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)	**A furnace takes a current of 10 Amp from a 220 volt dc supply for 8 hours. Calculate the electrical energy consumed in kWh.**
Ans	**Given Data:** I = 10 A, V = 220 V Power 'P' = V I ---------- **(1/2 Mark)** Power 'P' = 220×10 Power 'P' = 2200 Watts or 2.2 kW ---------- **(1/2 Mark)** **Energy Consumed :** Energy consumed = Power in (KW) x Time in (Hr) ---------- **(1/2 Mark)** Energy consumed = 2.2 x 8 Energy consumed = 17.6 kWh ---------- **(1/2 Mark)**
b)	**A potential difference of 2.5 volt causes a current of 250 micro Amp to flow in a conductor. Calculate the resistance of the conductor.**
Ans	**Given Data:** R =? V = 2.5V I = 250 micro amp = 250 x10^{-6} amp $\text{Resistance } R = \frac{V}{I_T} = \frac{2.5}{250 \times 10^{-6}}$ ---------- **(1 Mark)** $\text{Resistance } R = 10000\ \Omega \cong 10\ k\Omega$ ---------- **(1 Mark)**

c)	**List the classification of d.c. 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 **Or** a) Cumulative compound DC motor b) Differential compound DC motor
d)	**Define the following term related to A.C.: (i) Periodic time (ii) Instantaneous value**
Ans	**Time period:** ----------**--(1 Mark)** The time (in sec) required by an alternating quantity to complete its one cycle is known as time period. **Instantaneous value:**----------**(1 Mark)** The Value of AC quantity at any particular time instant is called as Instantaneous value
e)	**State the function of commutator in DC motor**
Ans	**The function of commutator in DC motor:** **(2 Mark)** The function of the commutator is to reverse the current in each conductor of the armature as it passes from one pole to another and thus to help the motor to develop a continuous and unidirectional torque
f)	**Write working principle of D.C. motor.**
Ans	**Working Principle of D.C. Motor :-** **(2 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 and its direction is given by Fleming’s left hand rule.

g)	**State any two applications of 3-phase squirrel cage induction motor.**
Ans:	**Applications of 3-phase squirrel cage induction motor (any two applications are expected of the following or similar. 1 Mark each)** For driving somehow constant load e.g. 1. Lathe Machine, 2. Workshop Machine and 3. Water pump 4. Constant speed applications
h)	**"An induction motor cannot run at synchronous speed". Give reason.**
Ans:	**Justification.: (Marks -2)** The working principle of three phase induction motor is based on relative motion between rotating magnetic field and rotor conductors i.e. (NS - N), According to Lenz's law rotor will try to catch the synchronous speed of rotating magnetic field to oppose the 'cause producing it'. But rotor never succeeds due to frictional losses. If rotor catches the synchronous speed of rotating magnetic field, (NS - N) i.e. relative motion will be zero and rotor stops to rotate and therefore three phase induction motor can never run on synchronous speed .
i)	**A single phase transformer of 50 Hz has maximum flux in core as 0.021 Wb, the number of turns of primary being 460 and that on secondary is 52. Calculate emf induced in primary and secondary windings of a transformer.**
Ans:	**Emf induced in primary winding of a transformer:** $E_1 = 4.44\,\phi_m\, f\, N_1$ ---------- **(1/2 Mark)** $E_1 = 4.44 \times 0.021 \times 50 \times 460$ $E_1 = 2144.52$ volts ---------- **(1/2 Mark)** **Emf induced in Secondary winding of a transformer:** $E_2 = 4.44\,\phi_m\, f\, N_2$ ---------- **(1/2 Mark)** $E_1 = 4.44 \times 0.021 \times 50 \times 52$ $E_1 = 242.424$ volts ----------**(1/2 Mark)**
j)	**State two advantages of autotransformer.**
Ans:	**Advantages of autotransformer- (Any Two accepted : 1 Mark each)** 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.

k) A transformer does not operate on d.c. supply. State reason.

Ans: **Reason:** **(2 Marks)**

The transformer works on the principle of mutual induction, for which current in one coil must change uniformly. If dc supply is given, the current will not change due to constant supply (as frequency is zero) and transformer will not work.

Practically winding resistance is very small. For dc, the inductive reactance X_L is zero as dc has no frequency. So total impedance of winding is very low for dc. Thus winding will draw very high current if dc supply is given to it. This may cause the burning of windings due to extra heat generated and may cause permanent damage to the transformer.

l) Write the function of fuse and MCCB.

Ans: **Function of Fuse:** **(1 Mark)**

It is protective device against over current, when the current exceeds the limiting value of fuse wire the fuse wire gets heated, melts and breaks the circuit.

Function of MCCB: **(1 Mark)**

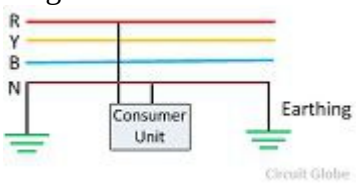
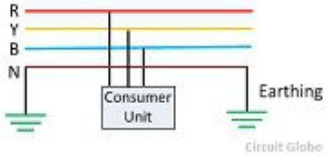
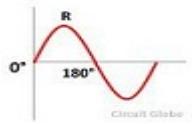
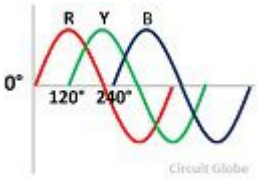
- It is a protective device against Overcurrent and Short Circuit when the current exceeds the limiting value of MCCB rating it will make supply OFF (Trip) automatically and protect the circuit/equipment.

