Important Instruction 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.

SECTION –I

Q.1 Attempt any Nine of the following **18 Marks**

a) State the Ohm's law. **(State-1 Mark & Equation-1 Mark)**

Ohms Law:-

The current flowing through a solid conductor is directly proportional to the difference of potential across the conductor. & inversely proportional to its resistance provided the temperature remains constant.

Equation:- **i.e** $I \alpha V \quad \therefore \frac{V}{I} constant \quad \therefore I = \frac{V}{R}$

$or \ \therefore V = I.R. \quad or \quad R = \frac{V}{I}$

Where R is constant called as resistance, V= voltage and I = Current

b) Define electrical power and energy.

Electrical power: **(1 Mark)**

The rate of doing work done is known as power. Its unit is watt

Electrical energy: **(1 Mark)**

The total work done in the circuit is known as energy. Its unit is KWH or joules.

c) State necessity of starter.

Necessity of the starter: **(2 Mark)**

The current drawn by motor $I_a = \frac{V - E_b}{R_a}$, at start speed $N = 0$, $\therefore E_b = 0$ and $I_a = \frac{V}{R_a}$.

As R_a is very small I_a will be dangerously high at the time of starting. This high starting current may damage the motor armature (& series field winding in the case of dc series motors). Hence to limit the starting current suitable resistance is inserted in series with armature which is called as starter. This starting resistance is cut-off in steps with increase in speed.

d) What is earthing?

Earthing: **(2 Mark)**

Connecting the metallic frame of the electrical machines /any electrical equipment body etc to ground is known as earthing. Earthing protected against the electric shock.

OR

- Earthing provides protection to the electrical machinery due to leakage current.
- Earthing provides protection to Tall Building & structure against lightening stroke
- Earthing is protects human from shocks

e) Two resistances of 4 ohm and 5 ohm are connected in series across 120V DC supply. Find current and power supplied to this circuit.

Given Data: R_1 =4 ohm R2 = 5 ohm in series V = 120V

$R_T = R_1 + R_2 = 4+5 = 9\text{ohm}$

$$Current \quad I = \frac{V}{R_T} = \frac{120}{9}$$

$Current \quad I = 13.333 \; Amp$

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

$Power \quad Supplied \quad P = V \; I \; = 120 \times 13.333$

$Power \quad Supplied \quad P = 1600 \quad Watt = 1.6 \; kW$

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

f) State the types of transformer on basis of voltage. **(2 Mark)**

The types of transformer on basis of voltage:

i) Step-up transformer

ii) Step down transformer

iii) 1-ph transformer

iv) 3-ph transformer

g) Why single phase induction motors are not self starting. **(2 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.

h) State any two advantages of three phase system over single phase system.

Advantages of 3-phase system over 1-phase system: - **(Any Two points each point 1 Mark)**

1. **More output:-** for the same size output of poly-phase machines is always higher than single phase machines.
2. **Smaller size:-**for producing same output the size of three phase machines is always smaller than that of single phase machines.
3. **More power is transmitted-** it is possible to transmit more power using a three phase system than single system.

4. **Smaller cross-sectional area of conductors-** if the same amount of power is transmitted then the cross-sectional area of the conductors used for three phase system is small as compared to that of single phase system.

5. Better power factor-power factor of three phase machines is better than that of single phase machines.

6. Three phase motors are self starting-three phase ac supply is capable of producing a rotating magnetic field when applied to stationary windings, the three phase ac motors are self starting. While single phase induction motor needs to use additional starter windings

7. Horse power rating of three phase motors is greater than that of single phase motor.

8. Power delivered by a single phase system fluctuates whereas for three phase system power delivered to the load is the same at any instant.

i) Why transformer core is laminated. **(2 Mark)**

1. The laminated core is used to provide the path of low reluctance (opposition) for the flux.

2. The core is laminated to reduce iron losses (eddy currents losses).

j) Name the various parts of DC machine. **(Any four parts expected: 1/2 marks each)**

1) Yoke:

2) Pole Cores & Pole shoe:

3) Armature core:

4) Armature winding:

5) Commutator:

7) Brush:

8) Cooling Fan:

9) End covers:

k) State necessity of earthing.

Necessity Earthing: **(2 Mark)**

- Earthing provides protection to the electrical machinery due to leakage current.
- Earthing provides protection to Tall Building & structure against lightening stroke
- Earthing is protects human from shocks.

l) States the types of wires.

Following types of wires: **(2 Mark)**

i) VIR (Vulcanized Indian Rubber)

ii) PVC (Polyvinyl Chloride) wires

iii) T.R.S. Wire

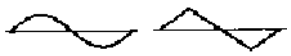
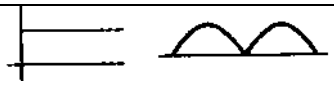
iv) Flexible wire

v) Lead sheathed wires

vi) CTS (Cab Tyre sheathed wires)

Q.2 Attempt any Four of the following **16 Marks**

a) Compare A.C. supply with D.C. supply (any four points). **(1/2 Marks Each Point)**

Sr no.	Points	A.C Supply	D.C Supply
1	Waveform		
2	Definition	It is a signal which changes its magnitude as well as its direction wrt. Time.	It is a signal which changes its magnitude but does not change its direction wrt. Time.
3	Use of transformer	Transformer use is possible	Transformer use is not possible.
4	Application	Ac motors, domestic and industrial supply	DC machines, HVDC system

b) State the function of no volt coil and overload coil in case of DC shunt motor starter.

