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.

Ans: **(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.

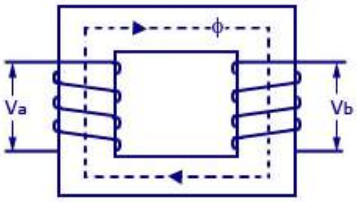
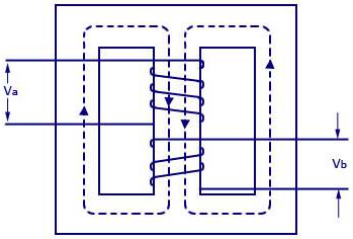
Equation:- **i.e** $I \propto V \quad \therefore \frac{V}{I} = constant \quad \therefore I = \frac{V}{R}$

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

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

b) Differentiate between core type and shell type transformer. (any two points)

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

S.No	Core Type Transformer	Shell Type Transformer
1.		

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

c) Two resistors of 30 ohm and 5 ohm are connected in series to a battery of 70 volt. Calculate: (i) total effective resistance (ii) current supplied to the circuit.

Ans: **Given Data:** R_1 =30 ohm R_2 = 5 ohm in series V = 70 V

i) Effective resistance: $R_T = R_1 + R_2 = 30+5= 35$ ohm

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

ii) Current supplied to the circuit:

$$\text{Current } I = \frac{V}{R_T} = \frac{70}{35}$$

$$\text{Current } I = 2 \text{ Amp}$$

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

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

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

Transformer works on faradays law of electromagnetic induction where alternating flux is required as working flux of transformer

When transformer operates on DC supply, stationary flux will be produced instead of alternating flux, so there is no induced emf in either primary or secondary winding.

OR

The primary winding will be burn if it is connected to DC Supply, because there is no self induced emf in primary winding,

e) List the various parts of dc machine.

Ans: **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:

f) State the necessity of the earthing.

Ans: **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.

g) Write two application of three phase induction motor.

Ans: **Applications of 3-Ph induction Motor**: **(Any Two Expected: 1 Mark each)**

i) Water Pumps ii) Tube wells iii) Lathes Machine iv) Line shaft v) Circular-saws vi) Grinders vii) Polishers viii) Wood Planners ix) Compressors x) Laundry washing machines xi) fans xii) Blowers

h) State the function of fuse. Name the material used for fuse wire.

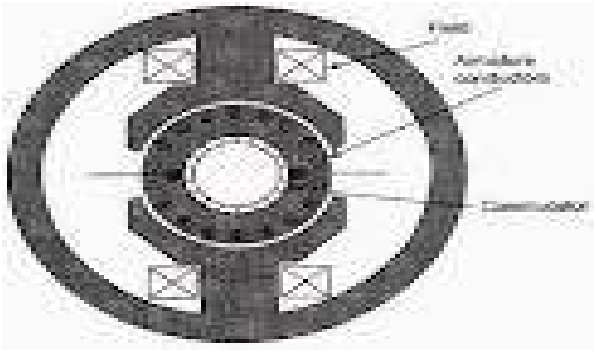
Ans: **(Function of fuse-1 Mark & Name of material used-1 Mark)**

Function of Fuse:

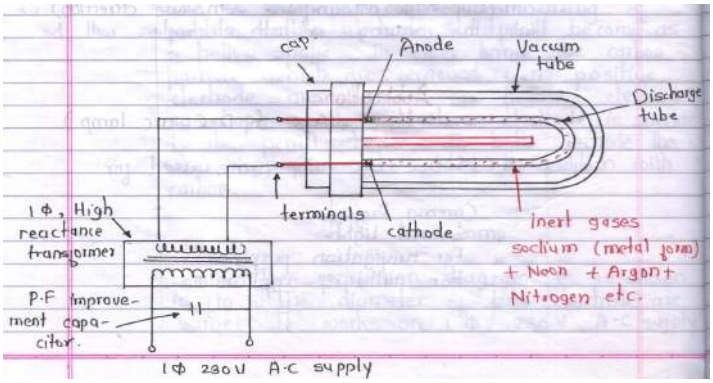
- Fuse is a wire of short length or thin strip of material having low melting point
- It is protective device against over current, occurs due over load or short circuit.
- When some faults, such as short circuit occurs or when load more than circuit capacity is connected in it, the current exceeds the limiting value, the fuse wire gets heated, melts and breaks the circuit.

