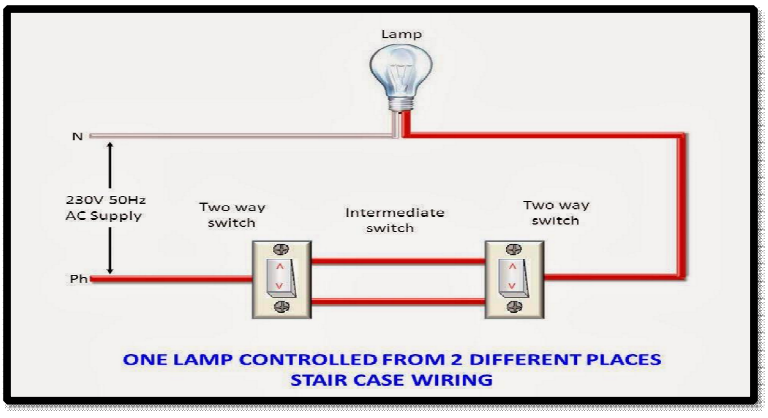
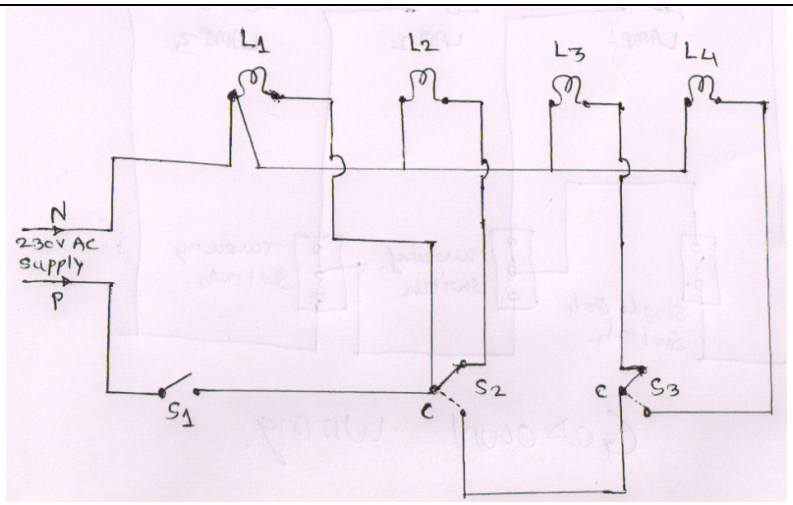
Important suggestions to examiners:

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.

SECTION — I

Q.1	**Attempt any NINE of the following:** **18 Marks**
a)	**State Ohm's law and write equation for finding current.**
Ans	**Ohms Law:-** ----------**(State-1 Mark & Equation-1 Mark)** 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** $I \propto V \quad \therefore \frac{V}{I} = constant \therefore I = \frac{V}{R}$ **Where** R is constant called as resistance, V=Voltage and I = Current
b)	**List classification of DC motor.**
Ans	**Types of DC Motor :-** **(2 Mark)** i) DC Shunt Motor ii) DC Series Motor iii) DC Compound Motor: a) Short Shunt Compound Motor b) Long short compound Motor
c)	**How single phase induction motors are made self starting?**
Ans	**Reason:** **(2 Marks)** The single phase induction motors are not self starting because the produced stator flux is alternating in nature and at the starting the two components of this flux cancel each other and hence there is no net torque.

	The solution to this problem is that if the stator flux is made rotating type, rather than alternating type, which rotates in one particular direction only. Then the induction motor will become self starting. Now for producing this rotating magnetic field we require two alternating flux, having some phase difference angle between them. When these two fluxes interact with each other they will produce a resultant flux. This resultant flux is rotating in nature and rotates in space in one particular direction only. Once the motor starts running, the additional flux can be removed. The motor will continue to run under the influence of the main flux only.
d)	**State the principle on which a transformer works.**
Ans	**Working Principle: - ---------- (2 Marks)** A Transformer works on the principle of Faradays law of electromagnetic induction. When their primary winding is connected to a.c. supply, it circulates an alternating current through it. This current flowing through the primary winding produces an alternating magenetic flux (Ø).This flux links with secondary winding through the magenetic core & induces an emf in it according to the faraday's laws of electromagnetic induction.
e)	**Draw neat diagram with all labelling : (i) Stair - case wiring (ii)Godown wiring**
Ans	**(Figure: 1 Mark)** **(i) Stair - case wiring**  **OR Equivalent figure** **(ii) Godown wiring :** **(Figure: 1 Mark)**



or equivalent figure

f) A battery of emf 12 volt is connected across a resistance of 10 ohm, calculate the current flowing through the resistance.

Ans **Current flowing through the resistance:**

$$\therefore I = \frac{V}{R}$$ ---------- **(1 Mark)**

$$\therefore I = \frac{12}{10} = 1.2\ Amp$$ ---------- **(1 Mark)**

g) Compare AC supply with DC supply. (any four points)

Ans **Compare AC supply with DC supply:** **(Any Four Point Expected : 1/2 each)**

S.No.	Points	AC Supply	DC Supply
1	Amount of energy that can be carried	Safe to transfer over longer city distances and can provide more power	Voltage of DC cannot travel very far until it begins to lose energy
2	Cause of the direction of flow of electrons	Rotating magnet along the wire	Steady magnetism along the wire
3	Frequency	The frequency of alternating current is 50Hz or 60Hz depending upon the country.	The frequency of direct current is zero.
4	Direction	It reverses its direction while flowing in a circuit.	It flows in one direction in the circuit.
5	Current	It is the current of magnitude varying with time	It is the current of constant magnitude.
6	Flow of Electrons	Electrons keep switching	Electrons move steadily in

		directions - forward and backward.	one direction or 'forward'.
7	Obtained from	A.C Generator and mains.	Cell or Battery.
8	Passive Parameters	Impedance.	Resistance only

h) What is fuse? Explain it's function.

