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.
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) Some of the questions are not clearly indicative of the exact answer expected. In such cases, credit may be given by judgment of relevant answer based on candidate's understanding.

Page No: 1 to 21 Model Answer Paper Solution and Page No: 22 to 24 Question Paper & Summery of Marking Scheme

Q.1 a) Attempt any ten of the following: …… 20 Mark

a) Give the formula to find the equivalent resistance when three resistors R_1,R_2 and R_3 are connected in parallel ----------(2 Marks)

$$\frac{1}{R_T}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$$ **OR**

$$R_T=\frac{R_1R_2R_3}{R_1R_2+R_2R_3+R_3R_1}$$

b) Define current and resistance with unit (For each Definition 1/2 mark &each unit 1/2 mark)

i) Current:-

Current is defined as the movement of electrons or flow of electrons inside a conducting material. It is denoted by I and measured in ampere.----------**(1/2 marks)**

OR $I=Q/t$

Where,

I = Average current in amperes
Q = Total charge flowing
T = Time in seconds required for the flow of charge

Units :– *Amperes* .----------**(1/2 marks)**

ii) Resistance-

It is defined as the opposition offered by a conductor to the flow of current. It is represented by R & its unit is ohm (Ω). .----------**(1/2 marks)**

OR The formula for resistance is given by

$R = \rho \times (l/a)$ OR $R = V/I$

Where ρ= resistivity of conducting material
l= length of conducting material
a= area of cross section of conductor

Unit :- Ohm (Ω).----------**(1/2 marks)**

c) What is an short circuit?---------- (2 Mark)

- When phase and neutral wire touches then short circuit takes place. **OR**
- When different phases (R, Y, B) touches each other then short circuit takes place **OR Equivalent**

d) State kirchhoff's current law. ----------(2 Marks)

It states that the sum of currents directed into any node in a circuit is equal to the sum of the currents coming out of the same node.

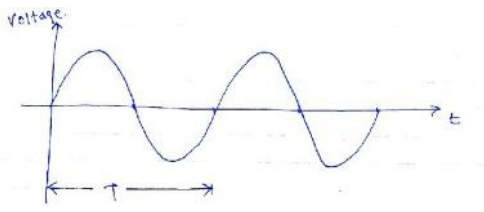
$\Sigma_{Node\ n}$ *currents entering node* $n = \Sigma_{Node\ n}$ *currents out co* min *g node n* **OR**

The total sum of all the branch currents in a parallel circuit must be exactly equal to the source current **OR** algebraic sum of all currents entering or leaving a node must be equal to zero.

$\therefore \Sigma I = o$

e) Define time period ----------(2 Mark)

Time Period (T) :- Time period is defined as the time taken in second by the waveform for an ac quantity to complete one cycle. **OR** T= 1/f



or Equivalent fig.

f) State the line and phase relationship in a delta connected load.---------- (2 Marks)

Line & phase relationship in delta connected:-

$V_L = V_{ph}$ *where* V_L *is line voltage and* V_{ph} *is phase voltage* .----------**(1marks)**

$I_L = \sqrt{3}\ I_{ph}$ *OR* $I_{ph} = I_L / \sqrt{3}$ *where* I_L *is line Current and* I_{ph} *is phase Currnts* .**(1 marks)**

g) Define phase sequence in 3- phase a,c. supply. ----------(2 Marks)

The phase sequence is defined as the sequence in which the three phases reaches their maximum positive values. There are two types of phase sequences.

Positive Phase sequence and Negative Phase sequence.

Normally the phase sequence is positive R-Y-B **OR**

Phase sequence is the sequence is which the currents or voltage in the 3-phase attain their peak position with particular reference of time e.g R,Y,B

h) Define voltage ratio and transformer ratio. **(Each definition 1 Mark)**

Voltage Ratio:- ----------(1 Marks)

It is the ratio of primary voltage to secondary voltage.

$$Voltage\ ratio = \frac{V_1}{V_2}$$

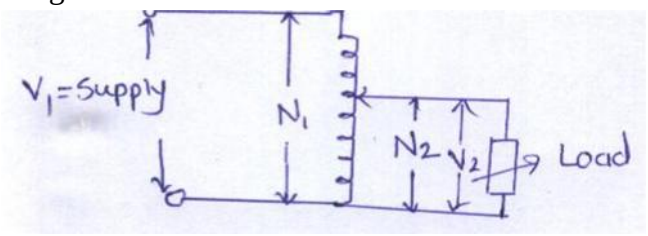
Transformation Ratio (k):- ----------(1 Marks)

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

$$Transformation\ \ ratio\ (k) = \frac{N_2}{N_1}\ or = \frac{E_2}{E_1}\ or = \frac{V_2}{V_1}\ or = \frac{I_1}{I_2}$$

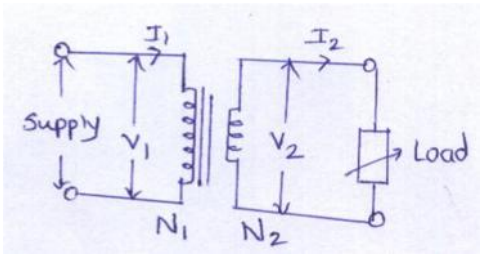
i) Which type of transformer has no electrical isolation? ----------(2Mark)

Single winding transformer or auto transformer has no electrical isolation between primary & secondary winding.



or Equivalent fig.

j) What is meant by step down transformer? ---------- (2Mark)



or Equivalent fig.

A transformer which reduces the supply voltage i.e a transformer whose secondary voltage is less than primary voltage is called step down transformer.

$V_2 < V_1$ or $N_2 < N_1$ in case of step down transformer

k) What would be the possible reasons if a split-phase motor runs too slow?

(Any two of the following reasons 1 Mark for 1 Reason)

Reasons if a split-phase motor runs too slow:-

- Over Load
- Broken Rotor Bars
- Shorted Stator Currents
- Low Voltage
- Low frequency

l) Which one of the following 1-phase induction motor has highest starting torque?

1) Split-phase1-phase motor. 2) Capacitor start induction run motor (2 Mark)

Highest Staring Torque:- Capacitor Start induction run motor has highest starting torque as compare to split phase single phase motor.

