) Reliability** Reliability is a way of ensuring that any instrument used for measuring experimental variables gives the same results every time. **OR** **Instrument Reliability** is defined as the extent to which an instrument ***consistently*** measures what it is supposed to.
d)	**Explain the dynamic characteristics of measuring system.**
Ans:	**(1 Mark explanation , Any 3 Characteristics: 3 Marks)** **Explanation:** Instruments rarely respond to the instantaneous changes in the measured variables. Their response is slow or sluggish due to mass, thermal capacitance, electrical capacitance, inductance etc. sometimes, even the instrument has to wait for some time till, the response occurs. These type of instruments are normally used for the measurement of quantities that fluctuate with time. The behaviour of such a system, where as the input varies from instant to instant, the output also varies from instant to instant is called as **dynamic response** of the system. **The dynamic Characteristics of a measurement system are:** 1) Speed of response: It is defined as the rapidity with which an instrument, responds to

the changes in the measured quantity.

2) Fidelity: It is defined as the degree to which a measurement system is capable of faithfully reproducing the changes in input, without any dynamic error.

3) Lag: It is defined as the retardation or delay, in the response of a system to the changes in the input.

4) Dynamic error: It is the difference between the true value of the quantity that is to be measured, changing with time and the measured value, if no static error is assumed.

e) State the difference between analog signal and digital signal.

Ans: **(Any Four Point expected: 1 Mark each)**

Sr.No.	Parameter	Analog Signal	Digital Signal
1	**definition**	An analog signal is any continuous signal w.r.t. time	A digital signal is a physical signal that is a representation of a sequence of discrete values
2	**Range of values**	-∞ to +∞	0 to 1 (binary)
3	**Examples**	Audio, video, amplifier ,rectifier signals	Combinational and Sequential ckts signals
4	**Accuracy**	less	more
5	**Waveform**	 a. Analog signal	 b. Digital signal

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

a) Define : (i) RMS value (ii) Average value (iii) Form factor (iv) Peak factor with respect to an alternating waveform.

Ans: **i) Meaning of R.M.S Value:** **(1 Mark)**

The r.m.s value of an alternating current is that steady current (d.c) which when flowing through a given resistance for a given time produces the same amount of heat as produced by the alternating current when flowing through the same resistance for the same time. **OR**

∴ RMS Value = Form Factor × Average Value **OR**

RMS Value = 0.707× maximum value

ii) Average value : **(1 Mark)**

Average value of A.C current is equal to the D.C current that is required to produce the same amount of charge. **OR**

$$Average\,value = \frac{RMS\ Value}{Form\ \ factor}$$

Average Value = $0.637\times$ maximum value

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

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

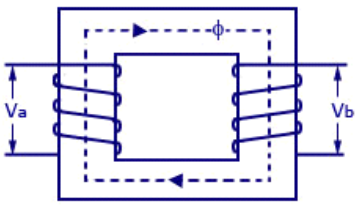
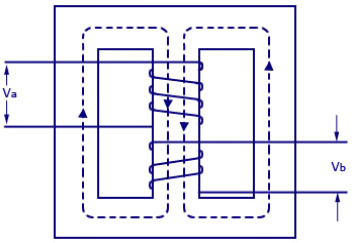
iv) Peak factor- **(1 Mark)**

It is defined as the ratio of the maximum value to its RMS Value

$$PeakFactor = \frac{\text{Maximum value}}{\text{RMS value}}$$

b) Compare core type and shell type transformer on any four points.

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.	Average length of the core is more	Average length of the core is less
4.	Magnetic Flux has only one continuous path	Magnetic Flux is distributed into 2 paths
5.	Suitable for high voltage & less output	Suitable for less voltage & high output
6.	Easy for repairs	Difficult for repairs
7.	Less in Weight	More in Weight
8.	Leakage flux are more	Leakage flux are less