Name the material used for fuse wire:

S.No	Material used for fuse wire	Melting point in ^{0}C
1	Tin	230
2	Lead	328
3	Zinc	419
4	Silver	960
5	Copper	1090
6	Aluminium	-

i)	**Write working principle of dc motor.**
Ans:	**Working Principle of D.C Motor :-** **(02 Marks)**  **(or similar figure)** When current carrying conductor is placed in magnetic field force will be exerted on the conductor & motor start rotating it works on Flemings left hand rule.
j)	**A 6 pole 3-phase induction motor operates from a supply whose frequency is 50Hz. Calculate synchronous speed of the motor.**
Ans:	**Given Data:** **P=6, F=50Hz Find N_S** $N_s = \frac{120 \times f}{P}$ ---------- **(1 Mark)** $N_s = \frac{120 \times 50}{6}$ $N_s = 1000 rpm$ ---------- **(1 Mark)**
k)	**Write two safety precautions to be taken while handling an electrical equipments.**
Ans:	**(Any Two 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.
l)	**A 200 kVA, 3300 / 240V, 50 Hz single phase transformer has 80 turns on secondary winding find maximum value of flux.**
Ans:	$E_2 = 4.44\,\phi_m\ f\ N_2$ …….. **(1 Marks)** $240 = 4.44 \times \phi_m \times 50 \times 80$ $\phi_m = \frac{240}{4.44 \times 50 \times 80}$, $\phi_m = \frac{240}{17760}$ $\phi_m = 1.351 \times 10^{-3}$ wb …….. **(1 Marks)**

Q.2	**Attempt any FOUR of the following:** **16 Marks**
a)	**Explain with a neat diagram, the construction of sodium vapour lamp.**
Ans:	**Neat diagram of sodium vapour lamp:** **(Figure: 2 Mark & Construction:2 Mark)**  **OR** **Construction:-** Above figure shows constructional details of sodium vapour lamp. It consists of 'U' shaped tube at the ends of the tube two electrodes are sealed. This tube is filled with sodium and small quantity of neon gas. Since there is great effect of the change of surrounding temperature on the light output given by the lamp, Hence the inner tube is enclosed in an outer double walled glass tube, before sealing the lamp vacuum is created between the two glass tube (inner & outer).
b)	**Write four point of comparison between single phase supply system and three phase supply system.**
Ans:	**Advantages of 3-phase system over 1-phase system: -** **(Any Four points expected 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.

c) A single phase transformer of 50 Hz has maximum flux in the core as 0.021 Wb, the no. of turns in primary being 460 and that on secondary is 52.Calculate emf induced in primary and secondary winding of a transformer.

Ans:

Emf induced in primary winding of a transformer:

$E_1 = 4.44\,\phi_m\,f\,N_1$ ---------- **(1 Mark)**

$E_1 = 4.44 \times 0.021 \times 50 \times 460$

$E_1 = 2144.52$ volts ---------- **(1 Mark)**

Emf induced in Secondary winding of a transformer:

$E_2 = 4.44\,\phi_m\,f\,N_2$ ---------- **(1 Mark)**

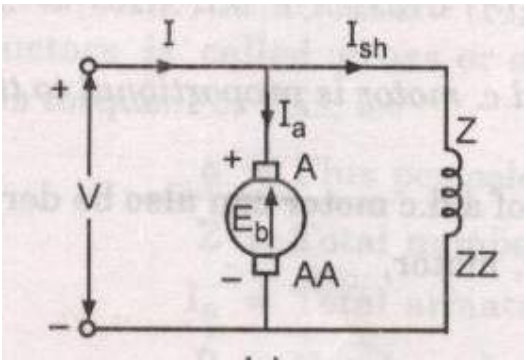
$E_1 = 4.44 \times 0.021 \times 50 \times 52$

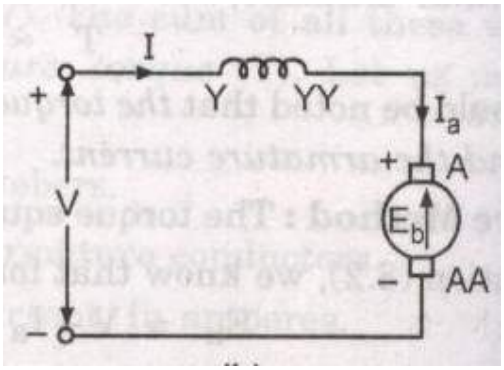
$E_1 = 242.424$ volts ---------- **(1 Mark)**

d) Draw different types of dc motors with circuit diagram and give one industrial application of each type.

