Important Instructions 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 principal components indicated in the 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 of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

1. a) Attempt any SIX of the following: Marks 12

i) State Ohm's law with its expression.

(Statement- 1 Mark, Expression – 1 Mark)

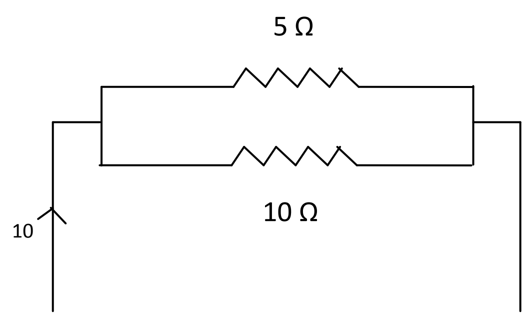
Ans: **Ohm's law** states that the current through a conductor between two points is directly proportional to the potential difference across the conductor provided temperature remains constant.

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

ii) A resistance of 10Ω is connected in parallel with 5Ω. If current through the combination is 10A. Calculate current through each resistance.

(Current through in each branch – 1 Mark)

Ans:



The current division formula finding for the current through 10 ohm Resistance

$$I_{10} = 10\ x\ \frac{5}{(10+5)} = \frac{50}{15} = 3.33Amp$$

So current the I5 = 10-3.33 = 6.67 Amp

iii) Define:

1) **E.M.F.**
2) **Potential difference.**

(Each definition – 1 Mark)

Ans: 1) E.M.F: Electromotive force, also called **emf** (denoted $\mathcal{E}$ and measured in volts), is the voltage developed by any source of electrical energy such as a battery or dynamo.

2) Potential difference: The amount of energy per unit charge needed to move a charged particle from a reference point to a designated point in a static electric field.

iv)Write formula for inductive reactance and capacitive reactance.

(Each formula – 1 Mark)

Ans: $X_L = 2\pi fL$

$X_C = \frac{1}{2\pi fc}$

v) Define:

1) **R.M.S. value**
2) **Form factor**

(Each definition – 1 Mark)

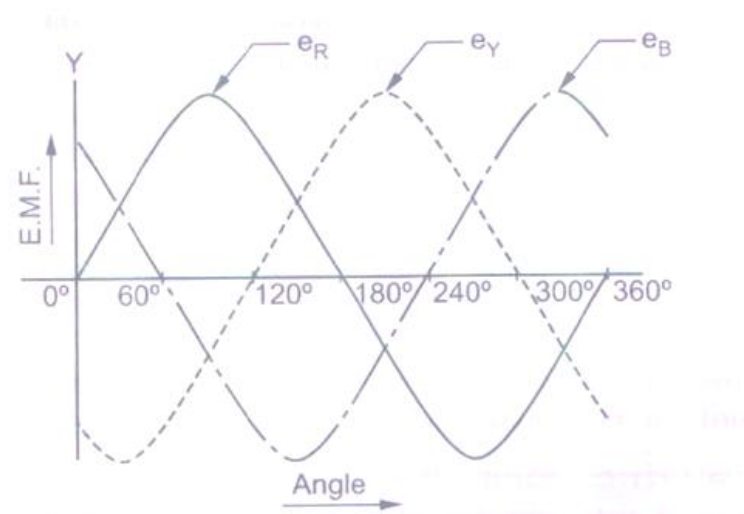
Ans: **1) R.M.S. Value** = The Effective or r.m.s value of an alternating current is given by that direct current which, when flowing through a given time produces the same amount of heat as produced by the alternating current when flowing through the same circuit for the same time.

2) Form Factor: The ratio of r.m.s value to average value is called the form factor of an alternating quantity. For sinusoidal current or voltage.

vi) Draw waveform representation of three phase supply with neat labels.

(Waveform -2 Marks)

Ans:



vii) State any two advantages of earthling.

(Each advantages- 1 Mark)

Ans: **1.** Protection of equipment and providing low resistance path to leakage current

2. To Safeguard the User from Electrocution or Shock.

viii) Give classification of fuses.

(Any 2 types: 2 Marks)

Ans: Types of fuses:

1) Dropout fuse
2) Kit-kat type
3) Expulsion fuse
4) H.R.C. fuse(High rupturing capacity)
5) Striker fuse
6) Switch fuse
7) Semienclosed or rewirable type.

ix) State Lenz's law.

Ans: Lenz's Law ***(2 Mark)***

Statement: The direction of Electromagnetic induced emf in such way that it opposes the basic cause of its induction.