Function of no volt coil in case of DC shunt motor starter: **(2 Mark)**

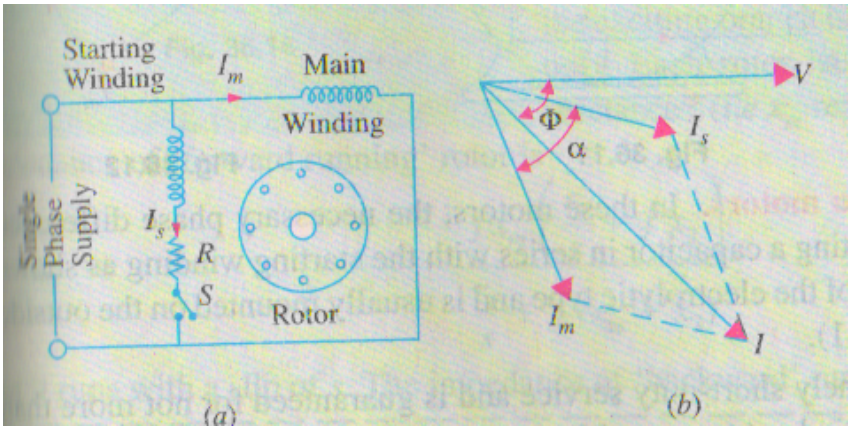
Whenever voltages is low then no-volt will be operate and motor will become off automatically or it will never on at low voltage.

Function of overload coil in case of DC shunt motor starter: **(2 Mark)**

Whenever motor is overloaded due to any reason due to this overload coil motor will become off automatically

c) Describe with the circuit diagram, the operation of resistors split single phase induction motor. **(Diagram: 2 Mark & Operation: 2 Mark)**

Circuit diagram of resistors split single phase induction motor:



or equivalent figure

Operation of resistors split single phase induction motor:

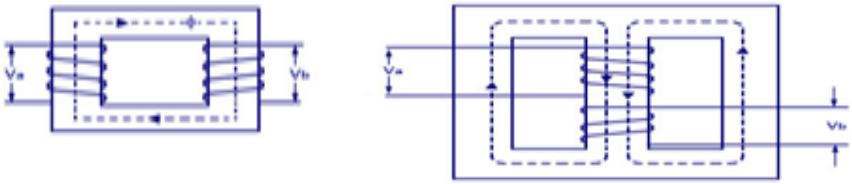
- In resistors split phase I.M shown in above figure 'a', the main winding has low resistance but high reactance whereas the starting winding has a high resistance, but low reactance.
- The resistance of the starting winding may be increased either by connecting a high resistance 'R' in series with it 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 IS 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.
- It 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.

d) Draw and explain core and shell type transformer.

(Each transformer: Figure: 1 Mark & each explanation: 1 Mark)

i) Core Type Transformer: **ii) Shell Type Transformer:**



Explanation:

i) Core Type Transformer:

The Winding surround the core, Average length of the core is more; Magnetic Flux has only one continuous path and less in weight.

It is Suitable for high voltage & less output of the transformer.

ii) Core Type Transformer:

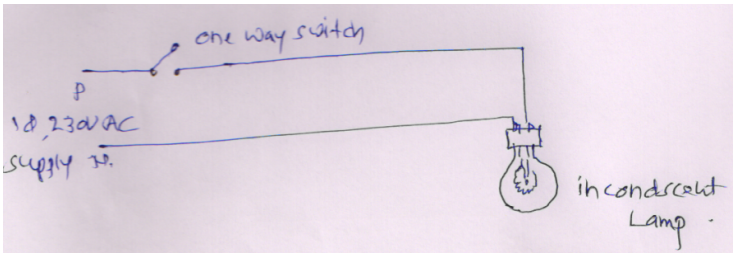
The core surrounds the windings, Average length of the core is less, and Magnetic Flux is distributed into 2 paths and more in weight

It is Suitable for less voltage & high output of the transformer.

e) Describe the operation of incandescent lamp with neat connection diagram.

(Neat diagram: 2 Mark & Operation: 2 Mark)

Incandescent lamp with neat connection diagram:



or equivalent figure

Operation of incandescent lamp

When the current the current is passed through the tungsten filament, it is heated to incandescence (while hot conditions) which then starts emitting energy in the form of light.

f) A coil connected in parallel across 120 V DC supply takes a current 2A find : i) Resistance of the coil ii) Power dissipated in coil. iii) Total energy consumed in 2 hours.

$$I = \frac{V}{R}$$

i) Resistance of the coil:

$$R = \frac{V}{I} = \frac{120}{2}$$ ---------- **(1/2 Mark)**

$$R = 60\ \Omega$$

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

ii) Power dissipated in coil.

$$P = I^2\ R\ = (2)^2 \times 60$$

---------- **(1/2 Mark)**

$$P = 240\ \ watts$$

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

iii) Total energy consumed in 2 hours.

$$E = P \times t\ = 240 \times 2$$

$$E = 480\ w-h$$

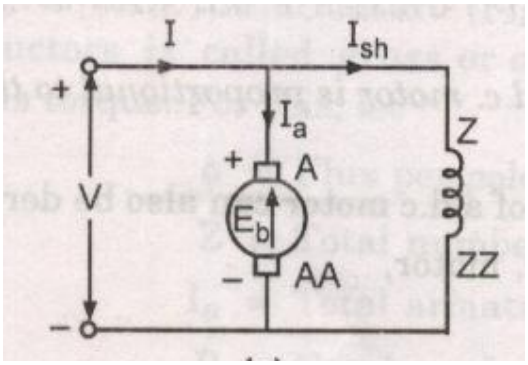
$$E = 0.48\ kwh$$

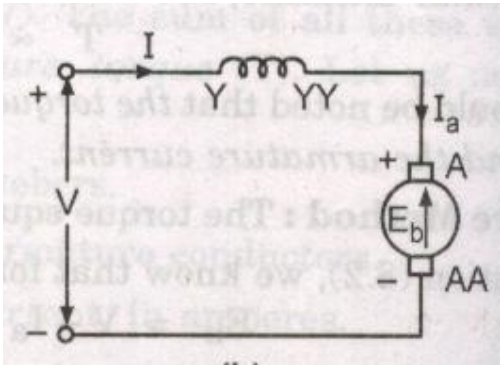
---------- **(1 Mark)**

Q.3 Attempt any Four of the following **16 Marks**

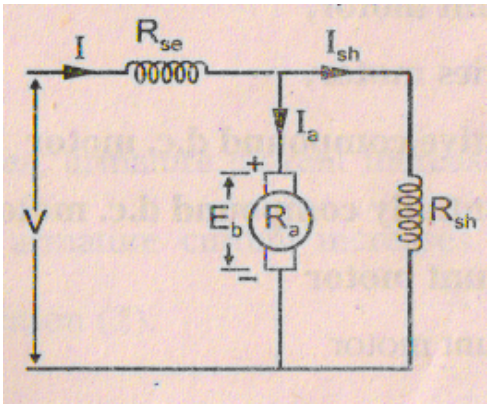
a) Draw circuit diagram of different types of DC motors and give one industrial application of each type.