Ans:

Fuse Means: **(1 Mark)**

- It is a protective device against over current, occurs due over load or short circuit.
- Fuse is a wire of short length or thin strip of material having low melting point

Function of Fuse: **1 Mark)**

- When some faults, such as short circuit occurs or when load more than circuit capacity is connected in it, the current exceeds the limiting value, the fuse wire gets heated, melts and breaks the circuit in this way it protect the circuit.

i) Enlist the types of wires with their applications.

Ans:

Types of wire used in electrical wiring: **(Any Two Types Expected: 1 mark each)**

i) VIR (Vulcanized Indian Rubber) : Residential Wiring & Commercial Wiring

ii) PVC (Polyvinyl Chloride) wires : Residential Wiring & Commercial Wiring

iii) Flexible wire : extension wire for tube, fan etc.

vi) Lead sheathed wires : Residential Wiring , Commercial , industrial Wiring

v) CTS (Cab Tyre sheathed wires) : Residential Wiring & Commercial Wiring

j) Give the two applications of D.C. motor.

Ans:

Application of D.C Motor:- ------(Any two applications expected each:1 Marks)

i) DC Shunt Motor : Lathes machine, constant head centrifugal pumps, compressor

ii) DC Series Motor : For electric traction and cranes, passenger elevators, continuous conveyors, grinders, polishers,

iii) DC Compound Motor: Wood working machine, Laundry washing machines, milling machines, passenger elevators, continuous conveyors, grinders, polishers, small cranes etc.

k)	**Why D.C. series motors are suitable for electric traction and cranes?**
Ans:	Reason for D.C. series motors are suitable for electric traction and cranes: **(2 Mark)** 1) DC Series motor has high starting torque. 2) Its characteristics are such that has torque increases speed decreases and vice vesa. 3) DC Series motor is variable speed motor. All above characteristics are the main requirements for electric traction and cranes
Q.2	**Attempt any FOUR of the following: 16 Marks**
a)	**State and explain Faraday's law 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. ----------**(Marks Allotted - 02)** **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 ----------**(Marks Allotted - 02)**
b)	**Explain the principle of operation of a d.c. motor.**
Ans:	**Working Principle of D.C Motor :-** **(4 Marks)** It is based on the principle of Faraday's law of electromagnetic induction, that when a current-carrying conductor is placed in a magnetic field, it experiences a mechanical force whose direction is given by Fleming's Left-hand rule and whose magnitude is given by Force, **F = B I l** newton **OR** When current carrying conductor is placed in magnetic field force will be exerted on the conductor & motor start rotating it works on Fleming's left hand rule.

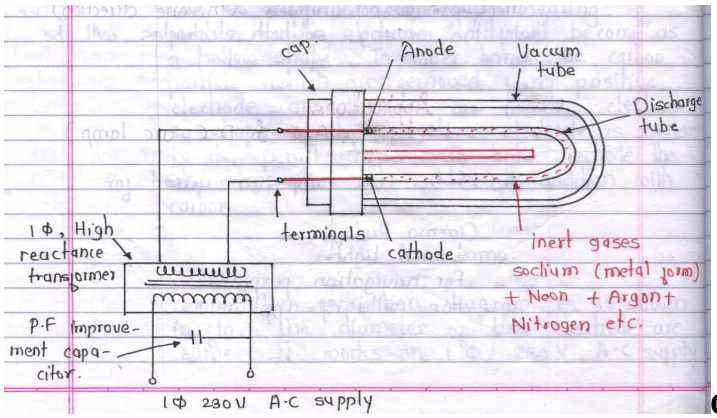
c)	**Explain operating principle of 3 - phase induction motor.**
Ans:	**Principle of 3- phase induction motor:-** **(4 Mark)** When 3-Phase supply is given to Stator, rotating magnetic field is produced. This rotating magnetic field links with stationary rotor conductors, so according to the Faraday's law of electromagnetic induction E.M.F will be induced in rotor conductor, as rotor conductor are short circuited. so current flows through the rotor conductor which produces rotor flux, So interaction between Stator & Rotor flux produces Torque in rotor & Hence rotor Starts rotating in the direction same as rotating magnetic field (Stator flux) according Lenz's law.
d)	**Define an auto - transformer. Write two advantages and applications of an auto - transformer.**
Ans:	**(Difination-2 Mark & any one advantages – 1 Marks & any one Application- 1 Marks)** **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. **Advantages of autotransformer-(Any one accepted)** 1. Saving of copper takes place.(Copper required is very less.) 2. Superior voltages regulation than two winding transformer.Autotransformer is smaller in size. 3. Cost is reduced in autotransformer as compared to conventional two winding transformer. 4. Copper losses are less. 5. High efficient than two winding transformer . 6. Small size and low cost. 7. Resistance and leakage reactance is less compared to two winding transformer.

Applications of Autotransformer - (Any one accepted)

1. Autotransformer used as variac (to change the voltage).
2. Autotransformer can be used as a starter for the induction motor.
3. Autotransformer is used to vary the supply voltage of a furnace.
4. Autotransformer can be used as a dimmerstat.
5. To give small boost to a distribution cable to correct the voltage drop.
6. Autotransformer used in control equipment for 1 phase and 3- phase electrical locomotives.

e) Explain the operation of sodium vapour lamps with neat diagram.