c)	**Explain in brief the insulated and ground return system.**
Ans:	**1) Insulated Return System:** **(Each Explanation: 2 Marks)** 1. Actually wire is used a return path for current 2. It is Number of wires require Two 3. There is no disadvantage such as steel which is underground get rusting when insulated wire is used as a return path. 4. Cost is more **2) Ground return system:** 1. Actually ground is used as a return path for current No wire is required. 2. Number of wire required one If ground is used as a return path than there is disadvantages such as steel which is underground get rusting 4. Cost is less **OR** In electrical power distribution systems, a protective ground conductor is an essential part of the safety Earthing system. Electrical circuits may be connected to ground (earth) for several reasons. In mains powered equipment, exposed metal parts are connected to ground to prevent user contact with dangerous voltage if electrical insulation fails. Connections to ground limit the build-up of static electricity when handling flammable products or electrostatic-sensitive devices. In some telegraph and power transmission circuits, the earth itself can be used as one conductor of the circuit, saving the cost of installing a separate return conductor.
d)	**State and explain the working principle of operation of transducer.**
Ans:	. **(List of Transducer-1 Mark, Figure-1.5 Mark & Explanation-1.5 Mark)** **Statement & Explanation:** An electrical **transducer** is a device which is capable of converting the physical quantity into a proportional electrical quantity such as voltage or electric current. Hence it converts any quantity to be measured into usable electrical signal. This physical

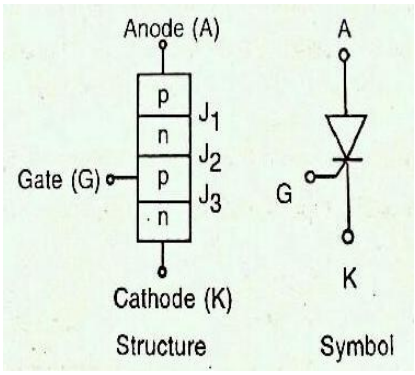
quantity which is to be measured can be pressure, level, temperature, displacement etc. The output which is obtained from the transducer is in the electrical form and is equivalent to the measured quantity. For example, a temperature transducer will convert temperature to an equivalent electrical potential. This output signal can be used to control the physical quantity or display it. Note that any device which is able convert one form of energy into another form is called as a **transducer**. For example, even a speaker can be called as a transducer as it converts electrical signal to pressure waves (sound).But an electrical transducer will convert a physical quantity to an electrical one.

Q.4 B) Attempt any Three of the following: 06 Marks

a) Explain the construction and working of SCR. Draw the V-I characteristics of SCR.

Ans: **(Allotted 2 Marks for diagram, 2 Marks for Working and 2 Marks for VI characteristics)**

Construction of S.C.R:–



or equiavlent figure

Working-

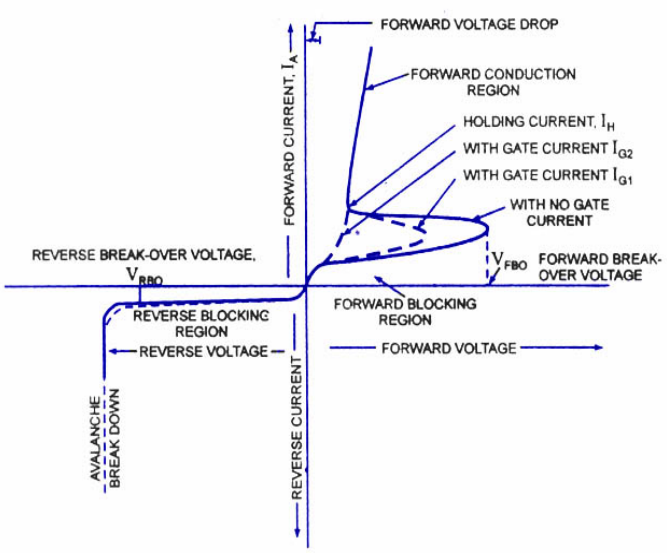
When the anode is made +ve w.r.t. cathode, the junctions J1 and J3 are forward biased, whereas junction J2 is reverse biased. Due to this reverse biased junction J2, only small leakage current flows from anode to cathode. The S.C.R. is then said to be in forward blocking state.

With anode +ve w.r.t. cathode, if anode-to-cathode voltage is increased to a sufficient large value, the reverse biased junction J2 will break. The voltage at which it occurs is called forward break over voltage V_{BO}. The junctions J1 and J3 are already forward biased, hence results in free movement of carriers across all three junctions, resulting in large forward anode current. The S.C.R. is said to be in conducting state.