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

a) Write comparison between single phase and three phase AC supply (any four points).

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

Parameter	Single Phase	Three Phase
Definition	Single Phase The power supply through one conductor.	Three Phase The power supply through three conductors.
Number of wire.	Single Phase Require two wires for completing the circuit.	Three Phase Requires four wires for completing the circuit.
Voltage	Single Phase Carry 230V	Three Phase Carry 415V
Phase Name	Single Phase Split phase	Three Phase No other name
Power Transfer Capability	Single Phase Minimum	Three Phase Maximum

Network	Single Phase Simple	Three Phase Complicated
Power Failure	Single Phase Occurs	Three Phase Do not occur
Loss	Single Phase Maximum	Three Phase Minimum
Efficiency	Single Phase Less	Three Phase High
Economical	Single Phase Less	Three Phase More
Uses	Single Phase For home appliances.	Three Phase-in large industries and for running heavy loads.
Power Supply Connection	Single Phase 	Three Phase 
Wave Shape	Single Phase 	Three Phase 

b) State the necessity of starter for dc motor. Also give two applications of dc series motor and dc shunt motor.

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

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

therefore back emf will be zero so $I_a = \frac{V}{R_a}$. 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 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.

Applications of DC series motor: **(Any Two applications expected: 1/2 each)**

1. Electrical Railways
2. Rolling mills
3. Metallurgical works
4. Mine hoists
5. Continuous conveyors
6. Cranes and valve operation etc.

Applications of DC shunt motor: **(Any Two applications expected: 1/2 each)**

1. Line shafts
2. Lathes
3. Vacuum cleaners
4. Pressure blowers
5. Reciprocating pumps
6. Wood working machines

c) Explain briefly the construction of a three phase I.M.

Ans: **(4 Marks)**

Induction motor have two main parts namely rotor and stator.

Stator:

As its name indicates stator is a stationary part of induction motor. A stator winding is placed in the stator of induction motor and the three phase supply is given to it.

Rotor:

The rotor is a rotating part of induction motor. The rotor is connected to the mechanical load through the shaft.

The rotor of the three phase induction motor are further classified as

1.Squirrel cage rotor
2. Slip ring rotor or wound rotor or phase wound rotor.

Depending upon the type of rotor construction used the three phase induction motor are classified as:

1. Slip ring induction motor
2. Squirrel cage induction motor

d) A 50 kVA single phase transformer has a turns ratio of 300/20. The primary winding is connected to a 2200 V, 50 Hz supply. Calculate:
(i) the secondary voltage on no load (ii) secondary current on full load

Ans: **Given Data -** $f = 50\ Hz,\ N_1 = 300,\ N_2 = 20,\ V_1 = 2200\ V\quad V_2 = ?$

(i) the secondary voltage on no load:

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

$$\frac{2200}{V_2} = \frac{300}{20}$$

$$V_2 = \frac{2200 \times 20}{300}$$

$$V_2 = 146.67\ Volt$$ ---------- **(1 Marks)**

(ii) Secondary current on full load (I_2):

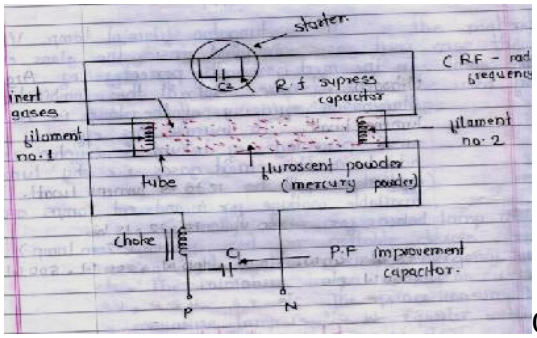
$$I_2 = \frac{KVA}{V_2}$$ ---------- **(1 Mark)**

$$I_2 = \frac{50 \times 10^3}{146.67}$$

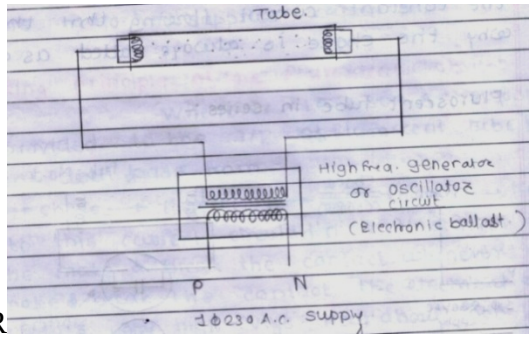
$$I_2 = 340.9\ Amp$$ ---------- **(1 Marks)**

e) Explain working principle of fluorescent lamp with diagram.

Ans: **Fluorescent Lamp:** **(Diagram- 2 Mark & Working Principal -2 Mark)**



OR



Construction:-

Fluorescent tube consists of tube, choke, starter & power factor improvement capacitor.

Working operation:-

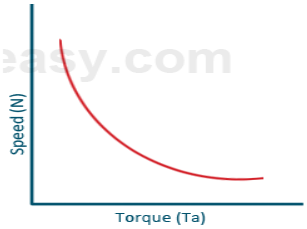
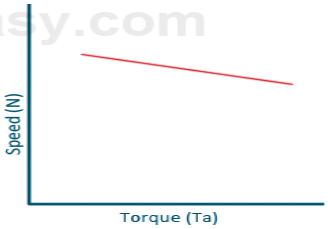
When switch is ON current flows through the choke-filament no1- starter-filament no. 2- to neutral, At that time choke induces high voltage which is applied to two filaments and ionized gas, Due to this there will be high voltage ionization so that light will be emitted through the tube. Choke is acting as ballast starter is used for make and break the circuit. To operate the fluorescent lamp, need a ballast (choke) to limit the current & provide the necessary starting voltage and starter for starting the tube.

f) State any four safety precautions to be taken while handling an electrical equipments.