i) D.C. Shunt Motor **ii) D.C. Series Motor** **(Each Diagram: 1 Mark)**





iii) D.C Compound Motor:



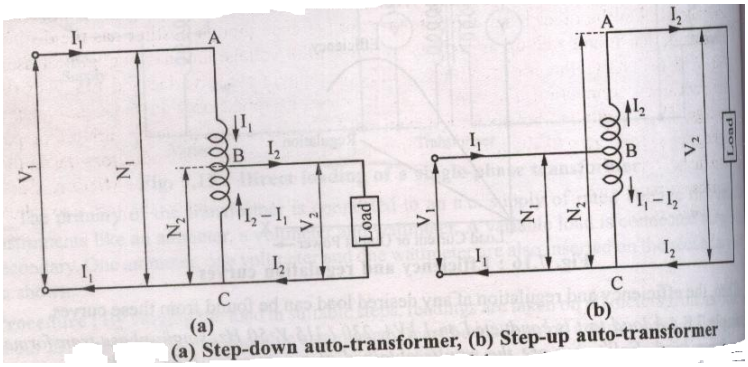
Industrial application Types of DC motor: **(1 Mark)**

a) DC Shunt Motor: - Pumps, Fans, Drill machine, grinding machine, wood cutting machine etc

b) DC Series Motor: - Lift, hoist, Train, cranes

c) DC Compound Motor: Paper Mill, Rolling Mill, Steel rolling mills, elevators, punchers

b) Describe working principle of auto transformer. **(Figure: 2 Mark & Working: 2 Mark)**



(a) Step-down auto-transformer, (b) Step-up auto-transformer

Auto Transformer:-

An Auto Transformer is a transformer having only one winding wound on a laminated magnetic core, the part of this winding being common to both the primary & secondary circuits auto transformer is also called as dimmerstat **OR**

Autotransformer explanation:-

- It is a transformer with one winding only.
- Autotransformer is a special transformer in which a part of winding is common for the primary and secondary windings.
- It consists of only one winding wound on a laminated magnetic core, with a rotary movable contact.
- Autotransformer can operate as a step down or a step up transformer.

c) Suggest various safety precautions which should be taken while working with electricity.

(Any four Precautions expected -1 Mark each)

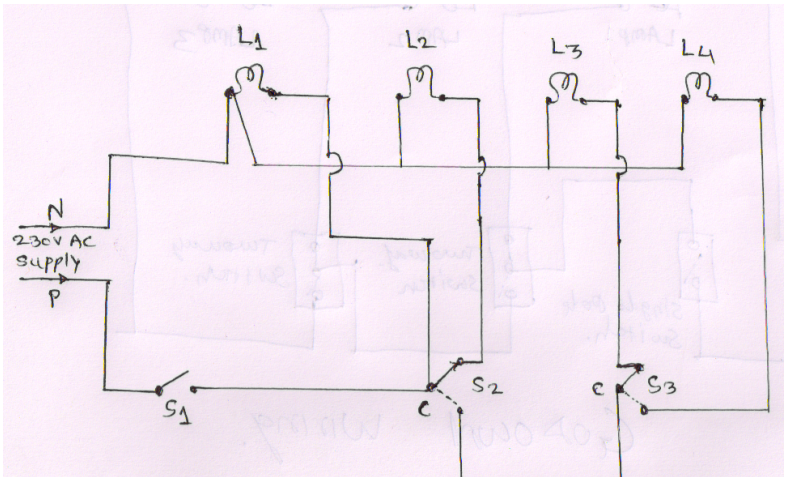
The Following are the precautions should be taken while working electricity:- (Any Four point expected)

i) Avoid working on live parts.
ii) Switch off the supply before starting the work.
iii) Never touch a wire till you are sure that no currents are flowing.
iv) Do not guess, whether electric current is flowing through a circuit by touching.
v) Insulate yourself on the insulating material like wood, plastic etc. before starting the work on live main.
vi) Your hand & feet must be dry (not wet) while working on live main.
vii) Rubber mats must be placed in front of electrical switch board/ panel.
viii) Use hand gloves, Safety devices & proper insulated tools.
ix) Ground all machine tools, body, and structure of equipments.

xi) Do not use aluminum ladders but use wooden ladders.
xii) Do not operate the switches without knowledge.
xiii) Use proper insulated tools & safety devices.
xiv) When working on live equipment obey proper instruction.
xv) Do not work on defective equipment.
xvi) Use safe clothing.
xvii) Use shoes with rubber soles to avoid shock.
xviii) Do not wear suspected Necklace, arm bands, finger ring, key chain, and watch with metal parts while working.
xix) Do not use defective material. Do not work if there is improper illumination such as in sufficient light or unsuitable location producing glare or shadows.
xx) Do not work if there is an unfavorable condition such as rain fall, fog or high wind.
xxi) Do not sacrifice safety rules for speed.
xxii) Do not allotted work to untrained person (worker) to handle electrical equipment.
xxiii) Make habit to look out for danger notice, caution board, flags, and tags.
xxiv) Warn others when they seen to be in danger near live conductors or apparatus.
xxv) Inspect all electrical equipment & devices to ensure there is no damage or exposed wires that may causes a fire or shock.
xxvi) Avoid using electrical equipment near wet, damp areas.
xxvii) Use approved discharge earth rod for before working.
xxviii) Never speak to any person working upon live mains.
xxix) Do not Do the work if you are not sure or knowledge of the condition of equipment/ machine.
xxx) Safety book/ Training should be given to all persons working in plants.

d) Draw wiring of godown wiring and describe the working.