Ans: **Neat diagram of sodium vapour lamp:** **(Figure: 2 Mark & Operation:2 Mark)**



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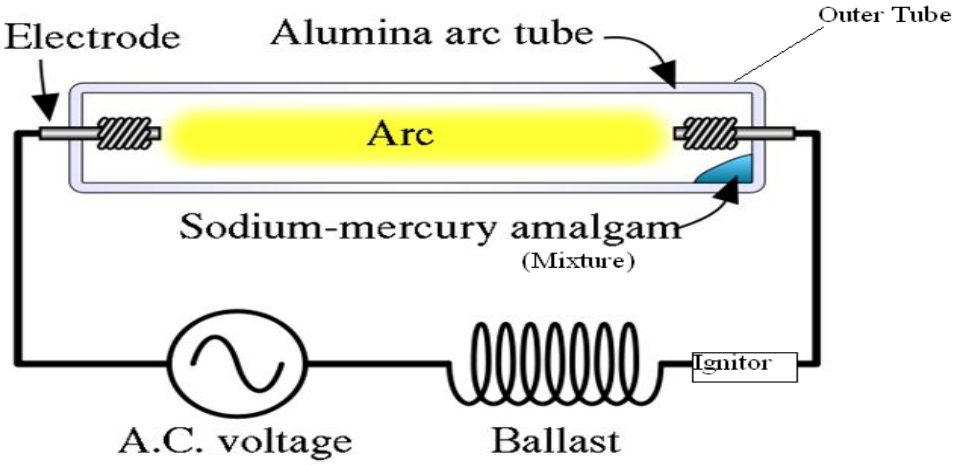


Working Principle:

- When the lamp is turned on, a high voltage at staring is applied across two electrodes, to initiate an arc which discharges and vaporizes xenon /neon gas (starting gas), sodium and mercury.
- The energized metal atoms emit light.
- After 2 to 5 minutes lamp will glow 100 %.
- For running the lamp low voltage of about 165 v is sufficient.
- The color of light produce is yellowish.

f) Define: (i) Turn Ratio (ii) Voltage Ratio

Ans:

i) Turns Ratio:- **(02 Marks)**

It is the ratio of secondary number of turns to primary number of turns of transformer.

$$Turns \ \ ratio\ (k) = \frac{N_2}{N_1}$$

ii) Voltage Ratio:- **(02 Marks)**

It is the ratio of secondary voltage to primary voltage of Transformer.

$$Voltage \ \ ratio\ (k) = \frac{V_2}{V_1}$$

Q.3 Attempt any FOUR of the following: 16 Marks

a) A resistance of 1 k ohm is connected across a 12 V battery for 2 hours. Calculate the power dissipated in the resistor and energy associated with it.

Ans:

i) Resistance :

$$R = 1\times10^3\ \Omega$$

ii) Power dissipated in resistance.

$$P = \frac{V^2}{R} = \frac{12^2}{1\times10^3}$$ ---------- **(1 Mark)**

$$P = 0.144 \ \ watts$$ ---------- **(1 Mark)**

iii) Total energy consumed in 2 hours.= Power x Time

$$E = P \times t = 0.144 \times 2$$ ---------- **(1 Mark)**

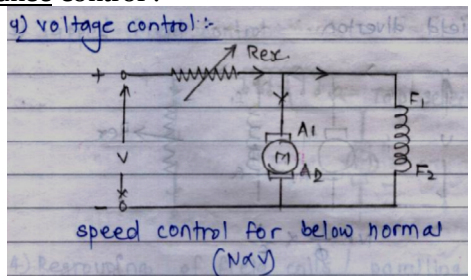
$$E = 0.288\ w-h$$ ---------- **(1 Mark)**

b)	**Explain the different methods of controlling the speed of (i) a d.c. shunt motor (ii) a d.c series motor**
Ans:	**Speed Control of D.C. Shunt motor :** **(Any one method expected-2 Mark)**

1) Armature Voltage Control Method for DC Shunt Motor:

Speed control by this method involves two ways .

1. Armature resistance control :



or equivalent figure

In this method armature circuit is provided with a variable resistance. Field is directly connected across the supply so flux is not changed due to variation of series resistance.

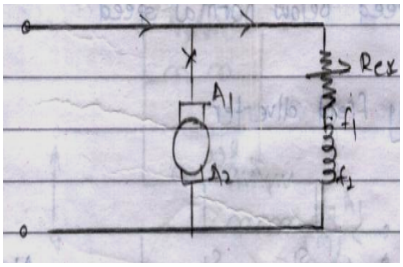
2. Armature voltage control:

This method of speed control needs a variable source of voltage separated from the source supplying the field current. The basic adjustable armature voltage control method of speed d control is accomplished by means of an adjustable voltage generator is called Ward Leonard system. This method involves using a motor – generator (M-G) set.

2) Flux (field) Control Method for DC Shunt Motor:-

By this method speed control is obtained by any one of the following means:

1. Field rheostat control of DC Shunt Motor:



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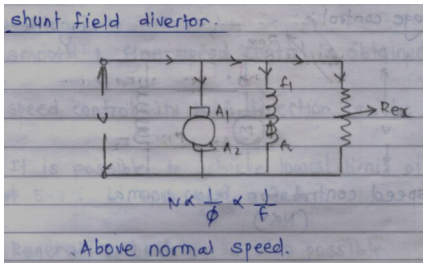


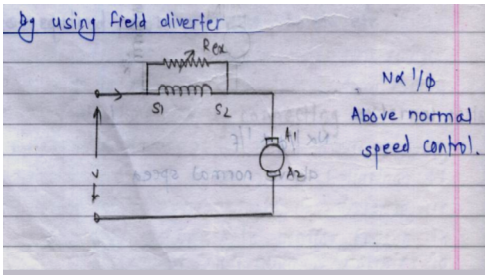
In this method, speed variation is accomplished by means of a variable resistance inserted in series with the shunt field . An increase in controlling resistances reduces the field current with a reduction in flux and an increase in speed. This method of speed control is independent of load on the motor. Power wasted in controlling resistance is very less as field current is a small value.