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

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

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.

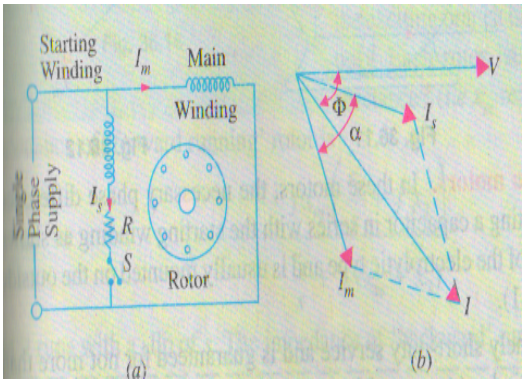
Q.3	**Attempt any FOUR of the following:** **16 Marks**
a)	**State and explain Ohm's law.**
Ans:	**Ohms Law:-** ---------- **(State-2 Mark & Equation-2 Mark)** The current flowing through a solid conductor is directly proportional to the difference of potential across the conductor. & inversely proportional to its resistance provided the temperature remains constant. **Equation:-** **i.e** $I \propto V \quad \therefore \frac{V}{I} = constant \therefore I = \frac{V}{R}$ $or \ \therefore V = I.R. \quad or \quad R = \frac{V}{I}$ **Where** R is constant called as resistance, V=voltage and I = Current
b)	**Draw the speed-torque characteristics of dc series and d.c. shunt motors. Explain the nature of the graphs.**
Ans:	**(Diagram- 1 Mark & Explanation -1 Mark for each motor)** **1) Speed-torque characteristics of DC Series Motor:**  **Explanation:** ➢ The speed at no load is dangerously high. ➢ The starting torque developed is high. ➢ The drop in speed with increase in load. **2) Speed-torque characteristics of DC Shunt Motor:**  **Explanation:** ➢ Starting torque is less

- The drop in the speed from no load to full load is small.
- DC shunt motor can be considered as a constant speed motor.

c) With neat construction explain working of R-split type of induction motor.

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

Circuit diagram of resistors split single phase induction motor:



or equivalent figure

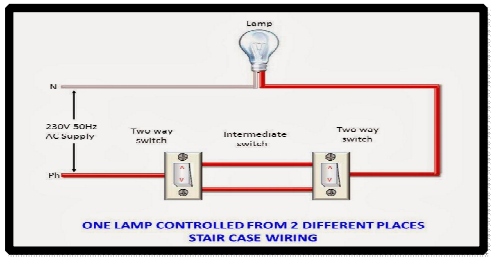
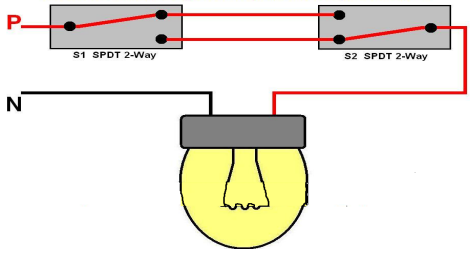
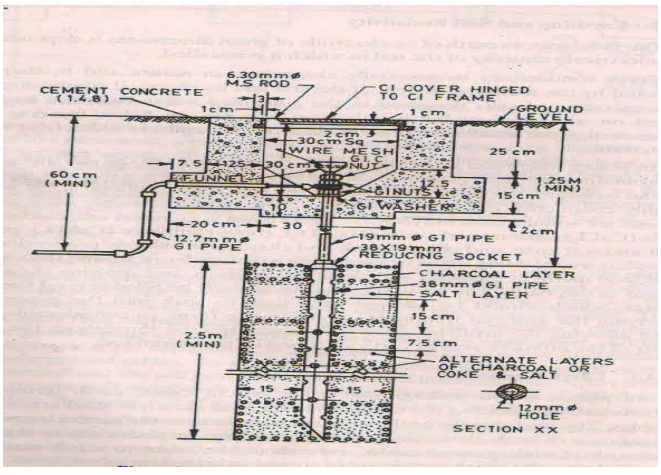
Operation of resistors split single phase induction motor:

- 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.

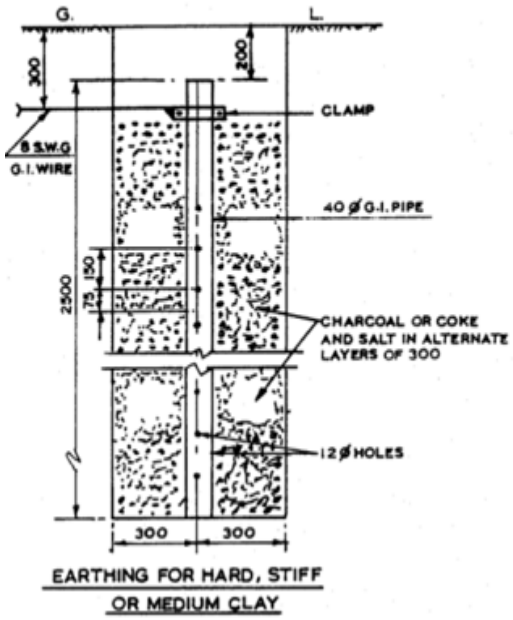
d) Write four characteristics of ideal transformer.