(Figure: 3 Mark & Working: 1 Mark)



Working of godown Wiring:

- S1: is ON – L1 & L2 : ON
- S2 : is ON – L1& L3 : ON
- S3: is ON– L1 & L4 : ON and Remains lamps is OFF

e) Compare squirrel cage and slip ring type three phase induction motors (any four points)

(Any four points each 01 Marks)

S.No	3-phase squirrel cage I.M	Slip ring 3-Ph I.M
1	Rotor is in the form of bars	Rotor is in the form of 3-ph winding
2	No slip-ring and brushes	Slip-ring and brushes are present
3	External resistance cannot be connected	External resistance can be connected
4	Small or moderate starting torque	High Starting torque
5	Starting torque is of fixed	Starting torque can be adjust
6	Simple construction	Completed construction
7	High efficiency	Low efficiency
8	Less cost	More cost
9	Less maintenance	Frequent maintenance due to slip-ring and brushes.
10	Starting power factor is poor	Starting power factor is adjustable & large
11	Size is compact for same HP	Relatively size is larger
12	Speed control by stator control method only	Speed can be control by stator & rotor control method

f) A single phase transformer has voltage ratio 230/115 Volts. It has hundred turns on primary, find the secondary turns, the secondary and primary full load currents

(In this problem KVA rating of transformer is not given so give mark for formula of calculation of current or Assume value s of KVA rating)

$V_I = 230V \quad V_2 = 115V \quad N_I = 100 \quad N_2 = 100 \quad I_1 = ? \quad I_2 = ?$

Step-I: To Find N_1:

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

$$N_2 = \frac{V_2}{V_1} \times N_1 \quad \text{……..……..…} \quad \textbf{(1 mark)}$$

$$N_2 = \frac{115}{230} \times 100$$

$$N_1 = 50 \ \ turns \quad \text{…….……..} \quad \textbf{(1 Mark)}$$

Step-II: To Find full load Primary current I_1:-

$$I_1 = \frac{KVA \times 10^3}{V_1 \ volt} \quad \text{…….……..} \quad \textbf{(1 Mark)}$$

Step-III: To Find full load Secondary I_2:

$$I_2 = \frac{KVA \times 10^3}{V_2 \ volt} \text{……..} \quad \textbf{(1 Mark)}$$

---------- **END OF SECTION-I**----------

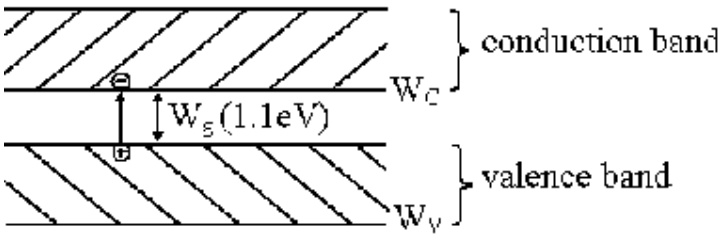
SECTION –II

Q.4 Attempt any NINE of the following

a) Define semiconductor. Draw energy band diagram of it.

(Definition – 1 mark, diagram – 1 mark)

The materials which have conductivity in between insulator & conductor and which have four electrons in its outermost orbit are called as semiconductor.



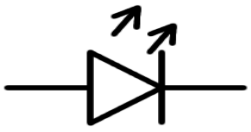
b) Define intrinsic semiconductor. List any two dopant materials to form N type semiconductor material. **(Definition – 1 mark, materials – 1/2 marks each)**

Intrinsic semiconductor- A pure form of semiconductor is called as intrinsic semiconductor.

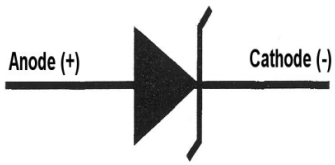
Ex. of N type semiconductor– phosphorous, arsenic

c) Draw the symbol of LED and zener diode. **(Symbol – 1 mark each)**

Symbol of LED:

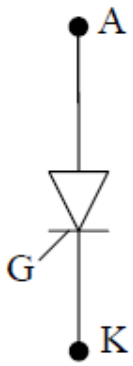


Zener diode:



d) Draw the symbol of SCR. List any two applications of SCR.

(Symbol – 1 mark, two applications – 1 mark)



Applications:

1) Phase controlled rectifier.

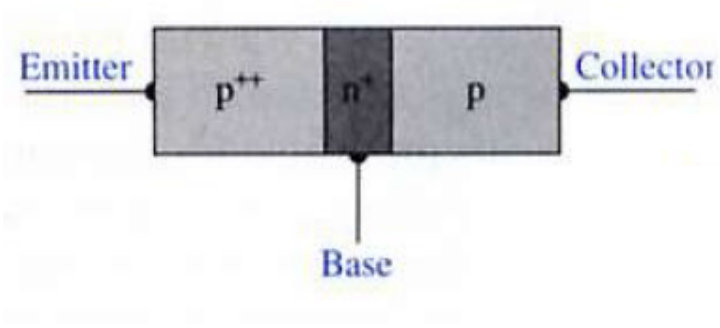
2) DC to AC converters. (Inverters)

3) DC to DC converters (choppers)

4) HVDC transmission systems.

e) Draw the construction diagram of PNP transistor and name the regions and terminals.