Speed Control of D.C. Series motor : **(Any one method expected-2 Mark)**

Field Control of DC Series Motor

The speed of dc motor can be controlled by this method by any one of the following ways:

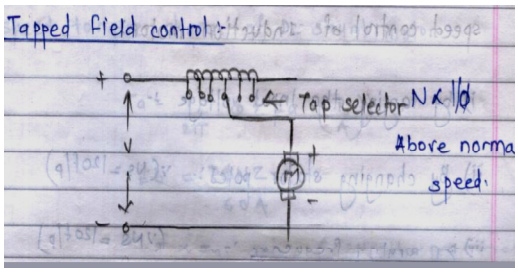
1. Field diverter method:



or equivalent figure

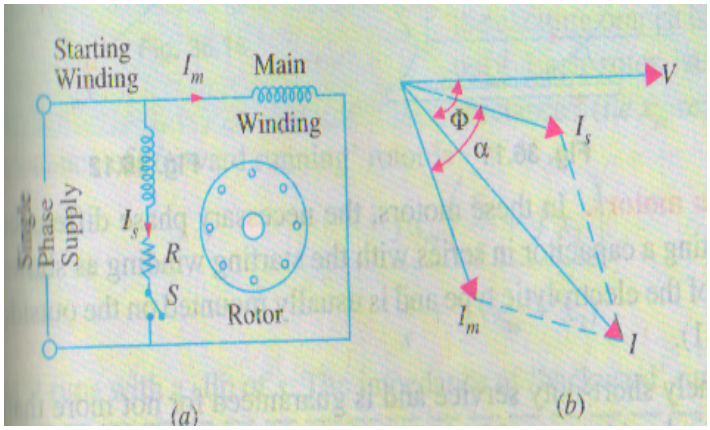
This method uses a diverter. Here the field flux can be reduced by shunting a portion of motor current around the series field. Lesser the diverter resistance less is the field current, less flux therefore more speed. This method gives speed above normal and the method is used in electric drives in which speed should rise sharply as soon as load is decreased.

2. Tapped Field control:



or equivalent figure

This is another method of increasing the speed by reducing the flux and it is done by lowering number of turns of field winding through which current flows. In this method a number of tapping from field winding are brought outside. This method is employed in electric traction.

c)	**Explain resistance split - phase motor in detail.**
Ans:	**(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**.** ➢ 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)	**A single phase 50 Hz, 230 V/115 V, 1 kVA transformer is loaded fully, find it's full load primary and secondary currents. Also find the currents at half load. Neglect losses.**
Ans:	**Given Data :- E_1= 230V , E_2=115V, S=1KVA , f= 50Hz** **At Full Load:-** Full Load KVA = 1 KVA ➢ **Primary Current =** $I_1 \equiv \frac{KVA \times 1000}{V_1}$

$$I_1 \equiv \frac{1\times1000}{230}$$

I_1= 4.3478Amp ---------- **(01 Mark)**

➢ Secondary Current = $I_2 \equiv \frac{KVA\times1000}{V_2}$

$$I_2 \equiv \frac{1\times1000}{115}$$

I_2= 8.699 Amp ---------- **(01 Mark)**

At Half Load:-

Half Load KVA $\equiv \frac{1\times1000}{2}$

= 0.5 KVA

➢ **Primary Current =**

$$I_1 = \frac{0.5\times1000}{230}$$

I_1= 2.174Amp ---------- **(01 Mark)**

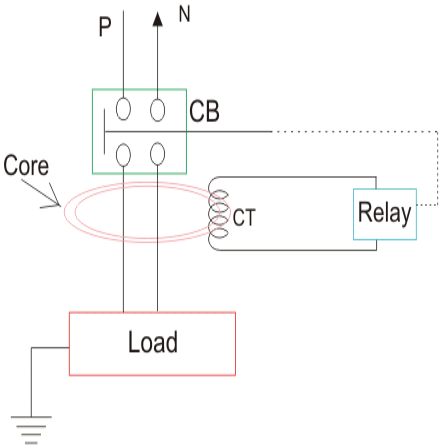
➢ **Secondary Current =**

$$I_2 = \frac{0.5\times1000}{115}$$

I_2= 4.347 **Amp** ---------- **(01 Mark)**

e) Describe earth leakage circuit breakers with diagram.

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



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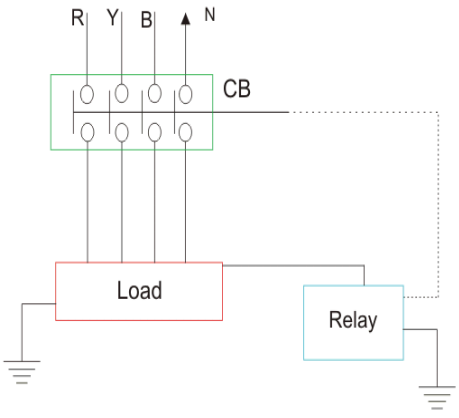
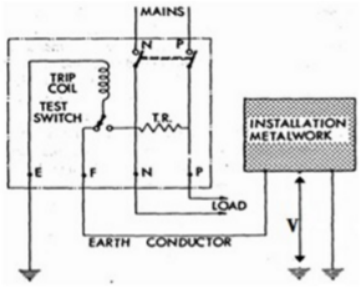


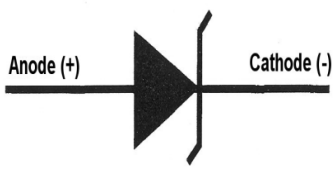
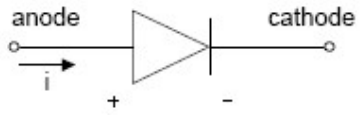
OR

	Earth Leakage Circuit Breaker (ELCB):  **ELCB:-** An Earth Leakage Circuit Breaker (ELCB) is a device used to directly detect currents leaking to earth from an installation and cut the power and avoid the person getting shock. There are two types of ELCBs: 1. Voltage Earth Leakage Circuit Breaker (voltage-ELCB) 2. Current Earth Leakage Current Earth Leakage Circuit Breaker (Current-ELCB). **OR** Earth leakage circuit breaker is a safety device used in electrical installations with high earth impedance to prevent shocks and disconnect power under earth fault conditions. Works on principle of relaying when the current in the earth path exceeds a set value. ELCB is used for protection against electric leakage in the circuit of 50 Hz or 60 Hz , rated voltage single phase 240 V, 3 ph. 4 kv. Rated current up to 60 Amp. When the earth fault occurs, the ELCB cuts off the power within the time of 0.1 sec. automatically to protect the personnel. Under normal conditions (IL — IN) = If is very low or nearly zero. The CT surrounding the phase and neutral senses the differential current under earth fault and actuates the CB to operate (open). The difference current If through fault path resistance R_e is the leakage to earth. If this value exceeds a preset value then the CB opens. Normally it is around 35 mA for tripping in domestic installations with tripping time being as low as 25msec.
f)	**Suggest various safety precautions which should be taken while working with electricity.**
Ans:	**The Following are the precautions should be taken while working electricity:-** **(Any Four point expected : 1 Mark each)** 1. Avoid working on live parts. 2. Switch off the supply before starting the work. 3. Never touch a wire till you are sure that no currents are flowing.