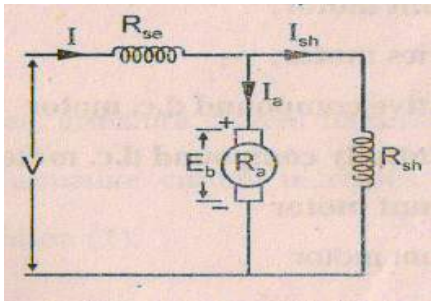
Ans:

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.

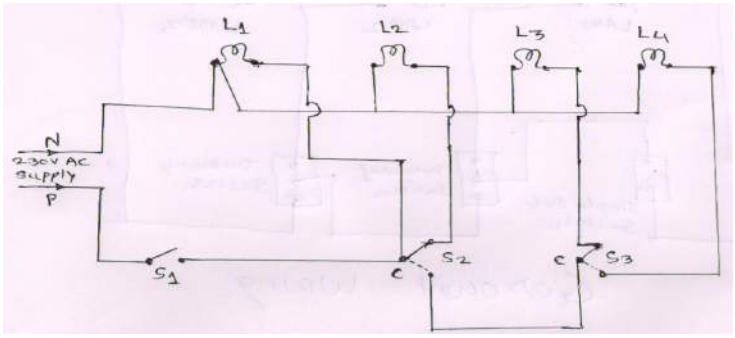
d) Compare squirrel cage and slip ring type three phase induction motor on the basis of (i) Starting torque. (ii) Efficiency (iii) Rotor construction (iv) Application

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

S.No	Point	3-phase squirrel cage I.M	Slip ring 3-Ph I.M
i)	**Starting torque.**	Small or moderate starting torque	High Starting torque
ii)	**Efficiency**	High efficiency	Low efficiency
iii)	**Rotor construction**	Rotor is in the form of bars	Rotor is in the form of 3-ph winding
iv)	**Application**	Water pumps, Tube wells, lathes, drills, line shafts, circular-saws, grinders, polishers, wood planers, compressors, Laundry washing machine, fans, blowers etc **(Any one)**	Driving line, Shafts, lifts, pumps, generators, winding machine, auxiliary fans, smoke exhausters, printing presses, elevators, compressors etc **(Any one)**

f) Draw wiring diagram of godown wiring and explain the working.

Ans: **(Figure: 3 Mark & Working: 1 Mark)**



or equivalent figure

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

Q.3	**Attempt any FOUR of the following:** **16 Marks**
a)	**What is the importance of improvement in power factor? State any two methods for power factor improvement.**
Ans:	**Because of following advantages of high power factor improvement of power factor is important:** **(Any Three Important are expected: : 1 Mark each)**

We know that, $P = \sqrt{3}\ V_L\ I_L\ Cos\phi$

- For same power to be transmitted at same voltage over a same distance

$$I \alpha \frac{1}{Cos\phi} \quad \alpha \frac{1}{P.f}$$

- From above equation it is seen that as power factor increases current decreases, due to decreases in current, system has following advantages

Cross section of conductor reduces:

$$\text{Cross section of conductor } \alpha\ I \ \alpha \frac{1}{P.f}$$

As P.F. increases current reduce so; cross section of conductor and its weight reduces hence its cost reduces

1. **Design of supporting Structure:**
   As weight of conductor reduces design of supporting structure (tower) becomes lighter, so its cost reduces.
2. **Cross section of terminal (contacts) reduces:**
   As power factor increases, current reduces. hence cross section of switchgear bus bar and contacts etc decreases.
3. **Copper losses reduces:**
   As power factor increases current reduces. So copper losses reduces. As a effect efficiency increase.

$$\text{Copper losses } \alpha\ I^2 \ \alpha \frac{1}{(P.f)^2}$$

e.g. Copper losses at 0.8 P.f. Lag $\alpha \frac{1}{(0.8)^2} \alpha\ 1.57$

Copper losses at 0.8 P.f. Unity $\alpha \frac{1}{(1)^2} \alpha\ 1$

Copper losses at unity power factor are 1.57 times less than copper losses at 0.8 power factor lagging.

4. **Voltage drop reduces:**
   As P.F. increases, current decreases. So voltage drop decreases, So regulation gets improved (better)

For eg: Voltage drop at 0.8 P.f. Lag $\alpha \frac{1}{(0.8)} \alpha\ 1.25$

Voltage drop at Unity P.f. $\alpha \frac{1}{1} \alpha\ 1$

Voltage drop at unity power factor are 1.25 times less than voltage drop at 0.8

power factor lagging.

5. Handling capacity (KW) of equipment increases:

As power factor increases, handling capacity of each equipment such as Alternator, transformer increases. e.g.