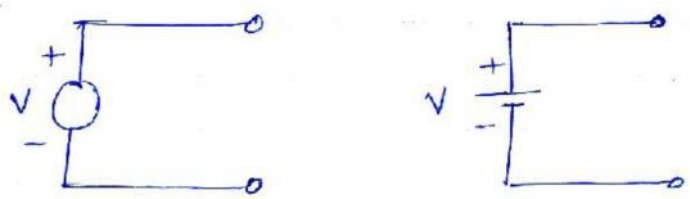
Q.2 Attempt any Four of the following: ----------16 Marks

a) Define ideal and practical voltage source. Draw their symbolic representation.

(1 mark meaning & 1 mark figure from Each voltage source)

i) Ideal voltage source- **(Figure: 1 Mark & Explanation 1 Mark)**

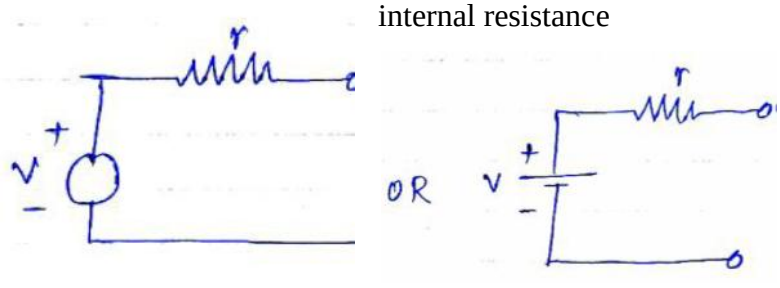
Ideal voltage source is voltage source whose magnitude remains constant with the change in load current. It has zero internal resistance.



or Equivalent fig.

ii) Practical voltage source- **(Figure: 1 Mark & Explanation 1 Mark)**

Practical voltage source is voltage source whose magnitude changes with the change in load current. It has finite value of internal resistance. Here, r = internal resistance



or Equivalent fig.

b) State & Explain Kirchhoff's voltage Law. (Statement 2 marks Explanation 2 marks)

Kirchhoff's Voltage Law:-

It states that, algebraic sum of voltage in loop or mesh is equal to zero.

Σ voltage =0

OR

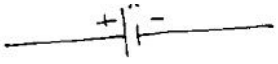
It states that in any closed loop the algebraic sum of potential rise is equal to algebraic sum of potential drop.

Σ Rise in voltage = Σ Fall in voltage

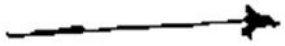
Sign convention for KVL

1. All loop taken in clockwise direction
2. While moving in a loop. If we cross the battery then the magnitude of voltage is the value of battery & polarity is,

a. Negative (potential drop), if positive plate is crossed first & then negative plate

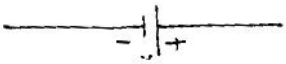


Voltage is negative i.e. -ve



Direction of movement in loop

Positive (potential rises), if negative plate is crossed first & then positive plate



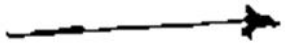
Voltage is positive i.e.+ve

→Direction of movement in loop

3. While moving in loop , if we cross a resistor the magnitude of voltage is product of current & resistance of resistor i.e. I*R . the polarity is

a. Negative if the direction of current in that resistor is same as direction of movement in loop.

Voltage is negative i.e.-IR

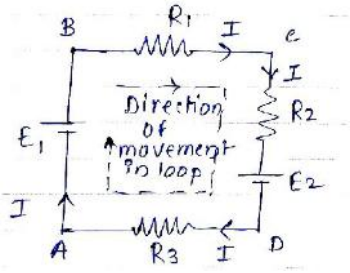


Direction of movement in loop

b. Positive if the direction of current in that resistor is opposite to direction of movement in loop.

Voltage is positive i.e.+ IR

Direction of movement in loop



Apply KVL to loop ABCDA

$\therefore + E_1 - IR_1 - IR_2 - E_2 - IR_3 = 0$

$E_1 = IR_1 + IR_2 + E_2 + IR_3$

We can conclude that

Σ Rise in voltage = Σ Fall in voltage

c) State the four advantages of A.C over D.C

(Any four points or other similar points should be consider 1 Mark each point)

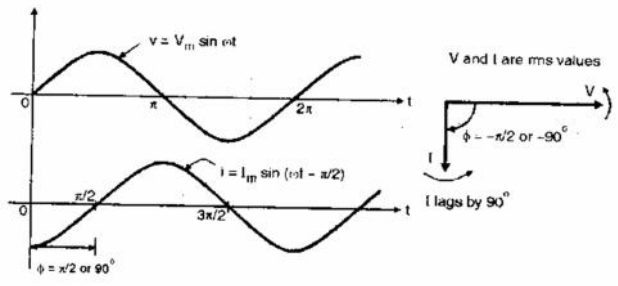
Following are the advantages of AC over DC :- ----------(1 Mark to each point)

- Step of AC voltage is simple
- It is possible to generate very large amount of power by using thee phase A.C.
- In ac system we can use transformers to reduce or increase the voltage levels. Transformers cannot be used in the DC circuits,
- The distribution of AC voltage is more efficient than the distribution of DC voltage. This is because distribution at higher level is possible.
- The construction of AC machines is simpler as compared to that of DC machines.
- .cost of A.C. sub-station is less than D.C. sub-station.
- Losses in A.C. sub-station is less than D.C. sub-station.
- Starting efficiency of A.C. is more than D.C. since voltage is reduced by transformer & in case of D.C. voltage is reduced by series resistance.
- Power loss can be reduced by increasing transmission voltage with the help of transformer.

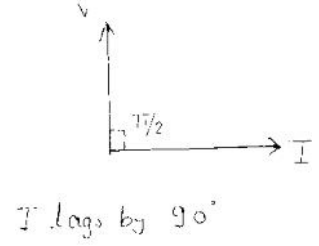
d) With the help of waveforms and phasor diagrams, show the phase relationship between voltage and current in pure inductive and capacitive circuit.