Without breakdown of junction J2, S.C.R. can be made ON by applying +ve voltage to gate w.r.t. cathode. Due to this, junction J3 is forward biased and conducts and

gate current flows. Free movement of carriers (holes and electrons) across the junction J3 results in injection of holes into n-region and electrons into p-region. The injected electrons in p-region force this p-region to lose its identity as p-region because it was having holes as majority carriers but with injected electrons, it is having holes as well as electrons in majority. Therefore junction J2 now has majority electrons on both side and it is disappeared and S.C.R. is made ON.

VI characteristics :



V-I Characteristics of SCR

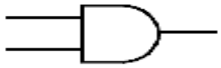
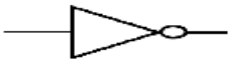
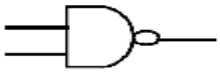
or equivalent figure

b) State the classification of logic gates. Draw the symbols and truth tables of any three logic gates.

Ans: **(2 Marks for Classification, 4 Marks for any Two logic gate symbol & truth table of each gate :)**

Classification of Gates		
Basic	**Derived**	**Universal**
AND	NAND	NAND
OR	NOR	NOR
NOT	EXOR & EXNOR	

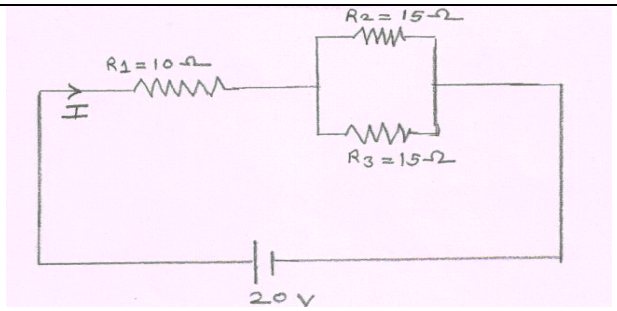
Symbols and Truth Table:

Gate Name	Symbol	Notation	Truth table
AND		F = A.B or F= AB	A B | A.B 0 0 | 0 0 1 | 0 1 0 | 0 1 1 | 1
OR		F = A+B	A B | A+B 0 0 | 0 0 1 | 1 1 0 | 1 1 1 | 1
NOT		F=A or F = A′	A | F 0 | 1 1 | 0
NAND		F = (A . B)′	A B | F 0 0 | 1 0 1 | 1 1 0 | 1 1 1 | 0
NOR		F = (A + B)′	A B | F 0 0 | 1 0 1 | 0 1 0 | 0 1 1 | 0
XOR		F = A⊕B F = A′B + AB′	A B | F 0 0 | 0 0 1 | 1 1 0 | 1 1 1 | 0

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

a) **A resistance of 10 ohm is connected in series with two resistances each of 15 ohm arranged in parallel. The above combination is connected across 20 V supply. Calculate : (i) Req. (ii) Total current**

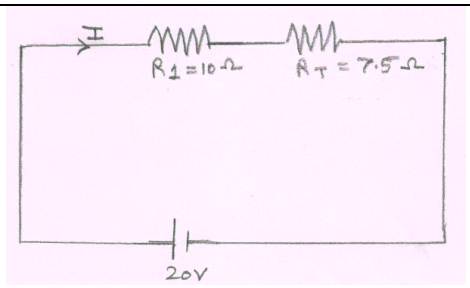
Ans:



Resistance in Parallel ($R_{parallel}$) = $\frac{R_2 \times R_3}{R_2 + R_3}$ - ---------- **(1/2 Mark)**

= $\frac{15 \times 15}{15 + 15}$

= 7.5 *ohm* ---------- **(1 Mark)**



i) Resistance in Series(R_{series}) Req = $R_1 + R_T$

$= 10 + 7.5$

$= 17.5\ ohm$ ---------- **(1 Mark)**

ii) Total Current 'I' = $\frac{V}{\text{Re}\ q}$ ---------- **(1/2 Mark)**

$= \frac{20}{17.5}$ - ---------- **(1 Mark)**

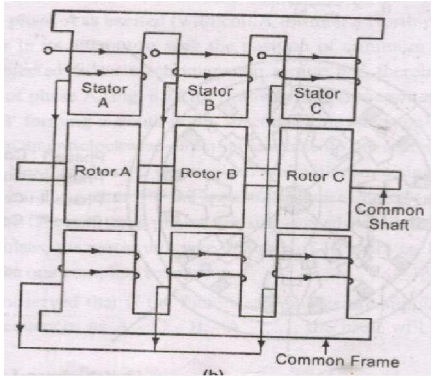
Total Current 'I' = 1.1428 Amp

b) State the types of stepper motor. Explain any one of them in brief.