S.No	KVA rating	P. F.	Handling capacity (KW)
1	1000	0.6	600
2	1000	0.8	800
3	1000	1.0	1000

6. KVA rating of equipments reduces:

As P.F. increases, current decreases. So KVA rating of all equipments for eg- alternator, transformer etc decreases, so its capital cost reduces.

For eg: KVA rating at Unity P.f. $\alpha \frac{1}{1} \alpha 1$

KVA rating at 0.8 P.f. Lag $\alpha \frac{1}{(0.8)} \alpha 1.25$

KVA rating required for equipment at unity power factor are 1.25 times less than KVA rating required at 0.8 power factor lagging.

Methods for power factor improvement. **(Any Two methods expected: 1 mark)**

1) By use of static capacitor (Condenser)

2) By use of over excited synchronous motor (Synchronous condenser)

3) By use of over excited Schrage motor

4) By use of phase advancer

b) Draw and explain different types of wire.

Ans: **Following types of wires:** **(Any Four Expected: 1 Mark each)**

i) **VIR: Vulcanized Indian Rubber:** Conductor used for wire is flexible and insulation is used Vulcanized Indian Rubber, Conductor may be copper or aluminum

ii) **PVC: Polyvinyl Chloride wires:** Conductor used for wire is flexible and insulation is used Polyvinyl Chloride wires, Conductor may be copper or aluminum

iii) **T.R.S. Wire:** Conductor used for wire is flexible and insulation is used T.R.S. Wire, Conductor may be copper or aluminum

iv) **Flexible wire:** Conductor used for wire is stranded and insulation is used P.V.C

Wire, Conductor may be copper or aluminum

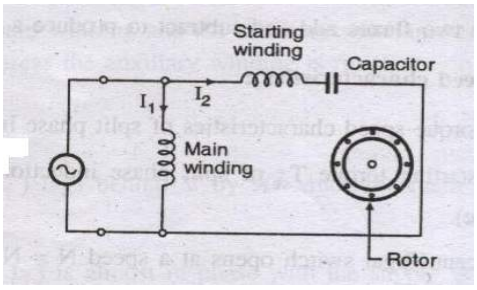
v) **Lead sheathed wires:** Conductor used for wire is stranded and insulation is used P.V.C Wire, Conductor may be copper or aluminum

vi) **CTS:** Cab Tyre sheathed wires: Conductor used for wire is stranded and insulation is used Cab Tyre sheathed wires, Conductor may be copper or aluminum

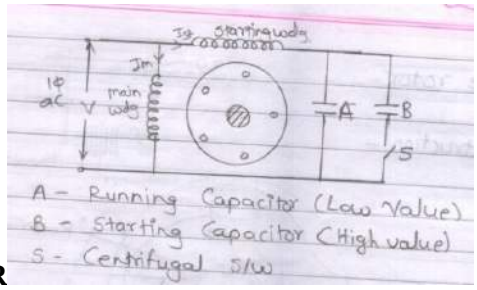
c) With connection diagram, explain working principle of capacitor start capacitor run single phase induction motor.

Ans: **(Diagram-2 Marks & Explain-2 Marks)**

Capacitor-start capacitor run 1-Ph Induction Motor:-



OR



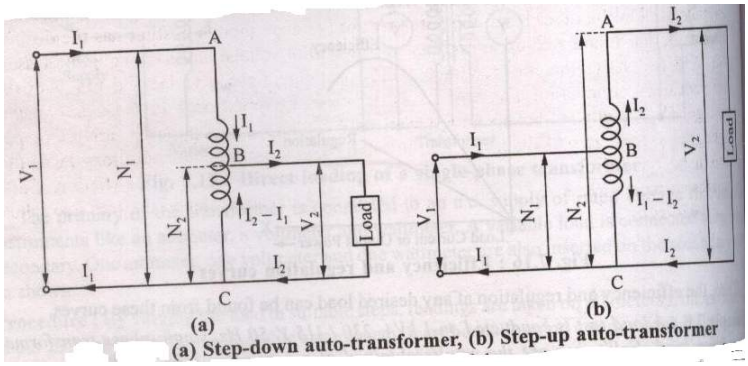
or Equivalent fig

Working Principle:

In these motors one capacitor is connected in series with the auxiliary winding. There is no centrifugal switch. Thus this winding along with the capacitor remains energized for both starting and running conditions. Capacitor used serves the purpose of obtaining necessary phase displacement at the time of starting and also improves the power factor of the motor.

d) Draw neat constructional sketch of auto transformer. State its two merits.