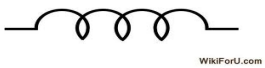
	4. Do not guess, whether electric current is flowing through a circuit by touching. 5. Insulate yourself on the insulating material like wood, plastic etc. before starting the work on live main. 6. Your hand & feet must be dry (not wet) while working on live main. 7. Rubber mats must be placed in front of electrical switch board/ panel. 8. Use hand gloves, Safety devices & proper insulated tools. 9. Ground all machine tools, body, and structure of equipments. 10. Earthing should be checked frequently. 11. Do not use aluminum ladders but use wooden ladders. 12. Do not operate the switches without knowledge. 13. Use proper insulated tools & safety devices. 14. When working on live equipment obey proper instruction. 15. Do not work on defective equipment. 16. Use safe clothing. 17. Use shoes with rubber soles to avoid shock. 18. Do not wear suspected Necklace, arm bands, finger ring, key chain, and watch with metal parts while working. 19. 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. 20. Do not work if there is an unfavorable condition such as rain fall, fog or high wind. 21. Do not sacrifice safety rules for speed. 22. Do not allotted work to untrained person (worker) to handle electrical equipment. 23. Make habit to look out for danger notice, caution board, flags, and tags. 24. Warn others when they seen to be in danger near live conductors or apparatus. 25. Inspect all electrical equipment & devices to ensure there is no damage or exposed wires that may causes a fire or shock. 26. Avoid using electrical equipment near wet, damp areas. 27. Use approved discharge earth rod for before working. 28. Never speak to any person working upon live mains. 29. Do not Do the work if you are not sure or knowledge of the condition of equipment/ machine. 30. Safety book/ Training should be given to all persons working in plants.

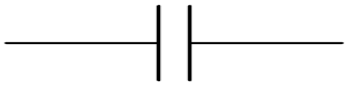
---------- (END PART-I) ----------

SECTION — II

Q.4	Attempt. any NINE of the following:18 Marks
a)	**Define semiconductor. Give its classification.**
Ans:	**(Definition – 1 Mark and classification – 1 Mark)** **Semiconductor** A solid substance that has conductivity between that of an insulator and that of most metals and the conductivity can be selectively controlled by doping the material with an impurity. Examples- Silicon, Germanium. **Classification** 1) Intrinsic semiconductor 2) Extrinsic semiconductor
b)	**Which type of impurities are added in pure semiconductor to obtain P - type and N - type semiconductor?**
Ans:	**(one impurity for p type – 1 Mark and n type – 1 Mark)** 1) p type - trivalent materials (Boron , Aluminium) 2) n type - pentavalent materials (Phosphorus , Arsenic)
c)	**State the majority and minority carriers in N - type semiconductor.**
Ans:	**Majority and minority carriers in N - type semiconductor** 1. Majority carriers- Electrons **(1 Mark)** 2. Minority carriers- Holes **(1 Mark)**
d)	**Draw the symbols of following :(i) P - N junction diode (ii) Zener diode (iii) Fixed inductor (iv)Fixed capacitor**
Ans:	**(Each symbol – 1/2 Mark)** **i) P-N junction diode** **ii) Zener Diode**  

iii) Fixed Inductor : **iv) Fixed capacitor :**

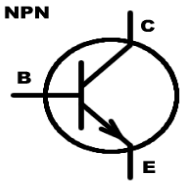




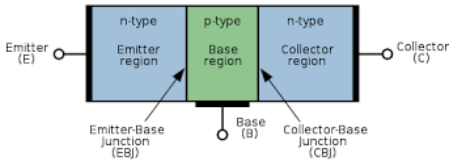
e) Draw the symbol of NPN transistor and draw its construction.

Ans: **(Symbol – 1 Mark and construction diagram – 1 Mark)**

1) Symbol :



2) Construction diagram



f) State any four applications of BJT.

Ans: **Applications of BJT:-** **(Any Four applications expected: 2 Marks)**

1. As an amplifier
2. As an switch in various electronics circuits.
3. Temperature sensor
4. Logarithmic Converter

OR any other four applications.

g) State the need of filter in regulated power supply.

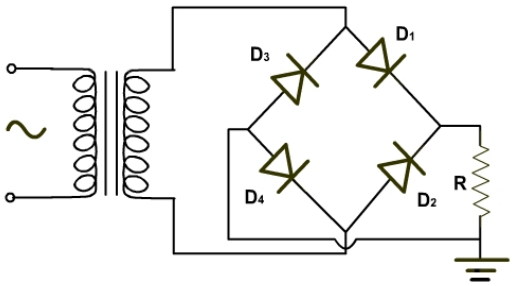
Ans: **(Explanation – 2 marks)**

Reason of need the filter in regulated power supply:

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

h) Draw the circuit diagram of full wave bridge rectifier.

Ans: **Circuit diagram of full wave bridge rectifier:** **(Diagram- 2 Marks)**



i) State the different types of filters used in regulated power supply.

Ans: **Following Types of filters used in regulated power supply:** **(4 types – 2 Marks)**

i) Shunt capacitor filter

ii) Series inductor filter

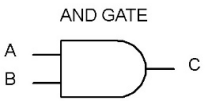
iii) LC Filter

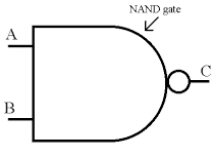
iv) CLC or π filter

j) Draw the logic symbol of AND and NAND gates.