Ans: **Types of Stepper Motor :-** **(2 Marks)**

1) Variable Reluctance Motor
2) Permanent Magnet Motor

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



or equivalent dia.

Working:-

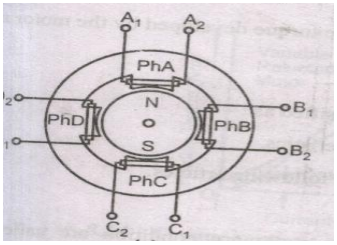
When phase A is excited rotor attempts minimum reluctance between stator and rotor and is subjected to an electromagnetic torque and there by rotor rotates until its axis coincides with the axis of phase A.

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.

c) Compare positive and negative return system on any four points.

Ans: **Distinguish between positive and negative return systems:**

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

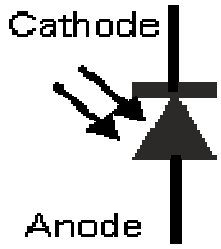
Negative return system: ---------- (2 Marks)

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.

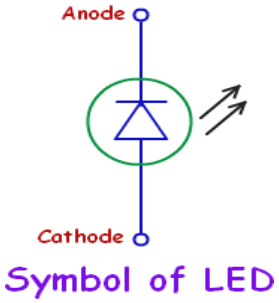
d)	Draw symbols of photodiode and LED. Also state the applications of both.

Ans: **(Each symbol – 1 Mark)**

Symbol of photodiode:



Symbol of LED:



Applications of photo diode: **(Any 2 for 1 Mark)**

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.

Applications of LED: **(Any 2 for 1 Mark)**

1. Burglar Alarm
2. Smoke detectors
3. Remote control devices
4. In CD players
5. In consumer electronics devices such as compact disc players
6. Light measurement, as in camera light meters, or to respond to light levels, as in switching on street lighting after dark.

e) Compare electrical and mechanical instruments on any four points.

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

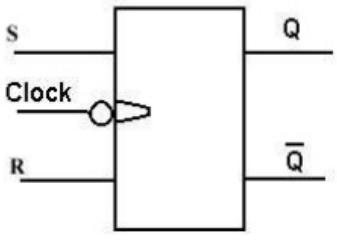
S.No.	Electrical Instrument	Mechanical Instruments
1	These instruments are used for rapid changes. Or sensitivity of the electrical instrument is more	These instruments are used for static & stable condition. Or sensitivity of the electrical instrument is less
2	They are able to record dynamic & transient 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

f) State the meaning of flip flop. Draw the symbols and truth tables of RS and D flip flop.

Ans: **Meaning of flip flop**: **(1 Mark)**

A flip-flop or latch is a circuit that has two stable states and can be used to store state information. A flip-flop is a bistable multivibrator. The circuit can be made to change state by signals applied to one or more control inputs and will have one or two outputs.

1) Symbol & Truth Table of RS flip flop : (1.5 Marks)



Symbol

(b) *SR* Flip-Flop

S	R	$Q(t+1)$	Operation
0	0	$Q(t)$	No change
0	1	0	Reset
1	0	1	Set
1	1	?	Undefined

Truth Table

2) Symbol & Truth Table of RS flip flop : **(1.5 Marks)**

D Flip-flop

Symbol

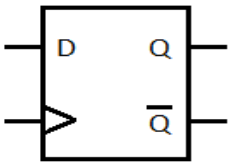


Table of truth:

clk	D	Q	$\overline{Q}$
0	0	Q	$\overline{Q}$
0	1	Q	$\overline{Q}$
1	0	0	1
1	1	1	0

Q.6 **Attempt any Four of the following:** **16 Marks**

a) **A 1-phase transformer has 500 turns in the primary and 1200 turns in the secondary winding. The cross sectional area of the core is 80 sq. cm. If the primary winding is connected to a 50 Hz supply at 500 V. Calculate : (i) ϕ_m (ii) B_m (iii) V_2**