Ans: **Sketch of auto transformer:** **(Figure: 2 Mark & Merits: 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**

Merits of Autotransformer explanation:- (Any Two points expected)

1. Copper required is very less.
2. High efficient than two winding transformer.
3. Small size and low cost.
4. Resistance and leakage reactance is less compared to two winding transformer.
5. Copper losses are less.
6. superior voltages regulation than two winding transformer.

e) 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 $N = 0$, $\therefore E_b = 0$ 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.

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

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

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

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

f)	**A furnace takes a current of 10 Amp from a 220 V, dc supply for 8 hours. Calculate the energy consumed in KWh.**
Ans:	**Given Data:** I = 10 A, V = 220 V Power 'P' = V I ---------- **(1 Mark)** Power 'P' = 220×10 Power 'P' = 2200 Watts or 2.2 kW ---------- **(1 Mark)** **Energy Consumed :** Energy consumed = Power in (KW) x Time in (Hr) ---------- **(1 Mark)** Energy consumed = 2.2 x 8 Energy consumed = 17.6 kWh ---------- **(1 Mark)**

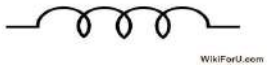
---------- **(END PART-I)** ----------

SECTION — II

Q.4 **Attempt. any NINE of the following:** **18 Marks**

a) **Draw the symbol of resistor and inductor.**

Ans: **The symbol of resistor and inductor:** **(1 Mark for each symbol)**

Sr. No.	Component	Symbol
i	Resistor	
ii	Inductor	

b) **State the applications of transistor. (any two)**

Ans: **Applications of transistor.** **(2 Marks for any 2 applications)**

1. As an amplifier
2. As a switch
3. In Integrated Circuit(IC)
4. Communication system
5. Power electronics

c) **What is the need of rectifier?**

Ans: **Need of Rectifier:-** **(2 Marks)**

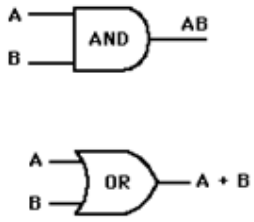
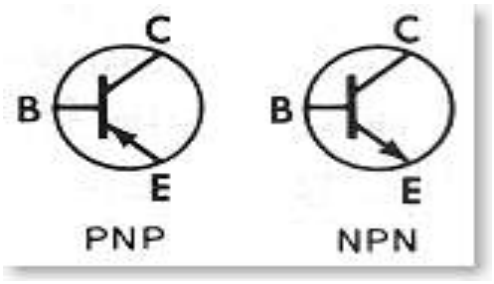
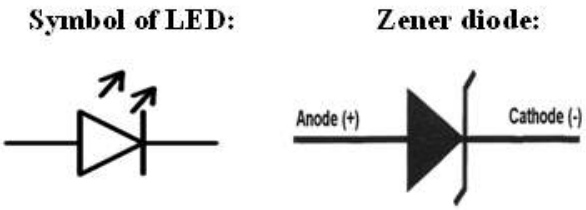
Rectifier is a circuit which converts an AC sinusoidal signal into DC one. Almost all the electronic circuits need a dc voltage power supply for their operation. The dc supply voltage is derived from the single phase ac main circuit.

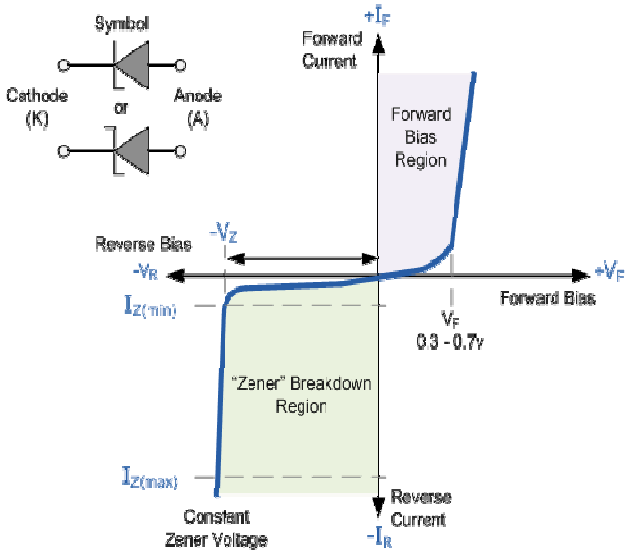
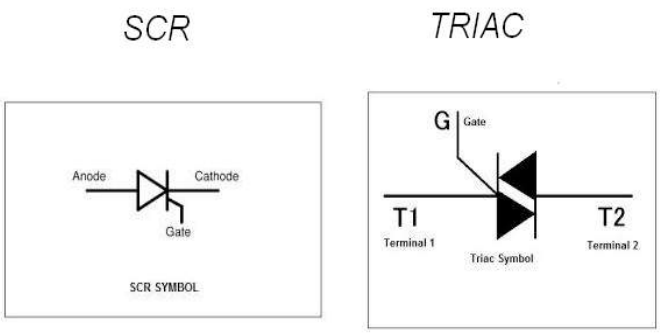
Using Rectifier the ac voltage or current is converted into corresponding direct (dc) quantity (dc voltage or dc current).