Ans: **Symbol of AND and NAND gates** : **(Each symbol - 1 mark)**

1) AND Gate 2) NAND Gate:





k) State the truth table of OR gate.

Ans: **Truth table of OR gate:** **(truth table – 2 Marks)**

Truth table

Truth Table of OR Gate

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

l) State Commutative and Associative laws of Boolean algebra.

Ans: **Commutative and Associative laws of Boolean algebra:** **(Each operation – 1/2 Mark)**

1. Commutative law :-

OR Operation : A + B = B + A

AND operation : A.B = B.A

2. Associative law :

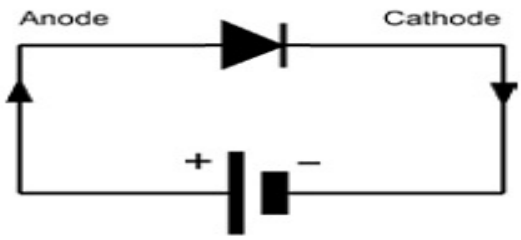
OR operation : A+ (B+C) = (A+B) +C

AND operation : A. (B.C) = (A.B).C

Q.5	**Attempt any FOUR of the following:16 Marks**
a)	**Describe forward and reverse biasing of P - N junction diode. State its two applications.**

Ans: **(Forward Biasing- 1 .5 Mark, Reverse biasing- 1.5 Mark , two applications – 1 Mark)**

1. Forward Biasing of P - N junction diode :



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.

2. Reverse biasing of P-N Junction:

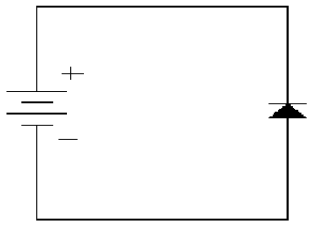


FIGURE2 REVERSED BIASED DIODE

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.

Application of P-N junction diode:

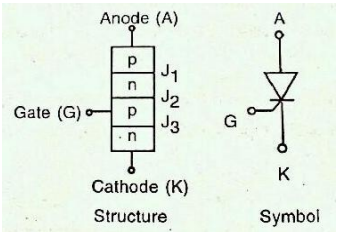
1) Rectifiers
2) Voltage multipliers
3) Clipper
4) Clamper

OR any other two specific applications.

b) Describe the working principle of SCR with the help of neat sketch. Draw its V - I characteristics.

Ans: **(Diagram -1 Mark, working principle- 2 Marks ,V - I characteristics-1 Mark)**

Diagram of SCR :



or equivalent figure

Working of SCR

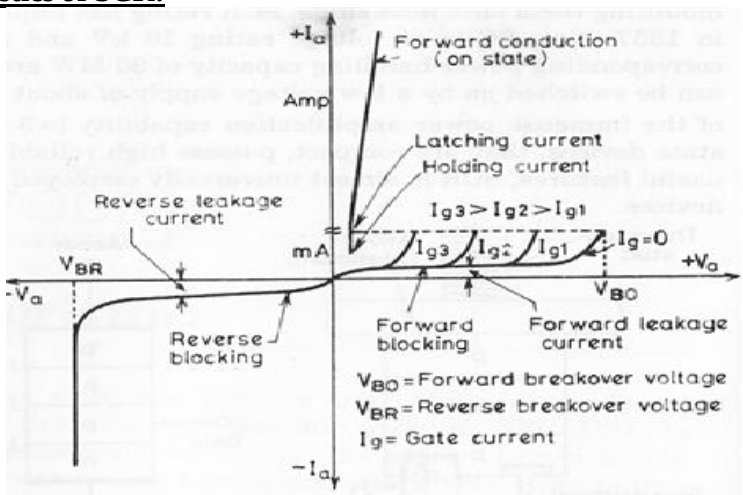
When the anode is made +ve w.r.t. cathode, the junctions J1 and J3 are forward biased, whereas junction J2 is reverse biased. Due to this reverse biased junction J2, only small leakage current flows from anode to cathode. The S.C.R. is then said to be in forward blocking state.

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.

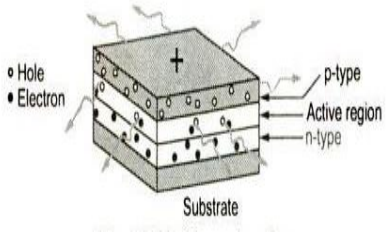
V - I characteristics of SCR:



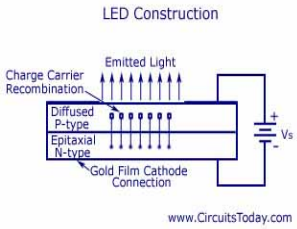
c) Describe the working principle of light emitting diode. State its two applications.

Ans: **(Diagram -1 Mark, working principle- 2 Marks , two Applications-1 Mark)**

Diagram light emitting diode :



or



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.

- G_aA_s, G_aP, G_aA_sP are used to get visible light.(G_aA_S- Infrared radiation, G_aP- Red or green, G_aA_sP- Red or yellow
- Colors of the emitted light depend on the type of material used.

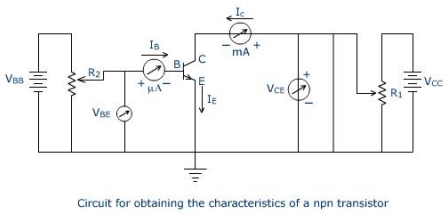
Applications of light emitting diode: (Any Two)

7 segment display, bar graph display, as a indicators, monitoring & control display, 14 segment display.

d) Draw the circuit diagram of CE configuration. Plot its output characteristics.