Ans:

1. Flux (ϕ_m) :

$$E_1 = 4.44\,\phi_m\ f\ N_1$$ …….. **(1/2 Marks)**

$$500 = 4.44 \times \phi_m \times 50 \times 500$$

$$\phi_m = \frac{500}{4.44 \times 50 \times 500},$$

$$\phi_m = 4.50 \times 10^{-3}\ wb$$ …….. **(1 Marks)**

2. Flux density (B_m) :

$$B_m = \frac{\phi_m}{area\ of\ core} \ldots$$ …….. **(1 /2Marks)**

$$B_m = \frac{4.50 \times 10^{-3}}{80 \times 10^{-4}}$$

$$B_m = 0.5625\ wb/m^2$$ …….. **(1 Marks)**

3. Secondary voltage ($V_2 = E_2$) :

$$E_2 = V_2 = 4.44\,\phi_m\ f\ N_2$$

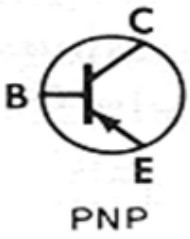
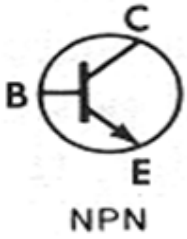
$$E_2 = 4.44 \times 4.50 \times 10^{-3} \times 50 \times 1200$$

$$E_2 = V_2 = 1198.80\ Volts$$ ……..…….. **(1 Marks)**

b) Compare PNP and NPN transistor on the basis of : (i) Symbol (ii) Direction of emitter current iii) VcE (iv) Application.

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

.

Sr.No.	Parameter	PNP transistor	NPN transistor
1	Symbol		
2	Direction of Emitter current	As shown in the symbol	As shown in the symbol
3	V_{CE}	$V_{EC} = V_{EB} - V_{CB}$, Emitter is at higher potential	$V_{CE} = -V_{BC} + V_{BE}$, emitter is at lower potential.
4	Application	Power amplifier , push-pull power amplifiers	Voltage amplifier & switch

c) Explain LVDT with neat sketch.

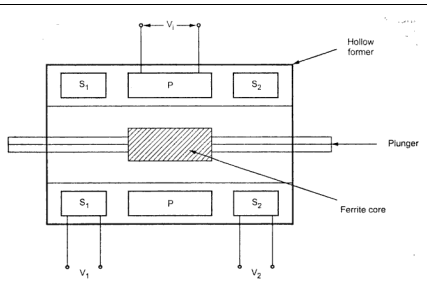
Ans: **Linear Variable Differential Transformer (LVDT):-**

(Figure: 2 Marks & Explanation: 2 Marks)

Linear Variable Differential Transformer (LVDT):-

It is the transducer most widely used to translate linear motion into electrical signals.

Construction-



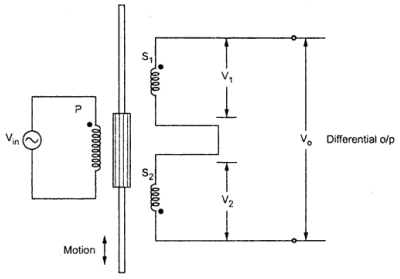
or equivalent dia.

P= primary winding

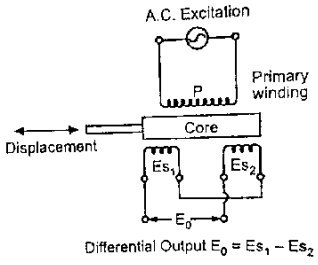
S1, S2= two secondary windings.

Working-

The secondary S1 and S2 are connected in series opposition so that voltages induced in each coil oppose each other. The electrical equivalent connection is shown below.



OR



or equivalent dia.

The position of movable core determines the flux linkage between the primary and each of the secondary windings.