(Phasor Diagram 1 Marks & Wave form 1 Marks)

i) Phasor Diagram & relationship between Voltage & current in pure inductive Circuit :-



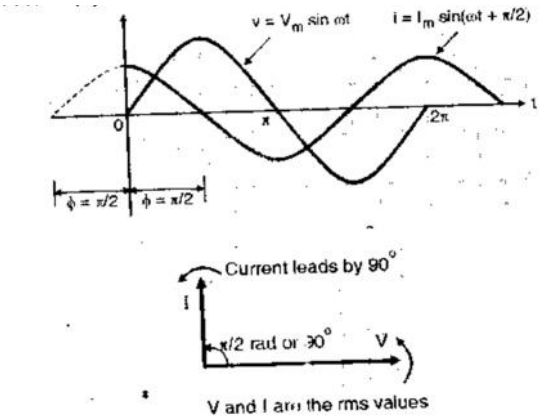
OR

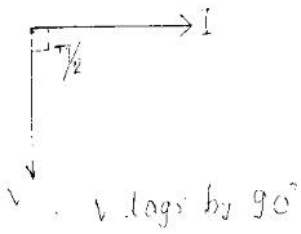


or Equivalent fig.

(Phasor Diagram 1 Marks & Wave form 1 Marks)

ii) Phasor Diagram & relationship between Voltage & current in pure Capacitive Circuit :-





OR **or Equivalent fig.**

e) What are the advantages of 3-phase system over 1-phase system?

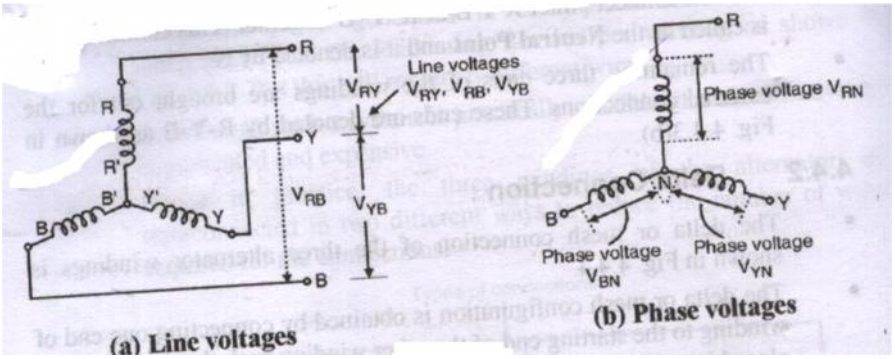
(Any four points or other similar points should be consider)

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

1. For the same size output of poly-phase machines is always higher than single phase machines.
2. For producing same output the size of three phase machines is always smaller than that of single phase machines.
3. It is possible to transmit more power using a three phase system than single system.
4. 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.

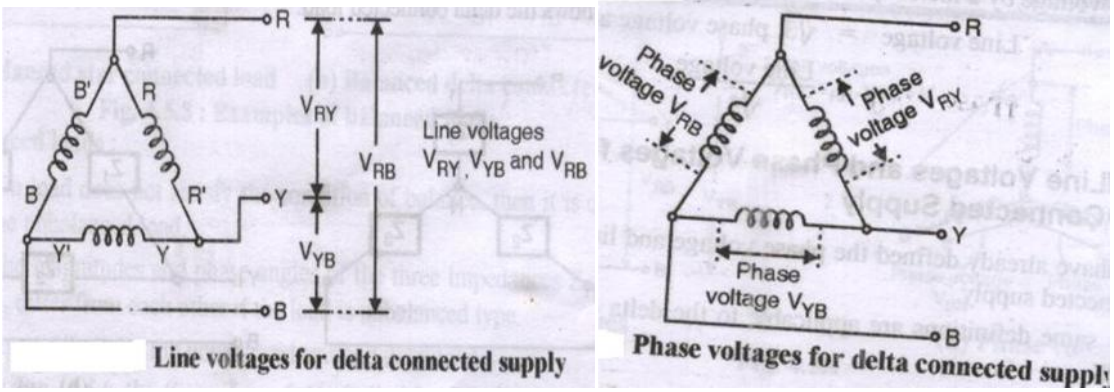
f) Draw diagrams for 3-phase star and delta connected system by showing with line and phase voltage. **(Star System 2 Mark & Delta System 2 Mark)**

3-Phase Star Connected system with line and phase voltage :- ---------- (2 Mark)



or Equivalent fig.

3-Phase Delta Connected system with line and phase voltage :- ----------(2 Mark)



or Equivalent fig.

Q.3 Attempt any Four of the following: ----------16 Marks

a) Define R.M.S. Value and Average Value.(For each definition 2 marks)

i) R.M.S Value:---------- (2 Mark)

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

$\therefore$ RMS Value = Form Factor $\times$ Average Value **OR**

RMS Value = 0.707$\times$ maximum value

ii) Average Value:----------(2 Mark)

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

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

AVERAGE Value = 0.637× maximum value

b) Define Active, Reactive and Apparent power with its unit. **(Definition 3 Marks & units 1 Marks)**

i) Active Power (P):-

The active power is defined as the average power P_{avg} taken by or consumed by the given circuit. **OR**

It is given by $P = V.I.Cos¤\ watt$ **Unit :-** Watt **OR** Kwatt

ii) Reactive Power (Q):-

The reactive power is defined as the product of V, I and sine of angle between V and I i.e. ¤

The reactive power is also called as imaginary power.

It is given by Q= V.I. sin ¤ **Units :-** VAR **OR** KVAR

iii) Apparent Power (S) :-

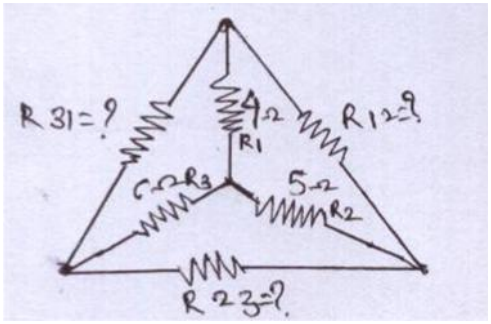
Apparent power is defined as the product of rms values of voltage (v) and current (I) it is given by

S=V.I OR $\sqrt{P^2+Q^2}$ **Units :-** VA **OR** KVA

c) Three resistances of 4, 5 and 6 ohms are connected in star convert it to equivalent delta.