d) **Why NAND and NOR gate are called universal gates?**

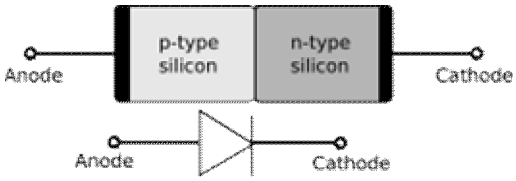
Ans: **Reason for NAND and NOR gate are called universal gates:** **(2 Marks)**

The NAND gate and NOR gate are called as universal gates since any other gates can be formed using number of NAND gates or NOR gates combination. They are used to create basic gates such as AND, NOT and OR. They can be used to implement much logic expression. We can use only one type of universal gate to implement any logic circuit.

e)	**Draw the symbol of AND gate and OR gate.**
Ans:	**Symbol of AND gate and OR gate:** **(1 Mark for each symbol)** 
f)	**Draw the symbol of NPN and PNP transistor.**
Ans:	**the symbol of NPN and PNP transistor:** **(1 Mark for each symbol)** 
g)	**Draw the symbol of zener diode and LED.**
Ans:	**Symbol of zener diode and LED:** **(1 Mark for each symbol)** 
h)	**Define Intrinsic and Extrinsic semiconductor.**
Ans:	**Intrinsic semiconductor-** **(1 Mark for definition)** The semiconductor which is in purest form like Si, Ge (without trivalent or pentavalent impurities/ doping) is called “Intrinsic semiconductor.” **Extrinsic semiconductor-** **(1 Mark for definition)** The semiconductor which is having doping of trivalent materials (Boron , Aluminium) or pentavalent materials (Phosphorus , Arsenic) is called “Extrinsic semiconductor.”

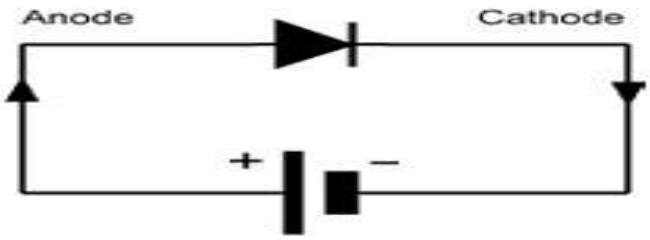
i)	**Draw VI characteristics of zener diode.**
Ans:	**VI characteristics of zener diode:** **(2 Marks)** 
j)	**Draw the symbol of SCR and TRIAC.**
Ans:	**Symbol of SCR and TRIAC:** **(1 Mark for each symbol)** 
k)	**List any two applications of TRIAC.**
Ans:	**Two applications of TRIAC:** **(2 Marks for any 2 applications)** 1. light dimmers 2. speed controls for electric fans 3. electric motors 4. AC power control

Q.5	Attempt any FOUR of the following: 16 Marks
a)	**Draw construction and explain working of PN junction diode in forward bias.**
Ans:	**onstruction of PN junction diode: -** **(2 Marks for construction & 2 Marks for working)**



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

Working of Diode when Forward Biased:-



When anode of the diode is connected to the +ve terminal of the dc supply and the cathode is connected to the –ve terminal, the diode is said to be Forward biased. When sufficient forward voltage is applied, the electrons from N region move towards the P region and the holes in the P region also move towards the N region. Due to this the barrier potential at the P-N junction goes on decreasing and finally becomes zero. Then the electrons from N region can cross the junction and recombine with the holes in the P region. Thus the forward current (IF) start to flow through the diode from anode to cathode. The minimum forward voltage at which the current(IF) starts to increase rapidly is called knee *voltage*. After this, the voltage drop across the diode remains constant and the current goes on increasing if the supply voltage is increased.

b)	**Define: (i) Conductor (ii) Semiconductor (iii) Insulator**
Ans:	**(i) Conductor :** **(2 Mark)**

A conductor is an object or type of material that allows the flow of electrical current in one or more directions. It offers ideally 0Ω resistance. OR In terms of energy band diagram, conductor means valency band and conduction band are overlapping each

other. Examples – Copper, ,Iron, Aluminium etc

(ii) 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 terms of energy band diagram, semiconductor means there is a small band gap present between valency band and conduction band.