Ans: **characteristics of ideal transformer:** **(Each point carrying 1 mark)**

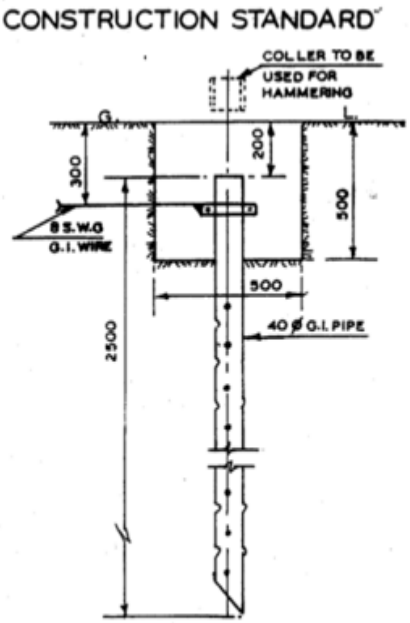
1. It is the transformer which does not have any losses
2. Its efficiency is 100%
3. Its regulation is 0%
4. The value of resistances and leakage reactance's is zero for ideal transformer.

e)	**Draw the wiring diagram for control of one lamp using two switches.**
Ans:	**For control of one lamp using two switches:** **(Figure: 4 Mark)**  OR  **OR Equivalent figure**
f)	**Why earthing is essential in electrical installation? Draw neat sketch of Pipe earthing and label it.**
Ans:	**Earthing is essential in electrical installation:** **(2 Marks)** ➢ The purpose of earthing is to minimize risk of receiving an electric shock if touching metal parts when a leakage current is present. ➢ Earthing is to ensure safety or Protection of electrical equipment and Human by discharging the electrical **leakage current** to the earth. **OR** ➢ Earthing is provided to protect human from shocks due to leakage current. ➢ Earthing provides protection to the electrical **motors and appliances.** due to leakage current. ➢ Earthing provides protection to the electrical **motors to protect against over voltage (Neutral earthing)** **Diagram for Pipe Type earthing :** **(2 Marks)** 

or equivalent figure



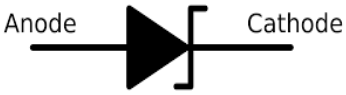
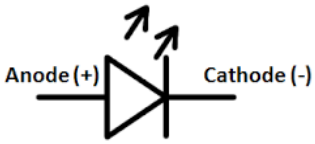
EARTHING FOR HARD, STIFF
OR MEDIUM CLAY

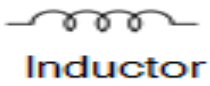
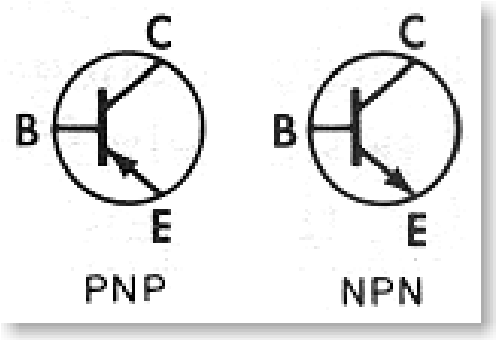


EARTHING FOR ORDINARY SOIL
WHERE PIPE COULD BE HAMMERED IN

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

SECTION — II

Q.4	**Attempt any NINE of the following:** **18 Marks**
a)	**List two applications of transistor.**
Ans:	1) Transistor used as a voltage amplifier. **(Two applications – 2 Marks)** 2) Transistor used as a power amplifier. 3) Used as Switch. 4) Used in digital circuits as – memory, gates. 5) Used in Oscillators & Multivibrators 6) Used in Time base generators.
b)	**Draw symbol of zener diode and light emitting diode.**
Ans:	**1) Zener diode** **2) light emitting diode:** **(Each symbol – 1 Mark)**  
c)	**Define semiconductor and insulator.**
Ans:	**1) Semiconductor** **(1-Mark)** The materials which have conductivity in between insulator & conductor and which have four electrons in its outermost orbit are called as semiconductor. **OR** In Semiconductors the gap between Valence band and Conduction band is very small i.e. 1.1 eV. So the conductivity is between conductors and insulator. **2) Insulator** **(1-Mark)** In Insulator the gap between Valence band and Conduction band is very large i.e. > 9 eV. **OR** Materials which have no conductivity or block flow of electrons are called insulators (e.g., rubber, glass, Teflon, mica, etc.)
d)	**State any two applications of TRIAC.**
Ans:	**Applications of TRIAC :** **(Two applications – 2 Marks)** 1) It is used as light dimmer.

	2) It is used as fans speed regulators. 3) It is used in UPS/SMPS. 4) It is used in Inverters. 5) In AC flasher. 6) In Induction heating.
e)	**Draw the symbol of inductor. List two applications of it.**
Ans:	**symbol of inductor:** **(Symbol 1-Mark, Two applications-1Mark)**  Inductor **Applications of inductor** 1) Filters 2) Choke uses in tube light
f)	**Draw neat symbol of PNP and NPN transistor.**
Ans:	**symbol of PNP and NPN transistor:** **(Each symbol 1-Mark)** 
g)	**Define filter. State its function.**
Ans:	**Definition** **(1 Mark)** Filters are circuits which are used to remove unwanted AC components from the output of rectifier. **Function** **(1 Mark)** To remove unwanted frequency components from the signal using different components such as Inductor, Capacitor etc.