(Step wise mark as shown solution)

Step I:-



$$R_{12} = R_1 + R_2 + \frac{R_1R_2}{R_3} = \frac{R_1R_2 + R_2R_3 + R_1R_3}{R_3}$$ ----**(1 Mark)**

$$R_{12} = 4 + 5 + \frac{4\times5}{6} = 12.33\,\Omega$$ ----------**(1 Mark)**

$$R_{23} = 5 + 6 + \frac{5\times6}{4} = 18.5\,\Omega$$ ----------**(1 Mark)**

or Equivalent fig.

$$R_{31} = 6 + 4 + \frac{6\times4}{5} = 14.8\,\Omega$$ ----------**(1 Mark)**

$R_{12} = 12.33\,\Omega$ $R_{23} = 18.5\ \Omega$ $R_{31} = 14.8\,\Omega$

d) What is the impedance of an a.c. circuit? What is its unit? State the factors on which it depend. (For definition 2 mark &unit 1 mark & factor 1 mark)

Impedance (Z):----------(2 Marks)

Impedance is defined as the total opposition offered by the circuit to the flow of alternating current. **OR**

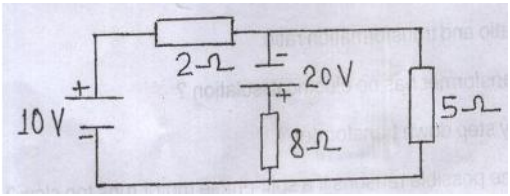
The combine effect of resistance and reactance is called as impedance.

Unit:- It is represented by Z. its unit is ohms.----------**(1 Mark)**

Factors on which is depend:----------(1 Mark)

Voltage, Current, Resistance, Inductive reactance, capacitive reactance. & P.F.

e) For the network shown in fig. No.1, Write equations only to solve this network using Maxwell's loop analysis method. (Step-I 2 Mark & Step-II 2 Mark as shown solution)

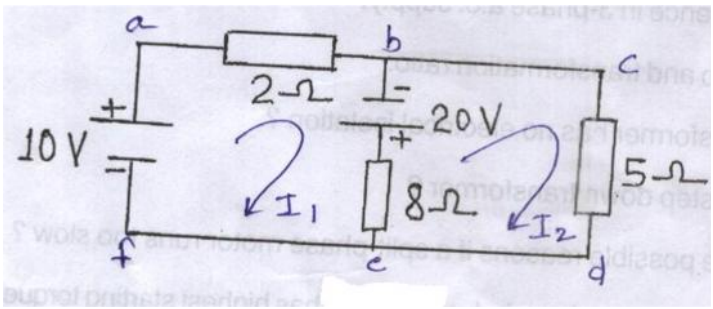


Step I :- For loop 1 (a b e f) applying KVL :----------**(2 Marks)**

$\therefore\ 10 - 2\ I_1 + 20 - 8\ (I_1 - I_2) = 0$ **OR**

$\therefore\ 30 - 10\ I_1 + 8\ I_2 = 0$ **OR**

$\therefore\ -10\ I_1 + 8\ I_2 = -30$



Step II :- For Loop 2 (b c d e) applying KVL ----------**(2 Marks)**

$\therefore\ -5\ I_2 - 8\ (I_2 - I_1) - 20 = 0$ **OR**

$\therefore\ -13\ I_2 + 8\ I_1 - 20 = 0$ **OR**

$\therefore\ 8\ I_1 - 13\ I_2 - 20 = 0$ **OR**

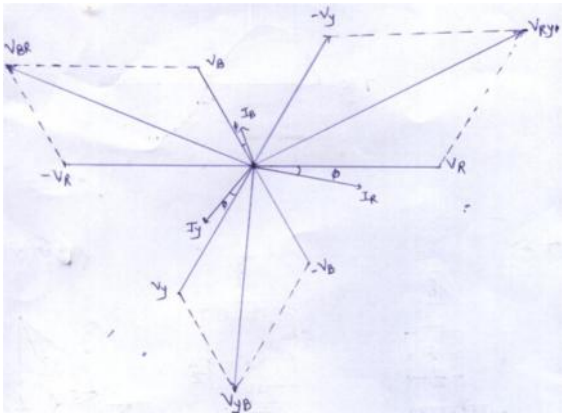
$\therefore\ 8\ I_1 - 13\ I_2 = 20$

f) What is the effect of unbalanced load on a 3-phase system, represent it with a vector diagram. (Any Two points or other similar points should be consider Effect 2 Mark & Vector diagram 2 Mark)

Effect of unbalance load on a 3-Ph System:- ----------(2 Marks)

1. Voltage drop in each line R, Y, B is different.
2. So voltage at terminal point between two lines V_{RY} not equal to V_{YB} not equal to V_{BY}.
3. Due to unbalance voltage ,equipment or machines performance gets affected.
4. If unbalance is beyond limit machines or equipment gets heated.

Vector Diagram for unbalanced load:- ----------(2 Marks)



or Equivalent fig.

Q.4 Attempt any Four of the following: ----------16 Marks

a) Three resistors of 50 ohm are connected in delta across a 400V, 50Hz a.c supply. Calculate the line current, Phase current, Line voltage and phase voltage.(For each unknown 1 mark)

Given Data:-

R= 50 ohm V= 400V f = 50 Hz

i) Line Voltage (V_L) = 400V **----------(1 Marks)**

ii) Phase Voltage (V_{ph}):----------(1 Marks)

∴ In delta connection :- Line voltage V_L= Phase Voltage V_{ph}

$V_L = V_{ph}$

V_{ph} = 400 volt

iii) Phase Current (I_{ph}) :----------(1 Marks)

$$I_{ph} = \frac{V_{ph}}{R}$$

$$I_{ph} = \frac{400}{50}$$

$$I_{ph} = 8\ Amp$$

iv) Line Current (I_{ph}) :- ----------(1 Marks)

∴ In delta connection :- Line current $I_L = \sqrt{3}$ Phase Current I_{ph}

Line current $I_L = \sqrt{3} \times I_{ph}$

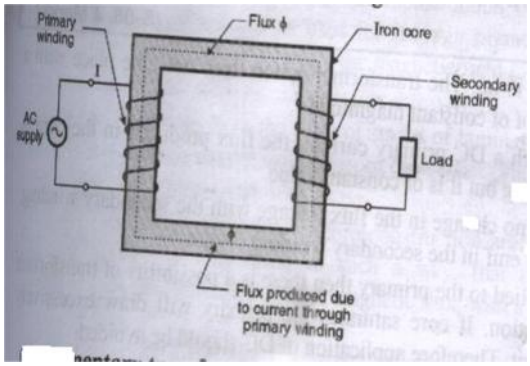
Line current $I_L = \sqrt{3} \times 8$

Line current $I_L = 13.8$ Amp

b) Draw a neat diagram of constructional details and state the principle of transformer.