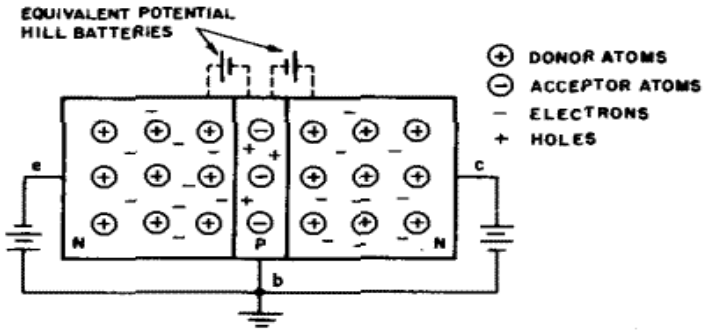
The conductivity can be selectively controlled by doping the material with an impurity. Examples- Silicon, germanium.

(iii) Insulator :- **(1 Mark)**

Any material that exhibits high resistivity to electrical current is known as an insulator, such as rubber, plastic, or wood. **OR** In terms of energy band diagram, insulator means there is a large band gap present between valency band and conduction band.

c) Draw and explain working of a NPN transistor.

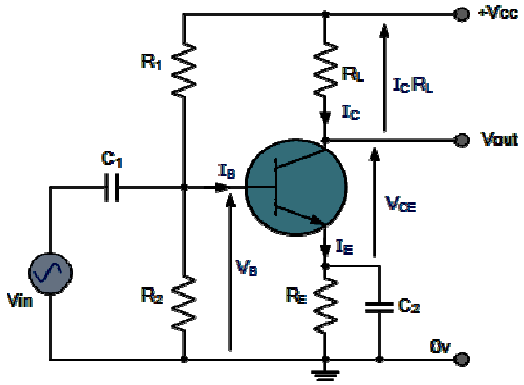
Ans: **Operation of NPN transistor-** **(2 Marks for diagram and 2 Marks for working)**



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 circuit diagram of single stage CE amplifier and state function of each component.**
Ans:	**Diagram :** **(2 Marks for diagram and 2 Marks for explanation)**



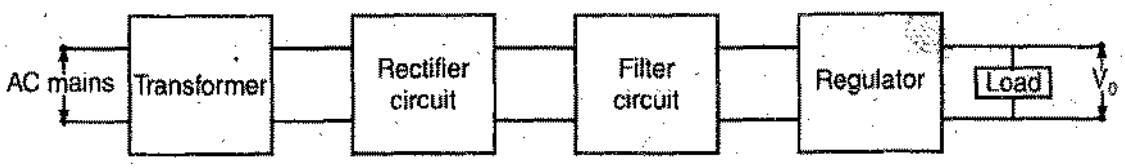
or equivalent fig

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.

- 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.

e)	**Draw the block diagram of regulated power supply and state function of each block in brief.**
Ans:	**(Block diagram-2 Mark & Function of each part-1/2 Mark)**

Basic block diagram of a regulated power supply :



OR any other equivalent diagram

Function of each block:

1) Transformer:

A Step down transformer is used to convert 230 V AC supply to required amount of AC supply (e.g. 5V, 9V, 12V, 24V).

2) Rectifier:

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction.

3) Filter:

A filter is used to remove unwanted AC components present on the output of rectifier.

4) Regulator:

It is used to maintain constant dc output voltage irrespective of change in input voltage or load resistance .

f) Describe De-morgan's Theorems

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)

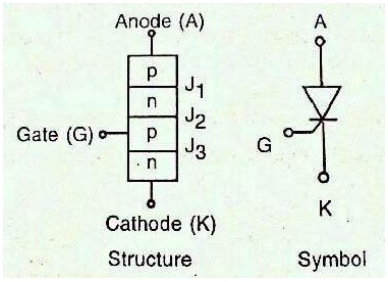
A	B	$\overline{A+B}$	$\bar{A}.\bar{B}$
0	0	1	1
0	1	0	0
1	0	0	0
	1	0	0

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) **Describe the working of SCR with the help of a 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.

b) Describe the working of LED with the help of a neat sketch.