(Diagram: 1 mark, regions: 1/2mark, terminals – 1/2 mark)



f) What is power amplifier? Define it. **(Function -- 1 mark, Definition – 1 mark)**

An Amplifier receives a signal from some pickup transducer or other input source and provides a larger version of the signal to some output device or to another amplifier stage. An input transducer signal is generally small (a few millivolts from a cassette or CD input or a few microvolts from an antenna) and needs to be amplified sufficiently to operate an output device (speaker or other power handling device).

g) What is need of regulated power supply? **(Need -- 2 marks)**

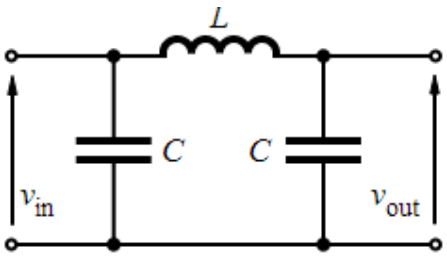
In general, electronic circuits & systems using transistors require a source of D.C. power. For example, in amplifiers, oscillators, timers D.C. voltage is needed. Batteries are rarely used for this purpose as they are costly and require frequent replacement. In practice, d.c. power for electronic circuits is most conveniently obtained from commercial a.c. lines by using rectifier-filter system, called a d.c. power supply.

h)What is filter? State the need of filter. **(Function -- 1 mark, Need – 1 mark)**

Filters are the electronics circuits used along with rectifiers in order to get a pure ripple free D.C. voltage

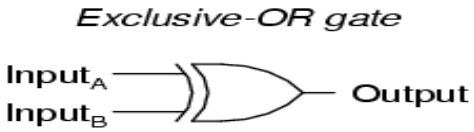
Need- In order to get a pure ripple free D.C. voltage from pulsating DC filters are needed.

i) Draw the circuit diagram of π filter. **(Diagram with components -- 2 marks)**



j) Draw the symbol of Ex-OR gate. Write the truth table of it.

(Symbol: 1 mark, Truth table: 1 mark)



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

k) Write the logic expression for OR gate & NAND gate. **(Two expression -- 1 mark each)**

The logic expression for

OR gate Y = A + B

NAND gate Y =

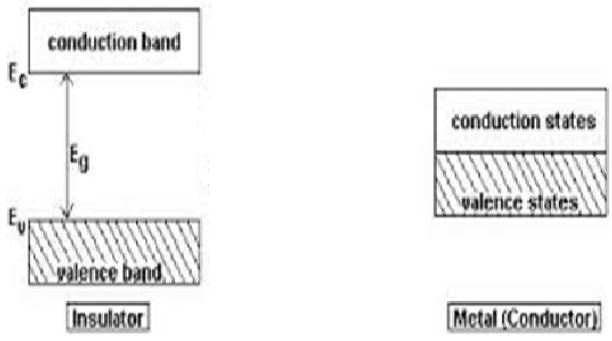
l) List types of digital display. **(Any two types -- 1 mark each)**

1. LED display
2. LCD display
3. Alphanumeric display
4. Seven segment display

Q.5 Attempt any FOUR of the following---------- 16 Marks

a) Draw the energy band diagram for insulator and conductor. Write the values of band gap for insulator and semiconductor. **(Two diagrams – 2 marks, two values – 2 marks)**

Energy band diagram for insulator and conductor:



Values of band gap for insulator and semiconductor.

i) The forbidden gap for insulators = 5 eV or more

ii) The forbidden gap for semiconductor = 1.1eV for Si

b) Describe working of TRIAC along with its construction.

(Construction diagrams – 2 marks, working – 2 marks)

The Triac is a member of the thyristor family. But unlike a thyristor which conducts only in one direction (from anode to cathode) a triac can conduct in both directions. Thus a triac is similar to two back to back (anti parallel) connected thyristosr but with only three terminals.

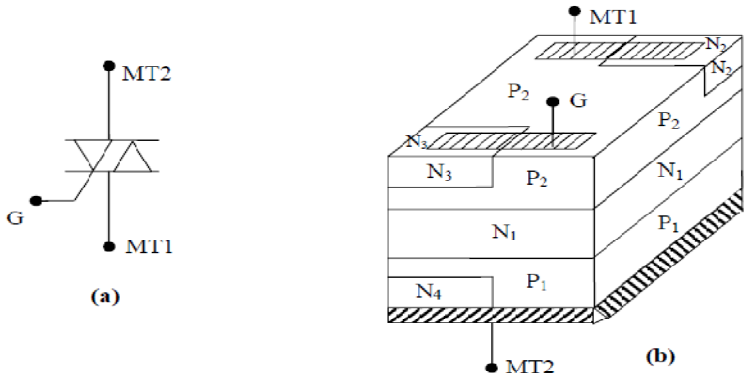


Fig. 4.12: Circuit symbol and schematic construction of a Triac
(a) Circuit symbol (b) Schematic construction.

Since a Triac is a bidirectional device and can have its terminals at various combinations of positive and negative voltages, there are four possible electrode potential combinations as given below

1. MT_2 positive with respect to MT_1, G positive with respect to MT_1
2. MT_2 positive with respect to MT_1, G negative with respect to MT_1
3. MT_2 negative with respect to MT_1, G negative with respect to MT_1
4. MT_2 negative with respect to MT_1, G positive with respect to MT_1

In trigger mode-1 the gate current flows mainly through the $P_2 N_2$ junction like an ordinary thyristor. When the gate current has injected sufficient charge into P_2 layer the triac starts conducting through the $P_1 N_1 P_2 N_2$ layers like an ordinary thyristor.