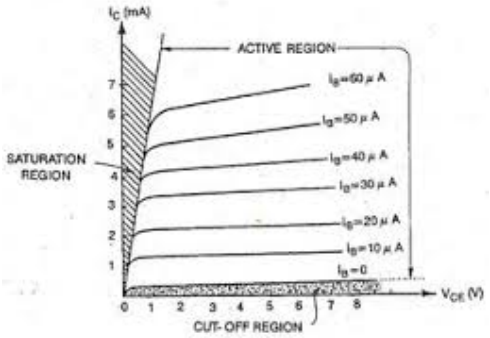
Ans: **(Circuit diagram – 2 Marks, output characteristics – 2 Marks)**

Circuit diagram of CE configuration:



Circuit for obtaining the characteristics of a npn transistor

Output characteristics :



e) Describe the working of centre tap full wave rectifier with its input and output waveforms.

Ans: **(Diagram -1 Mark, working principle- 2 Marks , input and output waveforms -1 Mark)**

Working of centre tap full wave rectifier:

When input ac supply is switched on, the ends M and N of the transformer secondary become +ve and -ve alternately. During the positive half-cycle of the ac input, terminal M is +ve, G is at zero potential and N is at –ve potential. Hence, being forward-biased, diode D_1 conducts (but D2 is reversed-biased) and current flows along MD_1CABG. As a result, positive half-cycle of the voltage appears across R_L.

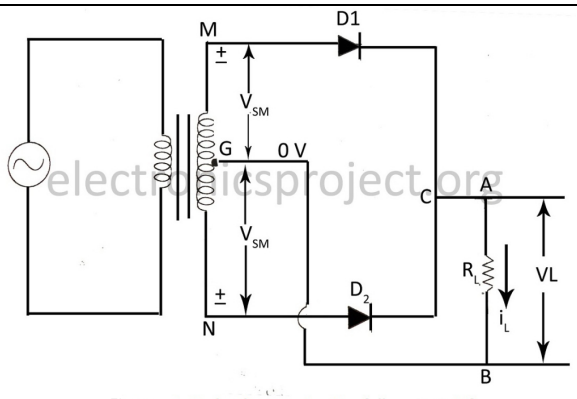
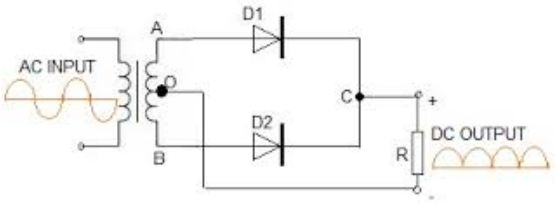


Figure 1-1: single-phase center-tap full-wave rectifier

During the negative half-cycle, when the terminal N becomes +ve, then D_2 conducts (but not D_1) and current flows along ND_2CABG. So, we find that the current keeps on flowing through R_L in the same direction (i.e. from A to B) in both half-cycles of ac input. It means that both half-cycles of the input ac supply are utilized as shown in figure 1-2. Also, the frequency of the rectified output voltage is twice the supply frequency. Of course, this rectified output consists of a dc component and many ac components of diminishing amplitudes.

Input and output waveforms in diagram -



Full Wave rectifier (Centre tap)

f) **Prove following De - Morgan's theorem with the help of truth table: (i)A+B = A•B (ii) A • B = A + B**

Ans: **(Each truth table – 2 Marks)**

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

$$\overline{A+B} = \overline{A}.\overline{B}$$

$$\overline{A.B} = \overline{A}+\overline{B}$$

This can be proved by using truth tables as follows:

A	B	$\overline{A+B}$	$\bar{A}.\bar{B}$
0	0	1	1
0	1	0	0
1	0	0	0
1	1	0	0

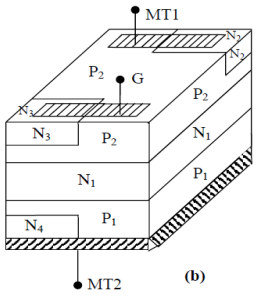
A	B	$\overline{A.B}$	$\bar{A}+\bar{B}$
0	0	1	1
0	1	1	1
1	0	1	1
1	1	0	0

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

a) **Describe the working of TRIAC with the help of neat sketch. Plot its V - I characteristics.**

Ans: **(Diagram -1 Mark, working principle- 2 Marks , V - I characteristics-1 Mark)**

Neat Sketch of TRIAC



Working Principal of Traic

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

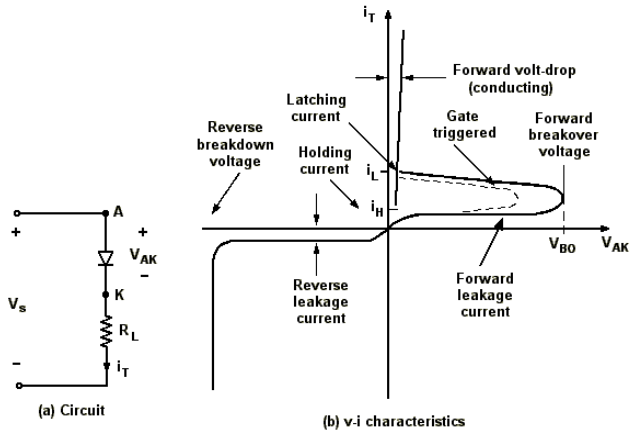
1. MT_2 positive with respect to MT_1, G positive with respect to MT_1
2. MT_2 positive with respect to MT_1, G negative with respect to MT_1
3. MT_2 negative with respect to MT_1, G negative with respect to MT_1
4. MT_2 negative with respect to MT_1, G positive with respect to MT_1

The triggering sensitivity is highest with the combinations 1 and 3 and are generally used. However, for bidirectional control and uniforms gate trigger mode sometimes trigger modes 2 and 3 are used. Trigger mode 4 is usually avoided.

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 the trigger mode-3 the gate current I_g forward biases the $P_2 P_3$ 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.

V - I characteristics Traic



b) State two applications of resistor, inductor and capacitor.