(Constructional Details 2 Marks & Working 2 Marks)

Constructional diagrams of transformer:- ----------(2 Marks)



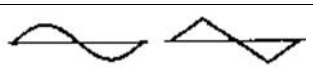
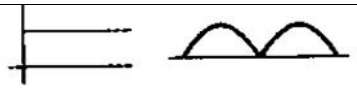
or Equivalent fig.

Working Principle: - ----------(2 Marks)

- The primary winding is connected to single phase AC supply. an ac current starts flowing through it.
- The AC primary current produces an alternating flux in the core.
- This Changes flux gets linked with the secondary winding through the core
- The varying flux will induce voltage into the secondary winding according to the faraday's laws of electromagnetic induction.

C) Compare D.C supply with A.C supply with the following parameters. ---------(4 Marks)

i) Waveform ii) Definition iii) Use of transformer iv) Application

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

d) Given Data :- **(Step wise mark as shown solution)**

V = 120 sin wt ----------i I = 2.5 sin ($wt + ®/2$)----------ii

To Find :- RMS =? Type of circuit?

Step-I:- To find max. value of voltage & current ; comparing equation I & ii with following equation iii & iv respectively

$\therefore v = V_m \sin wt$ iii

$\therefore i = I_m \sin wt$ iv

We get $V_m = 120\ volt$ $I_m = 2.5\ Amp$ ----------**(1 Marks)**

Step-II:- To find RMS value of voltage:

$\therefore V_{rms} = 0.707 \times V_m$

$\therefore V_{rms} = 0.707 \times 120$

$\therefore V_{rms} = 84.84\ volt$ ----------**(1 Marks)**

Step-III:- To find RMS value of current:

$\therefore I_{rms} = 0.707 \times I_m$

$\therefore I_{rms} = 0.707 \times 2.5$

$\therefore I_{rms} = 1.7675\ Amp$ ----------**(1 Marks)**

Step-IV:- From equation I & ii it clear that current is leading by angle $®/2$ to the voltage, So the circuit is purely capacitive ----------**(1 Marks)**

e) A balanced 3-Phase delta connected load having impedance per phase of (3+j4) is connected to 3-phase, 400V, 50 Hz, a,c supply. Calculate: i) Phase current ii) Line current iii) Power factor iv) Total power consumed.

(For steps 1/2 marks and final answer 1/2 mark for each unknown)

Given Data :

Impedance = 3+j4 ph = 3-ph V= 400V f = 50 Hz

i) Phase current = $\frac{V}{Z}$ ----------**(1/2 Marks)**

Phase current = $\frac{400}{3 + j4}$

(3+j4) rectangular to polar

$$r = \sqrt{3^2 + 4^2} \quad = \quad r = \sqrt{9+16}$$

$$r = \sqrt{25}$$

$$r = 5$$

$$¤ \; = \; \tan^{-1}\frac{x}{R} \; = \; \tan^{-1}\frac{4}{3} \; = \; 53.13$$

$$Z = r\angle ¤ \; = 5\angle 53.13^0$$

$$\text{Phase current } I_{ph} = \frac{400}{5\angle 53.13} 80\angle -53.13^0$$

$$I_{ph} = 80\angle -53.13^0 \; Amp$$ ----------(1/2 Marks)

ii) Line current (I_L) = $I_{ph}\sqrt{3} = 80\angle -53.13^0 \times \sqrt{3}$ ----------(1/2 Marks)

$$I_L = 138.56 \quad Amp$$ ----------(1/2 Marks)

iii) Power Factor:- $\cos ¤ = \cos 53.13 \; lag$ ----------(1/2 Marks)

$$\cos ¤ = 0.6 \; \; lag$$ ----------(1/2 Marks)

iv) Total Power consumed:- $\sqrt{3} \times VICos ¤$ ----------(1/2 Marks)

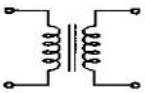
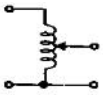
$$\sqrt{3} \times 400 \times 138.56 \times 0.6$$

$$Power \; \; consumed \; \; p = 57598.31 \; \; watt$$

$$Power \; \; consumed \; \; P = 57.598 \; KW$$ ----------(1/2 Marks)

f) Differentiate between two winding transformer and autotransformer on any four points.

(Any four points expected each point 1 Mark)

Sr no.	Points	Two winding transformer	Autotransformer
1.	**Symbol**		
2.	**Number of windings**	It has two windings	It has one winding
3.	**Copper saving**	Copper saving is less	Copper saving takes more as compared to two winding
4.	**Size**	Size is large	Size is small
5	**cost**	Cost is high	Cost is low
6	**Losses in winding**	More losses takes place	Less losses takes place
7.	**Efficiency**	Efficiency is low	Efficiency is high
8.	**Regulation**	Regulation is poor	Regulation is better
9.	**Electrical isolation**	Electrical isolation is present in between primary and secondary winding	There is no electrical isolation
10.	**Movable contact**	Movable contact is not present	Movable contact is present
11.	**Application**	Mains transformer, power supply, welding, isolation transformer	Variac, starting of ac motors, dimmerstat.

Q.5 Attempt any Four of the following:

a) Given Data :- **(Step wise mark as shown solution)**

N_1 = 1000 turns N_2 = 400 turns V_1 = 1250 V f = 50 Hz

e.m.f equation E_2 = ? A= 60 cm^2

i) The emf on the secondary side :-

transformer ratio (k) = $\frac{N_2}{N_1} = \frac{1000}{400}$

$k = 2.5$ ----------**(1 Marks)**

$$\frac{e_2}{e_1} = \frac{N_2}{N_1} = k$$

$$e_2 = e_1 k$$

$$e_2 = 1250 \times 2.5$$

$e_2 = 3125 Volts$ ----------**(1 Marks)**

To find flux density :-

$$e_2 = 4.44 \times f \times ¤_m \times N_2$$

$$3125 = 4.44 \times 50 \times 400 \times ¤_m$$

$$¤_m = \frac{3125}{4.44 \times 50 \times 400}$$

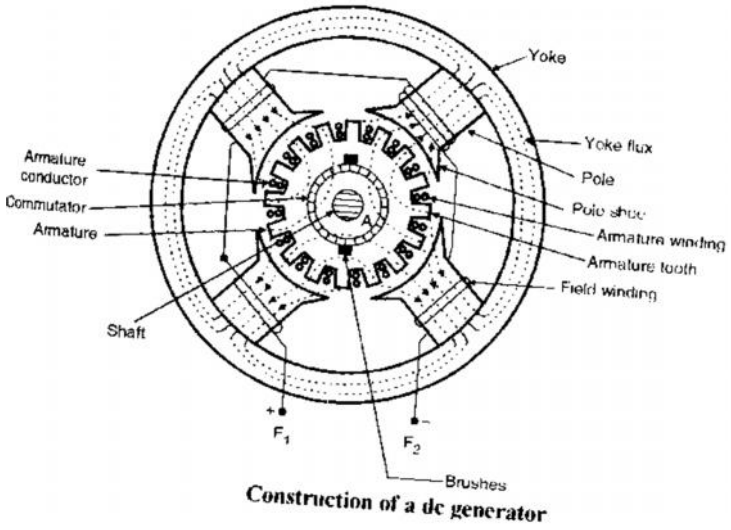
$¤_m = 0.0351\ wb$ ----------**(1 Marks)**