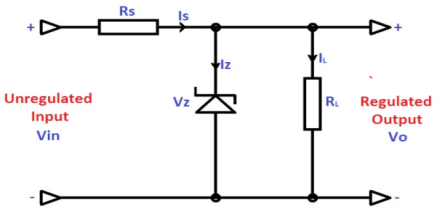
h) Write necessity of power supply.

Ans: **Necessity of power supply:** **(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.

i) State principle of zener shunt regulator.

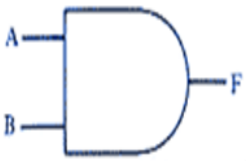
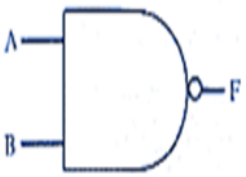
Ans: **Principle of zener shunt regulator:** **(Diagram 1-Mark, Principle 1-Mark)**



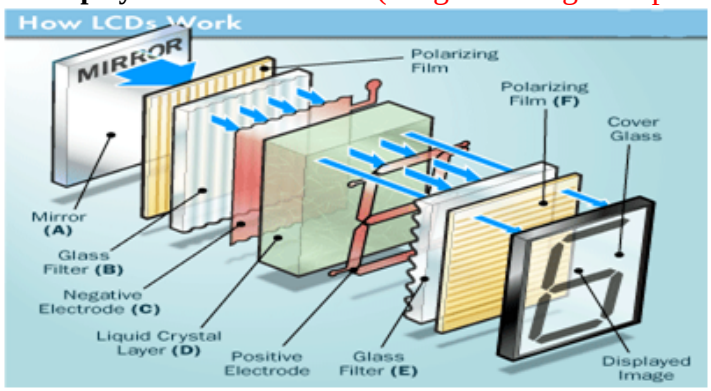
Zener Diodes are widely used as Shunt Voltage Regulators to regulate voltage across small loads. Zener Diodes have a sharp reverse breakdown voltage and in breakdown, voltage across zener will be constant for a wide range of currents. Thus we will connect the zener diode parallel to the load such that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

j) Draw symbol and truth table of: (i) AND gate (ii) NAND gate

Ans: **(Each Symbol 1-Mark, Each Truth table 1-Mark)**

Name	Graphic Symbol	Algebraic Function	Truth Table
AND		F = A • B or F = AB	A B | F 0 0 | 0 0 1 | 0 1 0 | 0 1 1 | 1
NAND		$F = (\overline{AB})$	A B | F 0 0 | 1 0 1 | 1 1 0 | 1 1 1 | 0

k)	**State working principle of LCD display.**
Ans:	**Working principle of LCD display:** (Diagram along with principle 2-Marks)

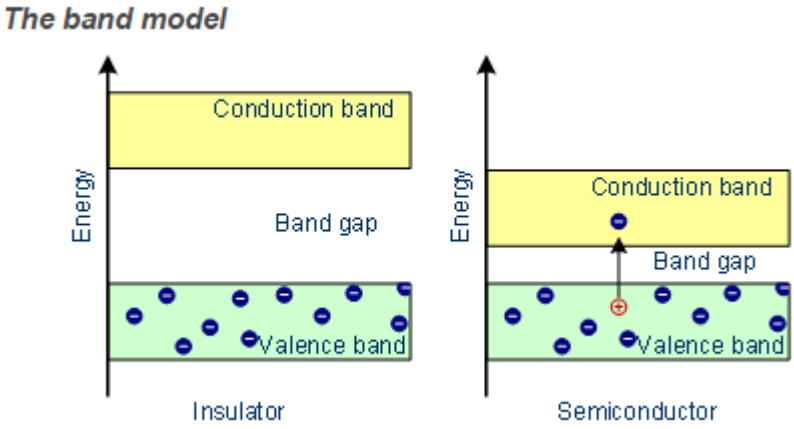


The principle behind the LCD's is that when an electrical current is applied to the liquid crystal molecule, the molecule tends to untwist. This causes the angle of light which is passing through the molecule of the polarized glass and also cause a change in the angle of the top polarizing filter. As a result a little light is allowed to pass the polarized glass through a particular area of the LCD. Thus that particular area will become dark compared to other. The LCD works on the principle of blocking light. While constructing the LCD's, a reflected mirror is arranged at the back. An electrode plane is made of indium-tin oxide which is kept on top and a polarized glass with a polarizing film is also added on the bottom of the device. The complete region of the LCD has to be enclosed by a common electrode and above it should be the liquid crystal matter.

Next comes to the second piece of glass with an electrode in the form of the rectangle on the bottom and, on top, another polarizing film. It must be considered that both the pieces are kept at right angles. When there is no current, the light passes through the front of the LCD it will be reflected by the mirror and bounced back. As the electrode is connected to a battery the current from it will cause the liquid crystals between the common-plane electrode and the electrode shaped like a rectangle to untwist. Thus the light is blocked from passing through. That particular rectangular area appears blank.

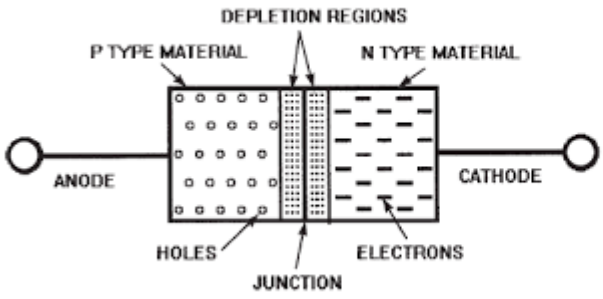
l)	**Which gates are called as universal gates? Why?**
Ans:	**Following gates are called as universal gates:** **(1-Mark)** NAND and NOR gates called as universal gates. **Reason:** **(1-Mark)** All other gates (AND, OR, NOT) can be formed using the combination of universal gates.