Ans: **(Resistor – 1 Mark , capacitor- 1 .5 Marks , inductor – 1.5 Marks)**

Applications of resistor:

- To limit the current or fuse
- sensors
- OR any other applications

Applications of Inductor:

- Used in Filters circuit.
- Oscillators
- OR any other applications

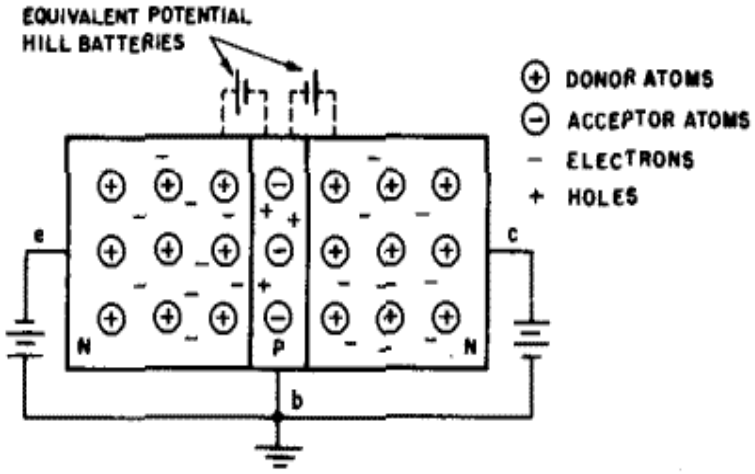
Applications of Capacitor

- Used as coupling & Bypass capacitor in amplifiers
- Used in Filters circuit.
- Oscillators
- OR any other applications

Explain the working of NPN transistor with neat diagram.

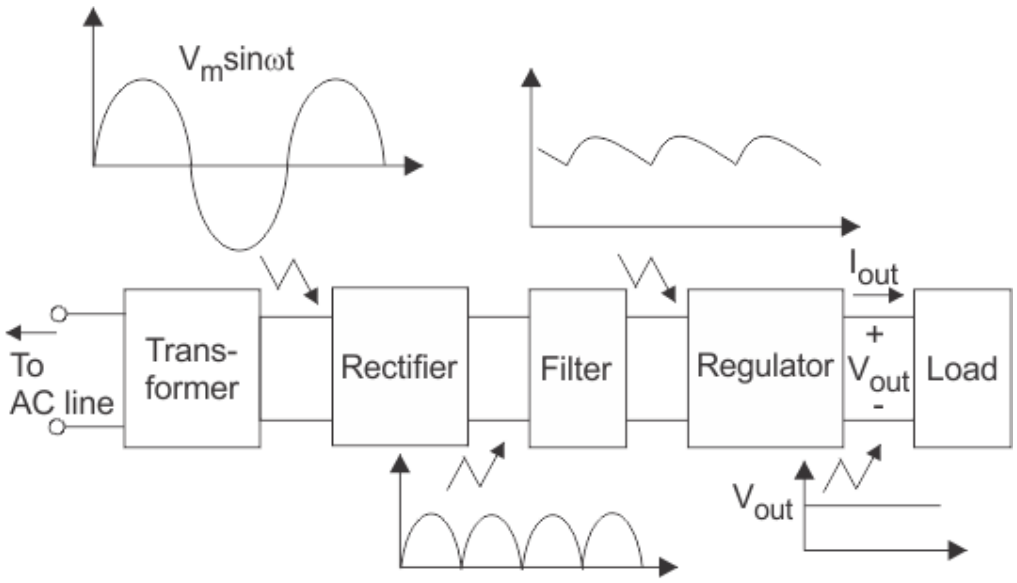
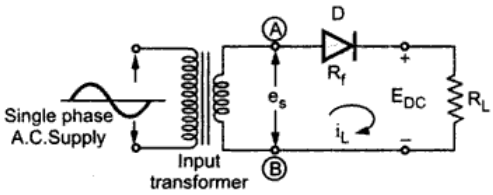
Ans: **(Diagram- 2 Marks , Operation – 2 Marks)**

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 the complete block diagram of regulated power supply, with necessary waveforms at each stage.**
Ans:	**(Block Diagram- 2 Marks , waveforms- 2 Marks)** **Block Diagram of Regulated power supply**  Components of typical linear power supply OR any other suitable diagram
e)	**Describe the working of half wave rectifier with input and output waveforms.**
Ans:	**(Circuit - 1 Mark ,Operation – 2 marks , waveforms- 1 Mark)** **Half wave Rectifier (Circuit) :-**  The rectifier circuit consists of resistive load, rectifying element and the source of a.c. voltage, all connected in series. To obtain the desired d.c. voltage across the load, the a.c. voltage is applied to rectifier circuit using suitable step-up or step-down transformer.

Operation

During the positive half cycle, terminal (A) becomes positive with respect to terminal (B). The diode is forward biased and the current flows in the circuit. The current will flow in almost full positive half cycle.

During the negative half cycle, terminal (A) becomes negative with respect to terminal (B). The diode is reverse biased and the no current flows in the circuit.

Waveform

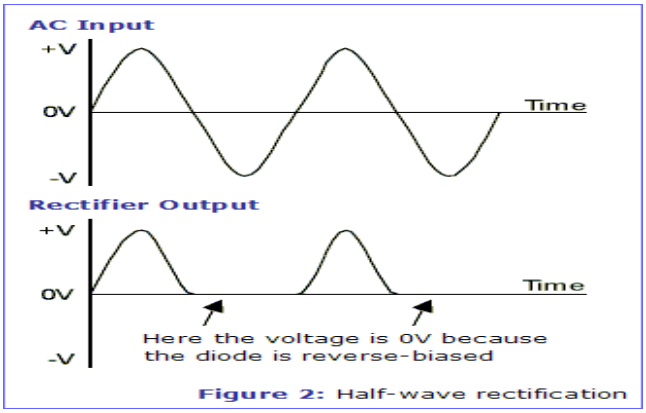


Figure 2: Half-wave rectification

f) Draw the symbol of EX - OR and EX - NOR gates and write its truth - table.

Ans: **(Each gate- 2 Marks)**

1. EX-OR Gate :

Exclusive-OR gate

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

2. EX-NOR Gate

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

---------- END----------