ii) Peak value of flux density :- take effective area of core is 60 cm^2

$$B_m = \frac{¤_m}{A} \quad \frac{0.0351}{60}$$

$B_m = 5.865\ wb/cm^2$ ----------**(1 Marks)**

b) Draw the constructional diagram of a D.C machine and label its parts. ----------(4 Marks)

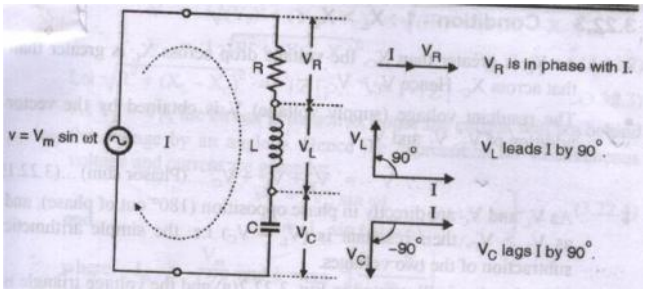


Construction of a dc generator

or Equivalent fig.

c) Draw a R-L-C series circuit. Draw the vector diagram. Also write equation.
(For R-L-C Series circuit 2 mark &vector diagram 1 mark & equation 1 mark)

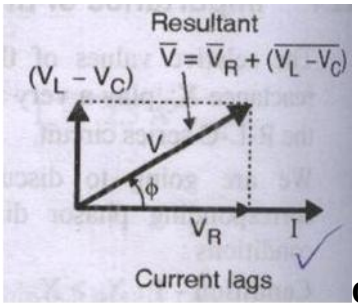
R-L-C Series circuit with vector diagram:----------(2 Marks)



or Equivalent fig.

(Note :- Any one vector diagram is expected from the following)----------(1 Marks)

Vector Diagram: $X_L > X_C$ (lagging) ii) $X_C > X_L$ (leading) iii) $X_L = X_C$ (unity)



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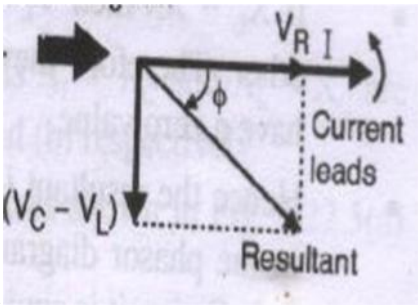

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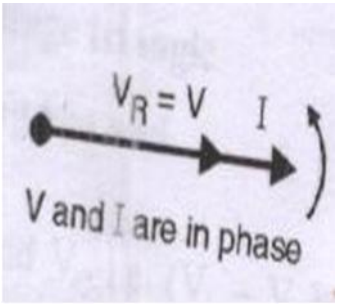


Equation of R-L-C (Note: - Any one equation is expected for the following-----(1 Marks)

Series circuit:----------(1 Mark)

i) $X_L > X_C$:- $\vec{V} = \vec{V}_R + (\vec{V}_L - \vec{V}_C)$; $I = \frac{V_m}{|Z|}$; ¤ $= \tan^{-1}(\frac{X_L - X_C}{R})$

ii) $X_C > X_L$:- $\vec{V} = \vec{V}_R + (\vec{V}_C - \vec{V}_L)$; ¤ $= \tan^{-1}(\frac{X_C - X_L}{R})$

iii) $X_L = X_C$:- $V = V_R$ *V & I in phase*

d) i) List different types of 1- phase induction motor. ii) Why 1-phase induction motor are not self starting.
[i)Types 2 mark & ii) reason 2marks]

i) Types of single phase induction motor- **(Any two types each type 1 Marks)**

1. Split phase induction motor.
2. Capacitor starts induction motor.
3. Capacitor start, capacitor run induction motor.
4. Shaded Pole induction Motor.

ii) Why 1-phase induction motor are not self starting:----------(2 Marks)

- When single phase AC supply is given to main winding it produces alternating flux.
- According to double field revolving theory, alternating flux can be represented by two opposite rotating flux of half magnitude.
- These oppositely rotating flux induce current in rotor & there interaction produces two opposite torque hence the net torque is Zero and the rotor remains standstill.

Hence Single-phase induction motor is not self starting.

e) What is necessity of earthing? State type of earthing. (Necessity 2 Marks & Type 2 Marks)

Necessity of Earthing:- ----------(2 Marks)

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

Types of Earthing:- **(Type of earthing expected any two each type 1 Mark)**

i) Plate Earthing.

ii) Pipe Earthing

iii) Rod Earthing.

iv) Earthing through water pipe mains

v) Horizontal strip Earthing

f) What is stepper motor? State its any two applications (Explanation 2 Mark & application 2 Mark)

Stepper Motor:- ----------(2 Marks)

- A stepper motor is basically an electromagnetic transducer or an incremental actuator which converts digital pulse into inputs into output shaft motion.
- The essential property of stepper motor is its ability to translate switched excitation into presizely defined increment of output shaft motion.

Application of Stepper Motor:- ----------(Any Two application each application 1 Marks)

In robotics & CNC machines

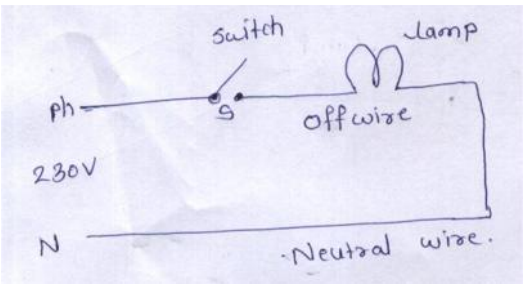
1. In computers, printers, tape recorder etc
2. Radar, satellite communication system
3. Biomedical application such as X ray machines, CT scan system
4. Position control system
5. CNC control of machine tools
6. Process control system
7. XY recorder & plotter
8. Watches

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

a) Draw the following simple control circuit in domestic installation.