Q.5	**Attempt any Four of the following:** **16 Marks**
a)	**Draw the energy level diagram of an insulator and semiconductor and explain the term forbidden energy gap.**
Ans:	**(Two Diagrams 2-Marks, Explanation 2-Marks)**



The separation between valence band and conduction band is known as forbidden energy gap. If an electron is to be transferred from valence band to conduction band, external energy is required, which is equal to the forbidden energy gap.

b)	**Explain construction and working of PN junction diode.**
Ans:	**Construction** **(1-Marks)**

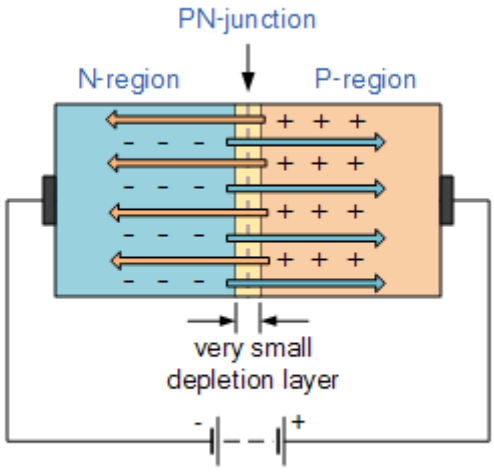


1. Forward Bias condition **(Diagram-1/2 Marks, Explanation 1-Mark)**

When a diode is connected in a **Forward Bias** condition, a negative voltage is applied to the N-type material and a positive voltage is applied to the P-type material. If this external voltage becomes greater than the value of the potential barrier, approx. 0.7 volts for silicon and 0.3 volts for germanium, the potential barriers opposition will be overcome and current will start to flow.

This is because the negative voltage pushes or repels electrons towards the junction giving them the energy to cross over and combine with the holes being pushed in the opposite

direction towards the junction by the positive voltage. This results in a characteristics curve of zero current flowing up to this voltage point, called the "knee" on the static curves and then a high current flow through the diode with little increase in the external voltage as shown below.



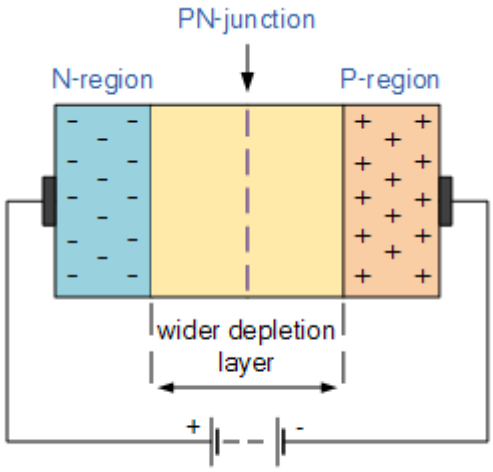
Forward Biasing Voltage

2. Reverse Bias condition **(Diagram-1/2 Marks, Explanation 1-Mark)**

When a diode is connected in a **Reverse Bias** condition, a positive voltage is applied to the N-type material and a negative voltage is applied to the P-type material.

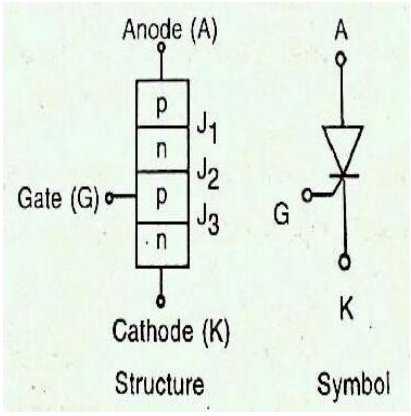
The positive voltage applied to the N-type material attracts electrons towards the positive electrode and away from the junction, while the holes in the P-type end are also attracted away from the junction towards the negative electrode.

The net result is that the depletion layer grows wider due to a lack of electrons and holes and presents a high impedance path, almost an insulator. The result is that a high potential barrier is created thus preventing current from flowing through the semiconductor material



Reverse Biasing Voltage

c)	**Explain working principle of SCR with the help of neat sketch. Also state its two applications.**
Ans:	**Structure of S.C.R. -** **(Diagram:1 , Working:2 Mark and Application: 1 Mark)**



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.

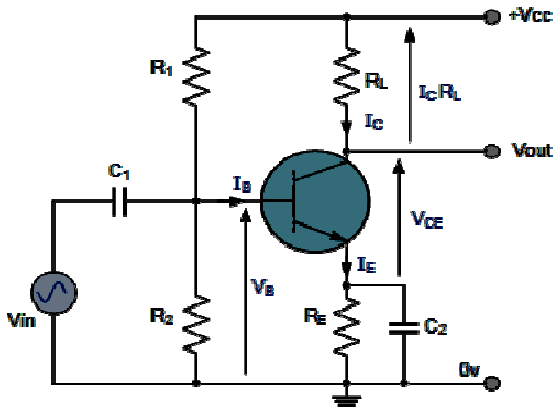
Applications of S.C.R.: -

1.Chopper 2.Inverter 3.Drives, etc.

d)	**Draw the circuit diagram of single stage common emitter amplifier and explain its working.**

Ans:

Diagram : **(2 Marks for diagram and 2 Marks for explanation)**



or equivalent fig

Explanation : :-

Transistor 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 transistor. 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.
- Cc1 = Input coupling capacitor
- Cc2 = Output coupling capacitor
- Ce = Emitter bypass capacitor.