OR

Direction of induced emf produced during the process of electromagnetic induction is always such way that it tends to setup a current opposing the basic cause responsible for induced emf.

b) Attempt any <u>TWO</u> of the following: Marks 8

i) State the type of single phase I.M. motor used in following applications:

1) Fan
2) Refrigerator
3) Food mixer
4) Hair dryers

(Each application -1 Mark)

Ans:
1) Fan: Resistance splite phase Motor
2) Refrigerator: Capacitor Splete Phase motor
3) Food mixer: Universal Motor
4) Hair dryers: Shaded pole Motor

ii) Give comparison of Auto-transformer with two winding transformer (any four points)

(Each point -1 Mark)

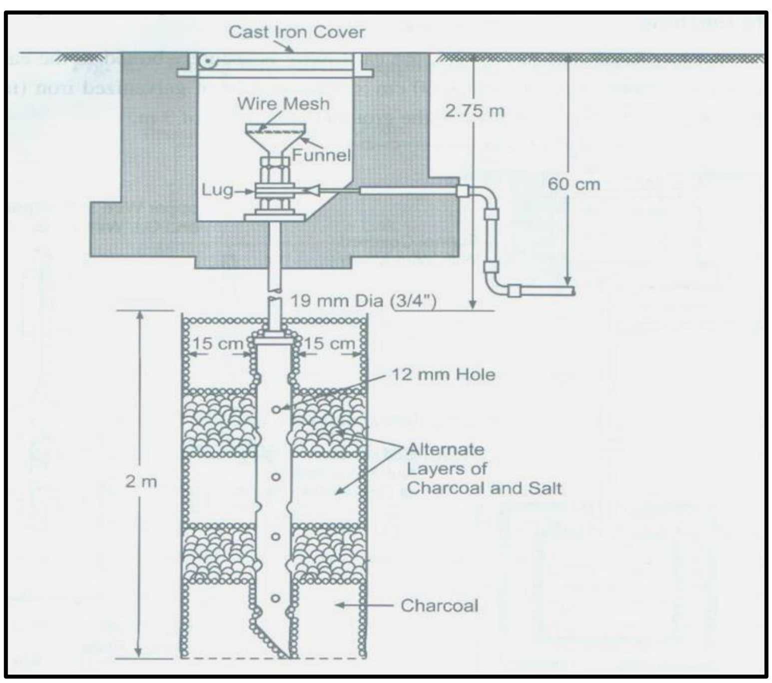
Ans:

Point	Two Winding Transformer	Auto transformer
Volume of copper required	More	Less
Cost	High	Low
Efficiency	Low	High
Application	Power supply, welding, Isolation Tr.	Variac, staring of A.C. motors, dimmer stat

iii) Explain with neat labelled diagram pipe earthing.

(Labeled diagram – 2 Marks, Explanation -2 Marks)

Ans:



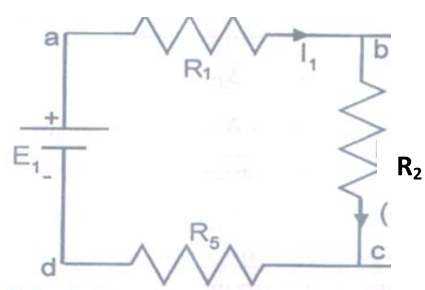
In this method the galvanized iron pipe of not less than 38.1 mm diameter and 2 m in length for ordinary soil and 2.75 m for dry and rocky soil is embedded vertically in the ground to work as earth electrode. The depth at which the pipe should be buried in the ground depends upon the soil condition the earth wire is fastened to the top section of the pipe with nut bolts. The pit area around the galvanized iron pipe is filled with alternate layers of salt and broken pieces of coke or charcoal. A funnel is fitted to the galvanized iron pipe at the top to pour salty water in the pit of earth electrode from time in the summer season as mentioned in the case of plate earting.

2. Attempt any FOUR of the following: Marks 16

a) With the help of simple circuit state and explain Kirchoff's voltage law.

(Statement – 1 Mark, Circuit – 1 Mark, Explanation -2 Marks)

Ans:



Statement: The algebraic sum of all the emf and voltage drop across each resistance over an entire loop is equal to zero.

for loop abcda

voltage drop across $R_1 = -I_1R_1$

voltage drop across $R_2 = -I_1R_2$

voltage drop across $R_5 = -I_1R_5$

$$-I_1R_1 - I_1R_2 - I_1R_5 + E_1 = 0$$

b) Determine the current in 2Ω resistance in Figure No. 1 using Mesh analysis.