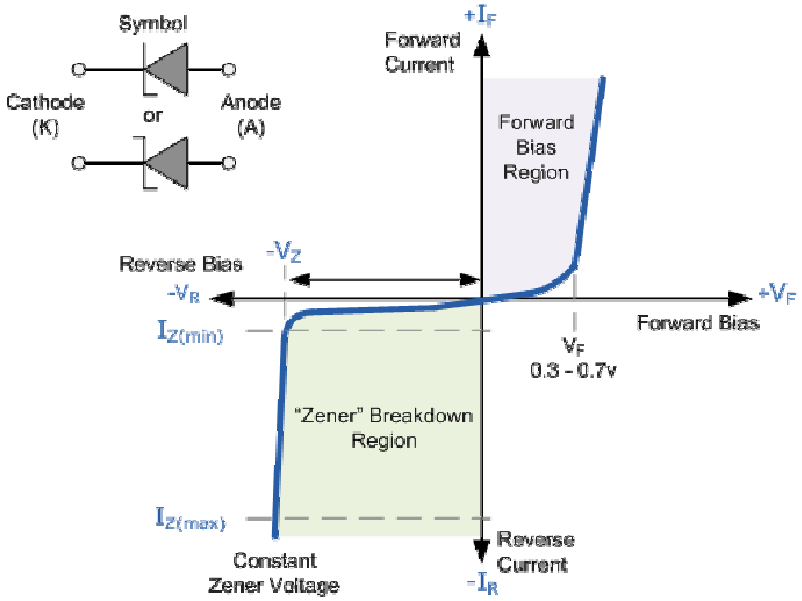
In trigger mode-2 the negative gate current flows mainly through the $P_2 N_3$ junction ,When the gate current has injected sufficient charge into P_2 layer the triac starts conducting through the $P_1 N_1 P_2 N_2$ layers.

In the trigger mode-3 the negative gate current I_g forward biases the $P_2 N_3$ junction and a large number of electrons are introduced in the P_2 region by N_3. Finally the structure $P_2 N_1 P_1 N_4$ turns on completely.

In the trigger mode-4 the gate current I_g forward biases the $P_2 N_2$ junction and a large number of electrons are introduced in the P_2 region by N_2. Finally the structure $P_2 N_1 P_1 N_4$ turns on completely.

c) Describe the operation of zener diode in reverse bias mode. Draw V I characteristics of zener diode. **(Characteristics – 1 mark, Description /operation – 3 marks)**

Zener Diodes are used in the "REVERSE" bias mode, i.e. the anode connects to the negative supply and from its I-V characteristics curve above, we can see that the Zener diode has a region in its reverse bias characteristics of almost a constant voltage regardless of the current flowing through the diode. This voltage across the diode (it's Zener Voltage, Vz) remains nearly constant even with large changes in current through the diode caused by variations in the supply voltage or load. This ability to control itself can be used to great effect to regulate or stabilize a voltage source against supply or load variations. The diode will continue to regulate until the diode current falls below the minimum Iz value in the reverse breakdown region.



d) Draw the circuit diagram of single stage CE amplifier. Write the working of it.

(Diagram – 2 marks, Working – 2 marks)

Circuit diagram of single stage CE amplifier:

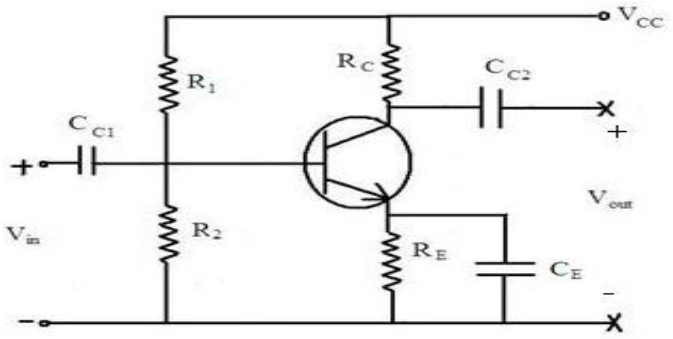


Figure 1 . RC-coupled CE BJT Amplifier

Transistor Q is configured in common emitter mode to design a voltage Amplifier. Small ac input Vin which is to be amplified is applied at the base of Q. Emitter is common(ground) and output is obtained at the collector of Q. As the transistor is NPN, +Vcc supply is applied as the biasing voltage.

WORKING:-

- Resistors R1 & R2 form voltage divider biasing .
- R1, R2 & RE (emitter resistor) are used to bias the transistor in the active region, because for operating the transistor as an amplifier it is necessary to bias it in the active region.
- Rc – collector resistor is used to control the collector current.
- C1= Input coupling capacitor
- C2=Output coupling capacitor
- CE = Emitter bypass capacitor.

1. In the absence of ac input, IB=IBQ, IC = ICQ, VCE = VCEQ. The Q point is selected in the active region of transistor.
2. As Vin is applied, the base current varies above and below IBQ .

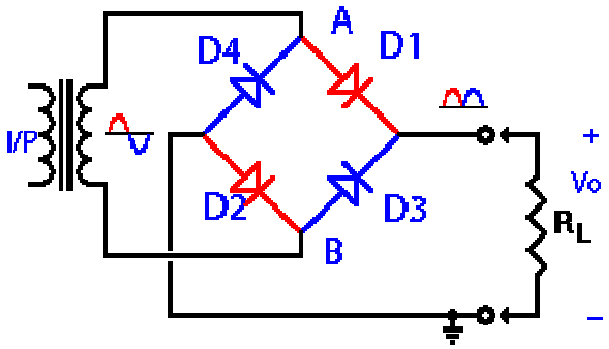
3. Hence Ic =βIB varies above and below ICQ. Variation in Ic is large.
4. Therefore voltage across Rc varies. VRC = Ic xRc.
5. Hence collector voltage Vc varies above and below VCE_Q as Vc = Vcc- Ic .Rc.
6. Through C2 only the ac part of Vc is coupled to the load. Vo is of same shape as Vin but of larger size.

   Thus amplification has taken place. Vo is also 180 degree phase shifted with Vin.

e) Draw the circuit of bridge rectifier. Describe its working.