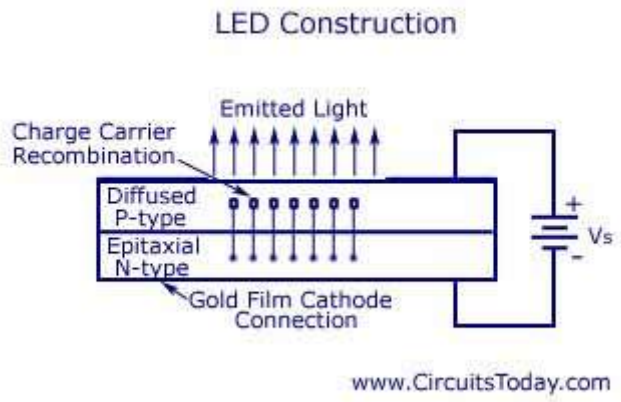
Ans:

Working of LED :- **(2 Mark)**

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 are holes 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

Diagram :- **(2 Mark)**



c) What is filter? State need of filter. List the types of filters.

Ans:

Definition of filter – **(1 Mark)**

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

Need of Filter:- **(Need-1 Mark & Types of filter -2 Mark)**

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

Types of filters:

i) Shunt capacitor filter

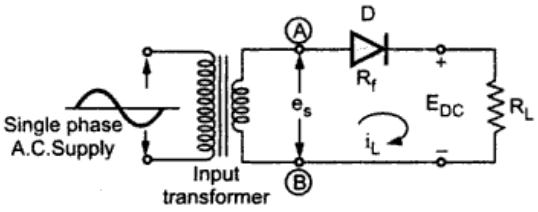
ii) Series inductor filter

iii) LC Filter

iv) CLC or π filter

d) Draw circuit diagram of half wave rectifier explain working with their input and output waveforms.

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)**

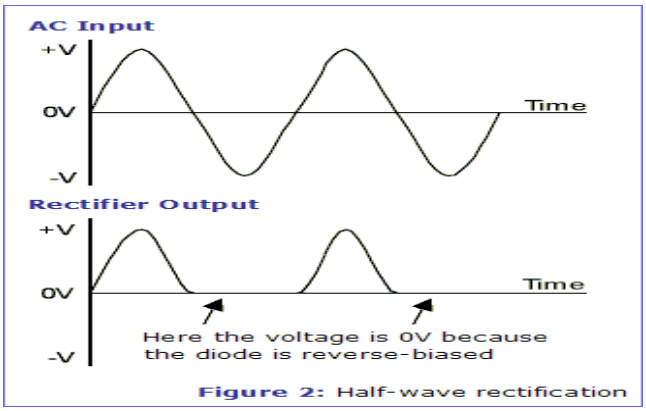
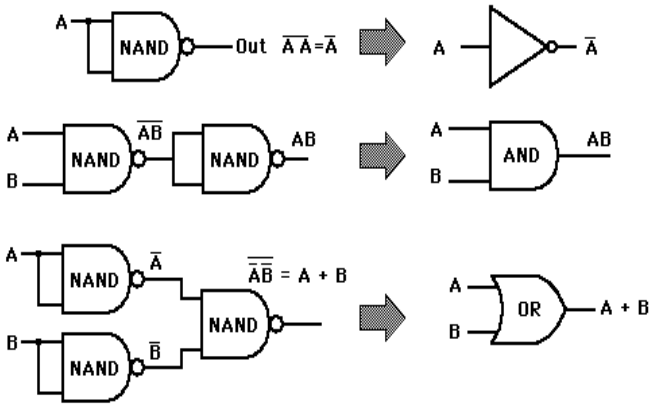


Figure 2: Half-wave rectification

e) Draw basic gates using NAND gate.

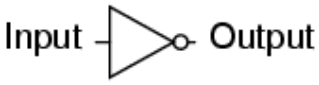
Ans: **Basic gates using NAND gates -** **(4 Marks)**



f) Draw symbol of NOT gate and EX-OR gate with their truth table.

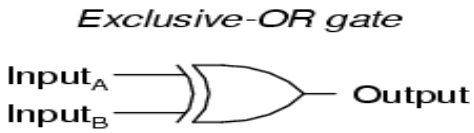
Ans: **Logic symbol and truth table of NOT Gate:** **(Symbol: 1 Mark, Truth table: 1 Mark)**

NOT gate truth table



Input	Output
0	1
1	0

Logic symbol and truth table of EX-OR Gate: **(Symbol: 1 Mark, Truth table: 1 Mark)**



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

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