Let V1= output of secondary S1

V2= output of secondary S2

Then V_O= V1-V2

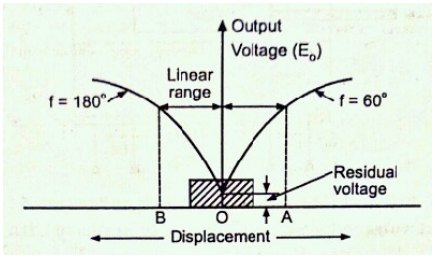
Case 1: when the core is at centre.

With the core in the centre, the induced voltages V1 and V2 in the secondary S1 and S2 are equal, since they oppose each other; the output will be zero volts.

Case 2: when core is displaced.

When the core is displaced from the null position, the induced voltage in the secondary towards witch the core has moved increases while that in other secondary decreases.

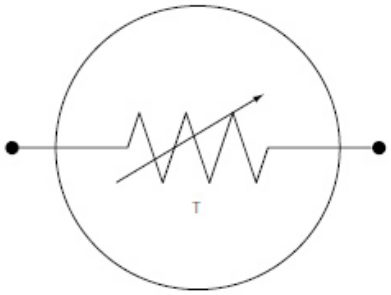
The phase difference between the output and input voltage changes by 180 degrees when the core moves through the null position. Therefore in actual measurement to determine positions uniquely, this phase change over is measured with phase sensitive detector.



or equivalent dia.

d) Draw and explain the construction and working of thermister. Draw characteristics of it.

Ans: **Construction :** **(1 Mark)**



or equivalent

Working principle of Thermistor:- **(1.5 Marks)**

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:

$R = R_o\, e^k$

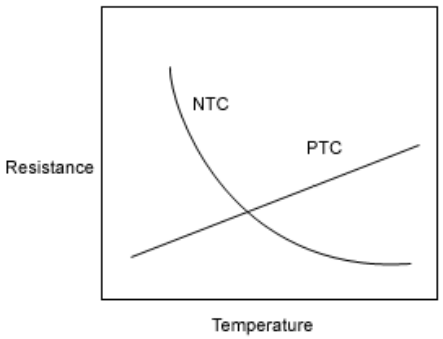
$K = \beta(1/T - 1/T_o)$

Where R is the resistance of the thermistor at any temperature T in ^{o}K (degree Kelvin)
R_o is the resistance of the thermistors at particular reference temperature $T_o$in ^{o}K
e 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.

Characteristics of thrermistor :

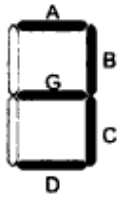


or equivalent characteristics

e) Explain 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.

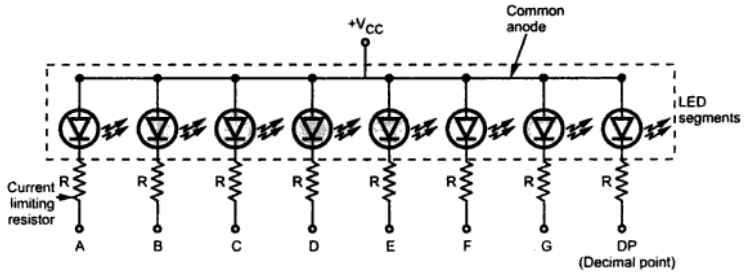


e.g. suppose we want to display the digit 3, then LED a,b,g.c,d should only be forward biased.

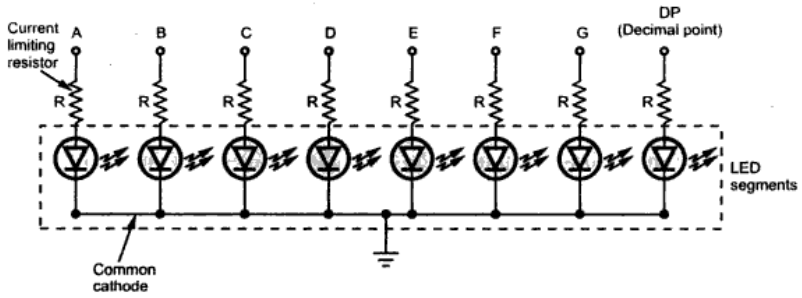
The two types of seven segment display are available-

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.



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