(Circuit Diagram – 1 mark, Working – 2 marks, waveform – 1 mark)

Circuit of bridge rectifier:

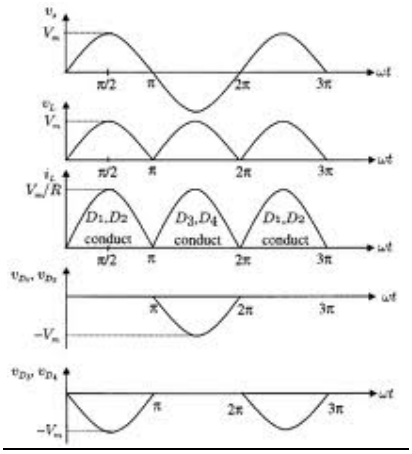


Working:-

The Bridge rectifier consists of a step down transformer, a rectifier circuit with four diodes and a load resistance RL .

- The 230 V ac input from mains is stepped down (reduced) using the step transformer.
- The reduced ac i.e. output of the secondary of the transformer is applied to the bridge circuit.
- The bridge consists of four diodes D1,D2,D3&D4, which offers full wave rectification. The diodes conduct in pair.
- During +ve half cycle of the ac input, point A is +ve& point B is –ve. Therefore diode D1 & D2 are forward biased and D3 & D4 are reverse biased. Therefore only D1 and D2 conduct and the current flows along the path " A-D1-RL-D2-B".
- During -ve half cycle of the ac input, point B is +ve& point A is –ve. D3 and D4 conduct while D1 & D2 remain reverse biased(off). Therefore the current follows following path" B-D3-RL-D4-A".
- In both the cases load resistance conducts in the same direction as shown in the above

The waveforms are as follows:-



f) Write the De Morgans theorem. Prove any one theorem.

(Two theorems/expressions: 2 marks, any one proof: 2 marks)

DeMorgan's Theorems are two simplification techniques that can be used to simplify Boolean expressions.

This can be proved by using truth tables as follows:

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

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

Q.6 Attempt any FOUR of the following---------- 16 Marks

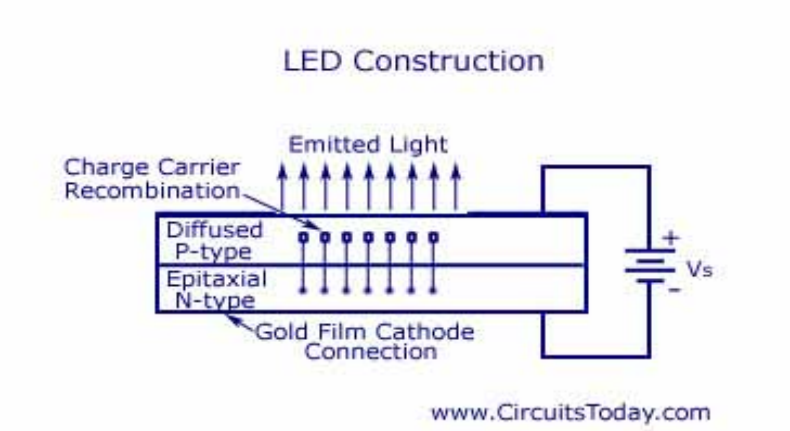
a) Describe the working principle of LED along with its construction. List any two applications.

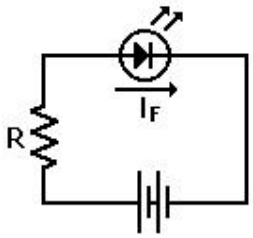
(Construction diagram - 1 Mark, working – 2 Marks, two applications – 1 Mark)

Working of LED - LED- Light Emitting Diode

- When it is forward bias, it emits visible light. The electrons are in the higher conduction band on the N-side, where holes are are in the lower valence band on p- side.
- When forward biased electrons recombine with the holes. During recombination energy is emitted in form of light.
- GaAs, GaP, GaAsP are used to get visible light.
- Colors of the emitted light depends on the type of material used
  GaAS- Infrared radiation, GaP- Red or green
  GaAsP- Red or yellow

Construction -





Applications-

1) As Indicator lamps in electronic devices
2) Light-emitting diodes are now used in applications as diverse asaviation lighting, automotive headlamps, advertising, general lighting, traffic signals, and camera flashes.

b) Define inductor and capacitor. Draw symbol and list two application of each.

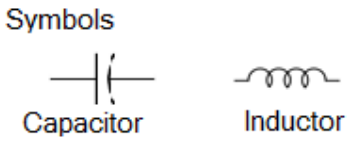
(Definition - 1 mark each, symbols – 1/2 mark each, two applications – 1 mark)

Inductor –

An **inductor**, also called a **coil** or **reactor**, is a passive two-terminal electrical component which resists changes in electric current passing through it. It consists of a conductor such as a wire, usually wound into a coil.

Capacitor –

It is a passive two-terminal electrical component used to store energy electro statically in an electric field.



Application –

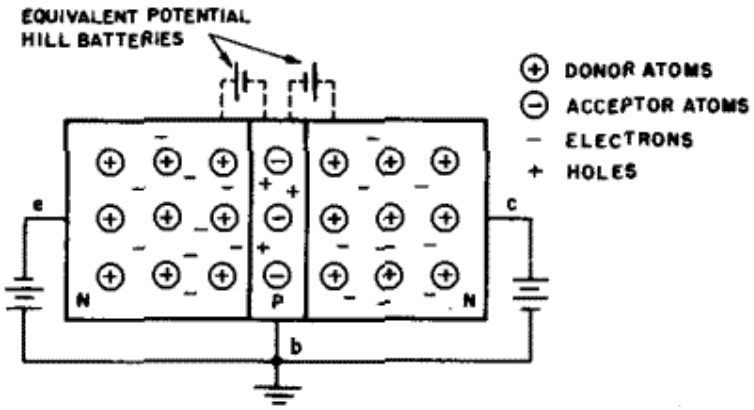
Inductor- 1) Filters 2) Choke uses in tube light

Capacitor – 1) filters 2) Amplifiers or (any other application)

C) Describe the working of NPN transistor.