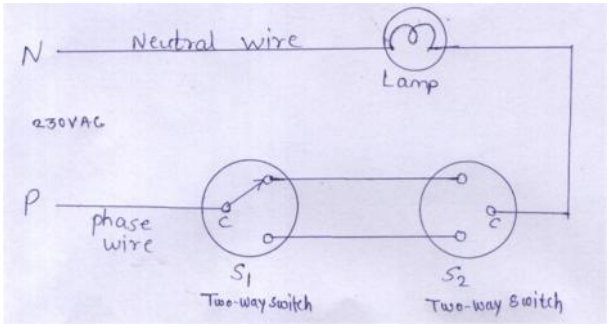
i) Control of one lamp from one point. ii) Control of one lamp from two point (Staircase wiring) (Each control diagram 2 Marks)

i) Control of one lamp from one point:----------(2 Marks)



or Equivalent fig.

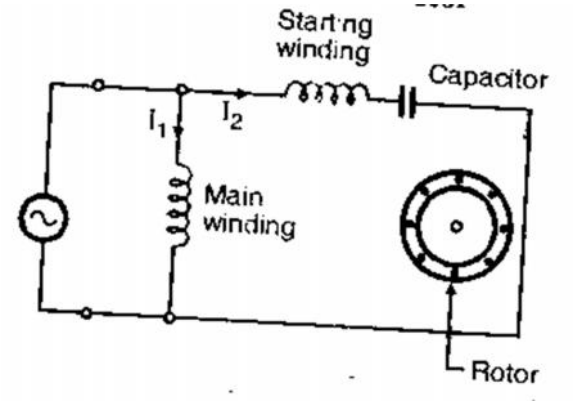
ii) Control of one lamp from two point (Staircase wiring) :- ----------(2 Marks)



or Equivalent fig.

b) Draw a neat labeled diagram of capacitor-start capacitor run 1-phase induction motor. (4 Marks)

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



or Equivalent fig.

c) Explains the trouble shooting in supply boards, by various possible faults, their probable reasons and fault findings procedures.

Trouble shooting in supply boards is as follows- ----(Any two points/similar points each points 1 Marks)

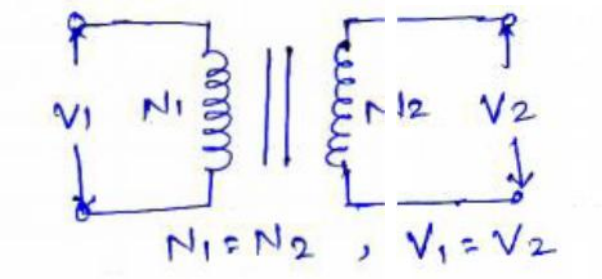
1. Connection may loose.
2. Switch terminals may loose.
3. Three plug points may not be property earthed.
4. Defective switch or plug.
5. Loose fixing of switch board by screw on wall.

Possible faults- 1.Open circuit fault----------**(2 Marks)**
2. Short circuit fault
3. Earth fault

Fault finding procedure----------**(1 Marks)**

1. By test lamp method (series lamp)
2. By use of tester.

d) Explain isolation transformer with function. ----(Figure 2 Mark & Explanation 2 Marks)

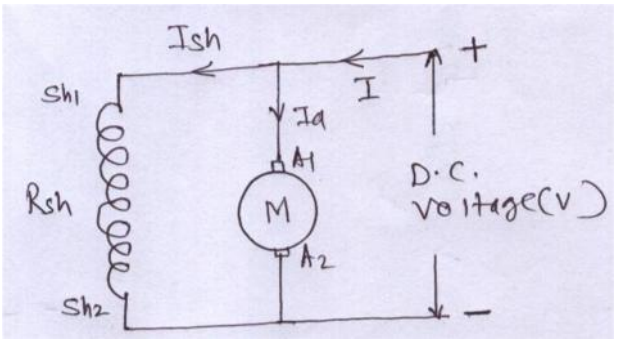


When number of turns of primary winding is kept equal to the number of turns in secondary winding that type of transformer is called as isolation transformer. That is $N_1=N_2$. hence in isolation transformation have 1 turns ratio . these transformer are used in power application to reduce the possibility of electrical shock from the equipments which has its chassis connected to one side of the 220V A.C.line.

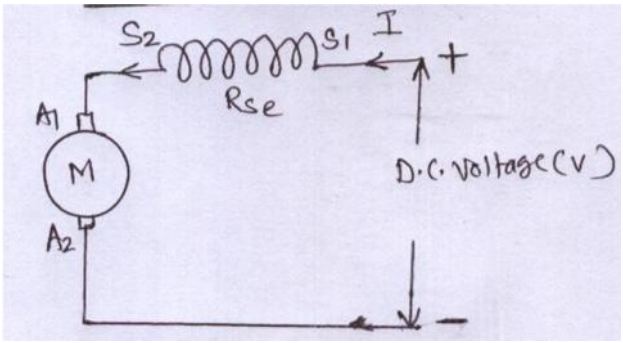
It is also used in audio frequency equipments to block direct current.

e) Represent D.C shunt and D.C Series Motors. Draw its sketches. Also give two applications of each type. (Each diagram 2 Marks and each two applications 2 Marks)

i) D.C Shunt Motor:-



ii) D.C Series Motor:-



or Equivalent fig.