1. In the absence of ac input, $I_B=I_{BQ}$, $I_C = I_{CQ}$, $V_{CE} = V_{CEQ}$. The Q point is selected in the active region of transistor.
2. As Vin is applied, the base current varies above and below I_{BQ} .
3. Hence Ic =βI_B varies above and below ICQ. Variation in Ic is large.
4. Therefore voltage across Rc varies. VRC = Ic x Rc.
5. Hence collector voltage Vc varies above and below VCE_Q

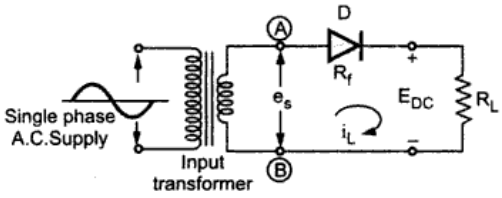
   As Vc = Vcc- Ic .Rc.

6. Through C out 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) Explain the working of half wave rectifier with the help of circuit diagram.

Ans: **Half wave Rectifier (Circuit) :-** **(Circuit - 1 Mark)**



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- **(2 Marks)**

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: **(Waveform - 1 Mark)**

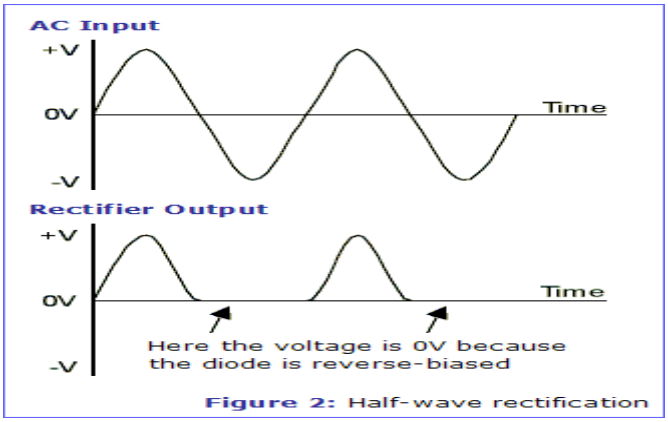


Figure 2: Half-wave rectification

f) **Write statement of De-Morgan's theorem. Explain proof of this theorem by using truth table.**

Ans: DeMorgan's Theorem is a simplification technique that can be used to simplify Boolean expressions. **(2 Marks)**

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

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

This can be proved by using truth tables as follows: **(2 Marks)**

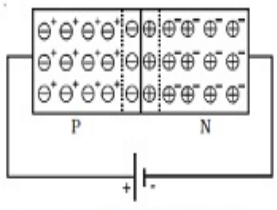
A	B	$\overline{A+B}$	$\bar{A}.\bar{B}$
0	0	1	1
0	1	0	0
1	0	0	0
	1	0	0

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

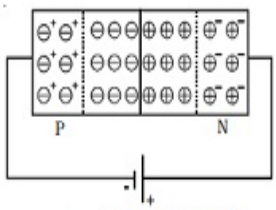
Q.6 **Attempt any Four of the following:** **16 Marks**

a) **Draw forward and reverse bias condition of PN junction diode. Also draw its V-I characteristics.**

Ans: **Forward and reverse bias condition of PN junction diode** **(Diagram 2-Marks)**

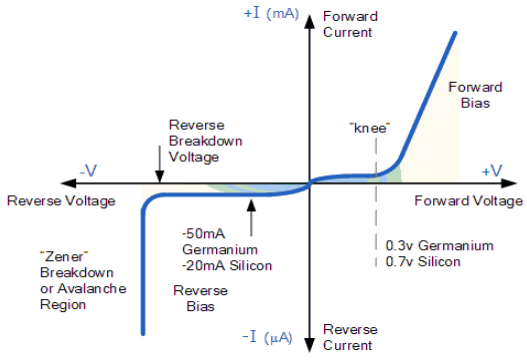


Forward biased PN junction diode



Reverse biased PN junction diode.

VI Characteristics: **(2-Marks)**

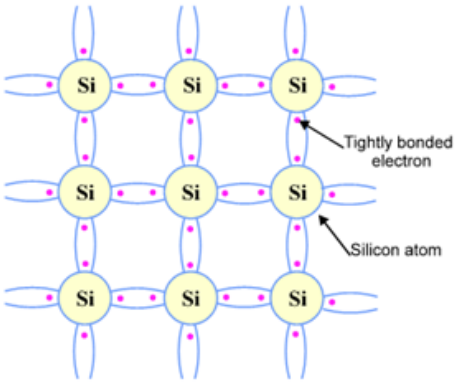


b) **Explain intrinsic and extrinsic semiconductor in details.**

Ans:

Intrinsic semiconductor- **(2-Marks)**

The semiconductor which is in purest form like Si, Ge (without trivalent or pentavalent impurities/ doping) is called "Intrinsic semiconductor."