(Construction diagram: 1 mark, working: 3 marks)

Operation of NPN transistor-



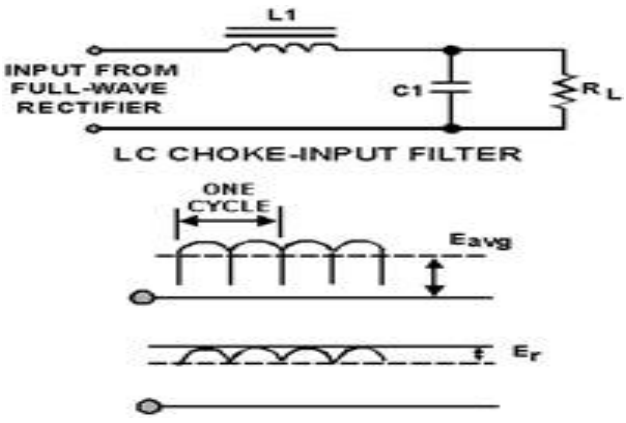
N-p-n transistor is made by sandwiching thin layer of p-type semiconductor between two layers of n-type semiconductor. It has three terminals - Emitter, Base and collector. The npn transistor has two supplies, one is connected through the emitter base and one through the collector base. The supply is connected such that emitter-base are forward biased and collector base are reverse biased. It means, Base has to be more positive than the emitter and in turn, the collector must be more positive than the base. The current flow in this type of transistor is carried through movement of electrons. Emitter emits electrons which are pulled by the base as it is more positive. This end up in the collector as it is more positive. In this way, current flows in the transistor.

Transistor can be used as an amplifier, a switch etc.

d) Draw and explain the diagram of LC filter with their output waveform

(Diagram - 1 mark, explanation/working – 2 marks, waveform – 1 mark)

Diagram / waveform -



or equivalent diagram

Explanation-

In inductor filter, the ripple factor is directly proportional to the load resistance. On the other hand in a capacitor filter, it is varying inversely with the load resistance. Hence if we combine the inductor filter with the capacitor the ripple factor will become almost independent of the load filter. It is also known as inductor input filter, choke input filter, L input or LC-section.

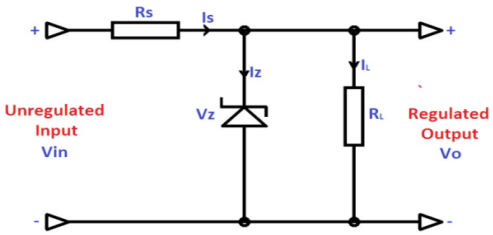
L-C filter is used to remove ac component from rectifier output and allow only DC component. In this circuit, L or inductor is connected in series with the load and removes ac component and C or capacitor grounds ac ripple. OR inductor offers high resistances to the AC

connected in parallel with load which filters out/grounds any AC component flowing through the choke. And thus, the ripples are removed and a smooth DC is provided to the load.

e) Describe the working of zener shunt regulator along with neat circuit diagram.

(Diagram - 1 mark, working – 3 marks)

Diagram of zener diode as voltage regulator:



Working:

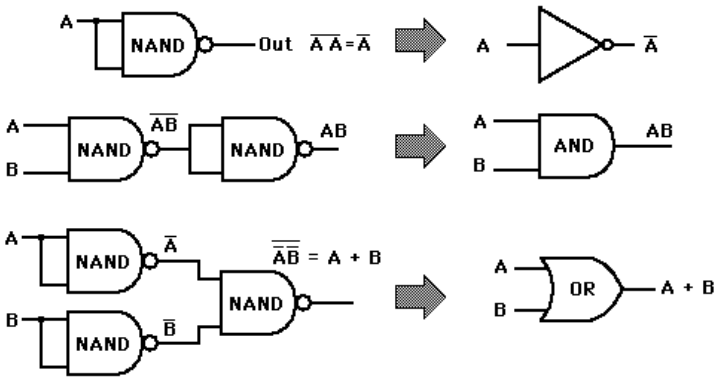
Zener Diodes are widely used as Shunt Voltage Regulators to regulate voltage across small loads. Zener Diodes have a sharp reverse breakdown voltage and in breakdown, voltage across zener will be constant for a wide range of currents. Thus we will connect the zener diode parallel to the load such that the applied voltage will reverse bias it. Thus if the reverse bias voltage across the zener diode exceeds the knee voltage, the voltage across the load will be constant.

f) Which gates are called as universal gates? Draw basic gates using any one universal gate

(Universal gates -- 1 mark, AND, OR, INVERTER using NAND or NOR gates: 3 marks)

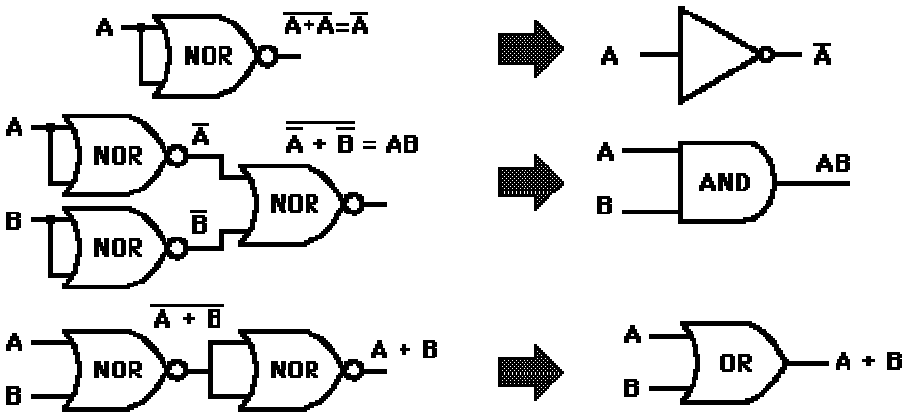
NAND and NOR gets called as universal gates

Basic gates using NAND gates -



OR

Basic gates using NOR gates:–



OR equivalent figure