Application of DC Shunt Motor: (Any two application are expected)

- For constant speed applications e.g. pumps, Laths, Vacuum cleaners, Blowers, Compressors, Wood planners, Milling machine, lifts, Grander. Paper making machine, Metal cutting machine

Application of DC Series Motor: (Any two application are expected)

- Where high starting torque is required such as e.g. Electric Traction, Hoists cranes, Conveyors belts, Rolling Mills,

f) i) Explain sockets in brief. ii) Various accessories used for any electrical installation

i) Sockets in brief. :- (Any two points/similar points each points 1 Marks)

- The body is made from Bakelite.
- Contacts are made from copper or brass.
- Sockets are Two pin or three pin.
- It is used to take the extension of supply with help of two pin or three pin top. E.g. Sockets are used for providing supply to the table lamp, fan, Charging the mobile etc. Every socket is controlled by a switch.

ii) Various accessories used for any electrical installation are as follows—

(Any two points/similar points each points 1 Marks)------(2 Marks)

i) Wires & Cables :
ii) Main switch & Distribution Boards:
iii) Conduits : PVC Pipe & Casing Capping
iv) Fuse :-
v) Energy Meter:
vi) Switches :- One way & Two switch
vii) Sockets outlet
viii) Ceiling rose, conduits junction
ix) Lamp Holder :- Batten holder & pendent holder, Angle holder
x) MCB
xi) Screw, grip, Steel grip

THE END

Next Pages are Page No. 22 to 24 Question Paper & Summery of Marking Scheme

Question Paper & Summery of Marking Scheme

Q.1 a) Attempt any ten of the following: …… 20 Mark

a) Give the formula to find the equivalent resistance when three resistors R_1,R_2 and R_3 are connected in parallel ----------**(2 Marks)**

b) Define current and resistance with unit **(For each Definition 1/2 mark &each unit 1/2 mark)**

c) What is an short circuit?---------- **(2 Mark)**

d) State kirchhoff's current law. ----------**(2 Marks)**

e) Define time period ----------**(2 Mark)**

f) State the line and phase relationship in a delta connected load.---------- **(2 Marks)**

g) Define phase sequence in 3- phase a,c. supply. ----------**(2 Marks)**

h) Define voltage ratio and transformer ratio. **(Each definition 1 Mark)**

i) Which type of transformer has no electrical isolation? ----------**(2Mark)**

j) What is meant by step down transformer? ---------- **(2Mark)**

k) What would be the possible reasons if a split-phase motor runs too slow?

(Any two of the following reasons 1 Mark for 1 Reason)

l) Which one of the following 1-phase induction motor has highest starting torque?

1) Split-phase1-phase motor. 2) Capacitor start induction run motor **(2 Mark)**

Q.2 Attempt any Four of the following: ----------16 Marks

a) Define ideal and practical voltage source. Draw their symbolic representation.

(1 mark meaning & 1 mark figure from Each voltage source)

b) State & Explain Kirchhoff's voltage Law. **(Statement 2 marks Explanation 2 marks)**

c) State the four advantages of A.C over D.C

(Any four points or other similar points should be consider 1 Mark each point)

d) With the help of waveforms and phasor diagrams, show the phase relationship between voltage and current in pure inductive and capacitive circuit.

(Phasor Diagram 1 Marks & Wave form 1 Marks)

e) What are the advantages of 3-phase system over 1-phase system?

(Any four points or other similar points should be consider)

f) Draw diagrams for 3-phase star and delta connected system by showing with line and phase voltage. **(Star System 2 Mark & Delta System 2 Mark)**

Q.3 Attempt any Four of the following: ----------16 Marks

a) Define R.M.S. Value and Average Value.**(For each definition 2 marks)**

b) Define Active, Reactive and Apparent power with its unit. **(Definition 3 Marks & units 1 Marks)**

c) Three resistances of 4, 5 and 6 ohms are connected in star convert it to equivalent delta.

(Step wise mark as shown solution)

d) What is the impedance of an a.c. circuit? What is its unit? State the factors on which it depend.
(For definition 2 mark &unit 1 mark & factor 1 mark)

e) For the network shown in fig. No.1, Write equations only to solve this network using Maxwell's loop analysis method. **(Step-I 2 Mark & Step-II 2 Mark as shown solution)**

f) What is the effect of unbalanced load on a 3-phase system, represent it with a vector diagram.
(Any Two points or other similar points should be consider Effect 2 Mark & Vector diagram 2 Mark)

Q.4 Attempt any Four of the following: ----------16 Marks

a) Three resistors of 50 ohm are connected in delta across a 400V, 50Hz a.c supply. Calculate the line current, Phase current, Line voltage and phase voltage. **(For each unknown 1 mark)**

b) Draw a neat diagram of constructional details and state the principle of transformer.
(Constructional Details 2 Marks & Working 2 Marks)

c) Compare D.C supply with A.C supply with the following parameters. ---------**(4 Marks)**

d) Given Data :- **(Step wise mark as shown solution)**

e) A balanced 3-Phase delta connected load having impedance per phase of (3+j4) is connected to 3-phase, 400V, 50 Hz, a,c supply. Calculate: i) Phase current ii) Line current iii) Power factor iv) Total power consumed.
(For steps 1/2 marks and final answer 1/2 mark for each unknown)

f) Differentiate between two winding transformer and autotransformer on any four points.
(Any four points expected each point 1 Mark)

Q.5 Attempt any Four of the following:

a) Given Data :- **(Step wise mark as shown solution)**

b) Draw the constructional diagram of a D.C machine and label its parts. ----------**(4 Marks)**

c) Draw a R-L-C series circuit. Draw the vector diagram. Also write equation.
(For R-L-C Series circuit 2 mark &vector diagram 1 mark & equation 1 mark)

d) i) List different types of 1- phase induction motor. ii) Why 1-phase induction motor are not self starting. **[i)Types 2 mark & ii) reason 2marks]**

e) What is necessity of earthing? State type of earthing. **(Necessity 2 Marks & Type 2 Marks)**

f) What is stepper motor? State its any two applications **(Explanation 2 Mark & application 2 Mark)**

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

a) Draw the following simple control circuit in domestic installation.

i) Control of one lamp from one point. ii) Control of one lamp from two point (Staircase wiring) **(Each control diagram 2 Marks)**

b) Draw a neat labeled diagram of capacitor-start capacitor run 1-phase induction motor.

(4 Marks)

c) Explains the trouble shooting in supply boards, by various possible faults, their probable reasons and fault findings procedures.

Trouble shooting in supply boards is as follows- ----**(Any two points/similar points each points 1 Marks)**

d) Explain isolation transformer with function. ----**(Figure 2 Mark & Explanation 2 Marks)**

e) Represent D.C shunt and D.C Series Motors. Draw its sketches. Also give two applications of each type. **(Each diagram 2 Marks and each two applications 2 Marks)**

f) i) Explain sockets in brief. ii) Various accessories used for any electrical installation

i) Sockets in brief. :- **(Any two points/similar points each points 1 Marks)**

ii) Various accessories used for any electrical installation are as follows—

(Any two points/similar points each points 1 Marks)------(2 Marks)

END