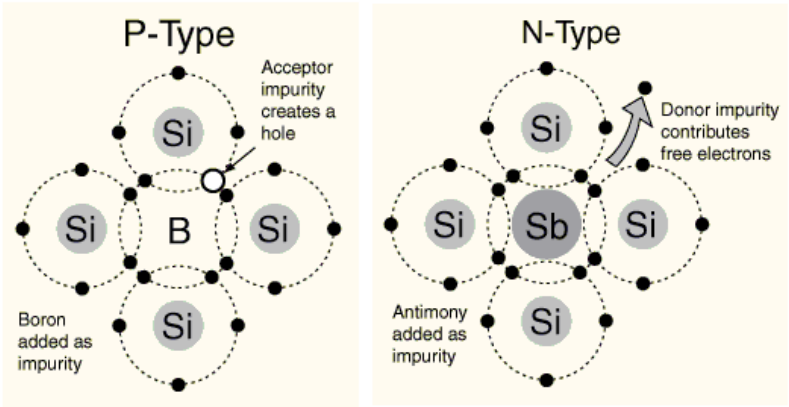


Extrinsic semiconductor- **(2-Marks)**

Extrinsic semiconductor is an impure semiconductor formed from intrinsic semiconductor by adding small quantity of impurity atoms called dopants.
The process of adding impurities to the semiconductor crystal is known as doping.
This added impurity is very small of the order of one atom per million atoms of semiconductor

The semiconductor which is having doping of trivalent materials (Boron , Aluminium) or pentavalent materials (Phosphorus , Arsenic) is called "Extrinsic semiconductor."
Depending upon the type of impurity added the extrinsic semiconductor are classified as

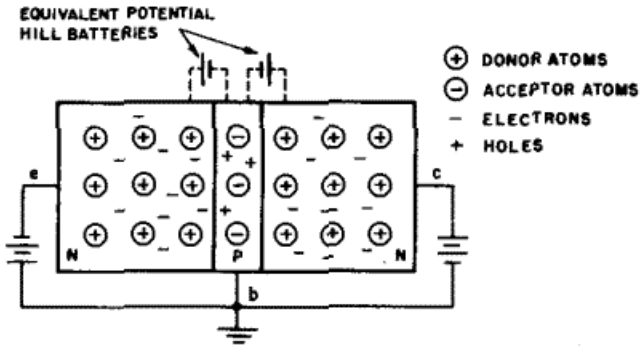
1. N-type semiconductor
2. P-type semiconductor



c) Explain the working of NPN transistor with the help of neat sketch.

Ans: **(Diagram 2-Marks, Explanation 2-Marks)**

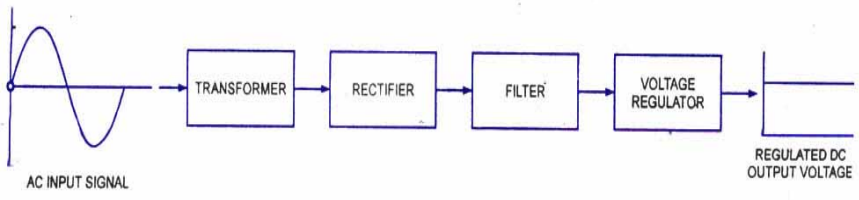
Operation of NPN transistor-



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.

d) Draw and explain block diagram of power supply.

Ans: block diagram of power supply: **(Diagram 2-Marks, Explanation 2-Marks)**



Block Diagram of a DC Power Supply

1) Transformer: It Converts an AC input source to AC required output without changing frequency. The transformer is step up or step down transformer.

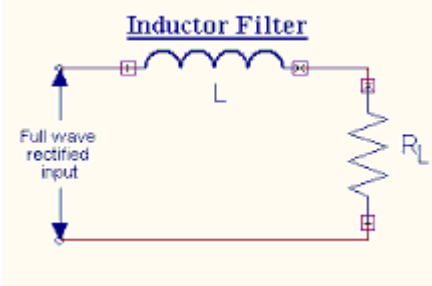
2) Rectifier: It is a circuit which is used to convert AC into pulsating DC. A rectifying diode is used.

3) Filter: It is a circuit used to convert pulsating DC into pure DC. A inductor and capacitors are used as filter

4) Voltage regulator: An unregulated DC voltage is converted into regulated DC voltage. IC 78XX & 79XX series are used as regulator.

e) Draw and explain circuit diagram of series inductor filter.

Ans: **Circuit diagram of series inductor filter:** **(Diagram 2-Marks, Explanation 2-Marks)**



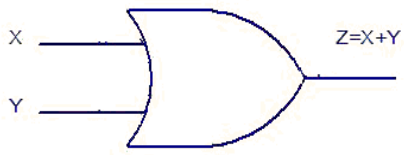
As the name of the filter circuit suggests, the Inductor L is connected in series between the rectifier circuit and the load. The inductor carries the property of opposing the change in current that flows through it.

In other words, the inductor offers high impedance to the ripples and no impedance to the desired dc components. Thus the ripple components will be eliminated. When the rectifier output current increases above a certain value, energy is stored in it in the form of a magnetic field and this energy is given up when the output current falls below the average value. Thus all the sudden changes in current that occurs in the circuit will be smoothened by placing the inductor in series between the rectifier and the load.

f) Draw symbol and truth table for following gate: (i) OR gate (ii) NOR gate

Ans: **(Each symbol 2-Marks, Each truth table 2-Marks)**

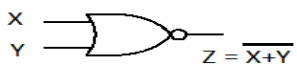
OR Gate



TRUTH TABLE

INPUTS		OUTPUT
X	Y	Z
0	0	0
0	1	1
1	0	1
1	1	1

NOR Gate



TRUTH TABLE

INPUTS		OUTPUT
X	Y	Z
0	0	1
0	1	0
1	0	0
1	1	0

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