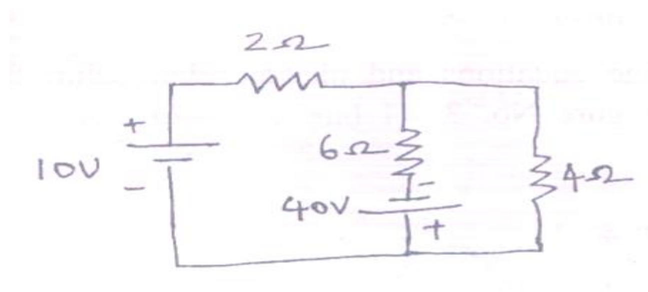
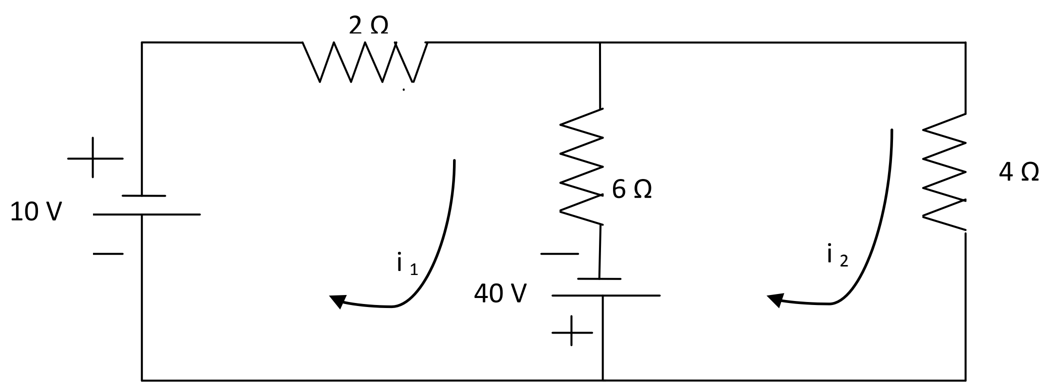


Fig. No. 1

(Loop Current direction – 1 Mark, equation for two loops- 2 Marks, Answer- 1 Mark)

Ans:



KVL in mesh loop equation 1.

$-2i_1-6(i_1-i_2)+40+10=0$

$50-2i_1-6i_1+6i_2=0$

$8i_1-6i_2=50$ ----------------1.

KVL in mesh loop equation 2.

$-6(i_2-i_1)-40-4i_2=0$

$-6i_2+6i_1-4i_2=40$

$-6i_1+10i_2= -40$ --------------2.

Solving equation 1. & 2.

$$\begin{bmatrix} 8 & -6 \\ -6 & 10 \end{bmatrix} \begin{bmatrix} i1 \\ i2 \end{bmatrix} = \begin{bmatrix} 50 \\ -40 \end{bmatrix}$$

Current flowing 2 Ω

$$i1 = \frac{\Delta 1}{\Delta}$$

$$\Delta = \begin{bmatrix} 8 & -6 \\ -6 & 10 \end{bmatrix}$$

= 80-36

= 44

$$\Delta_1 = \begin{bmatrix} 50 & -6 \\ -40 & 10 \end{bmatrix}$$

= 500-240

= 260

i_1 = 260/44

i_1= 5.9 Amp

c) Find equivalent resistance between A and B using star – delta conversion figure No. 2.

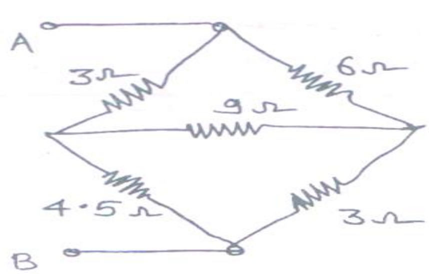
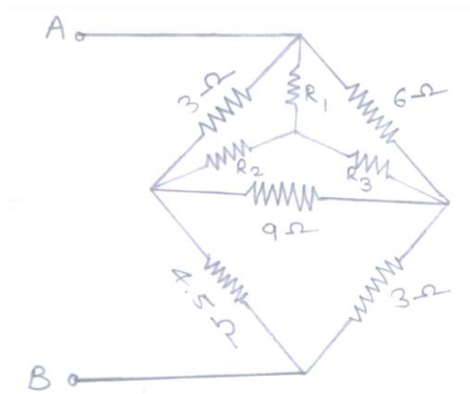


Fig. No. 2

(Delta to Star- 2 Marks, Final Answer – 2 Marks)

Ans:



Find Delta R_1, R_2, R_3

$R_1 = 3 \times 6 / 3 + 6 + 9$

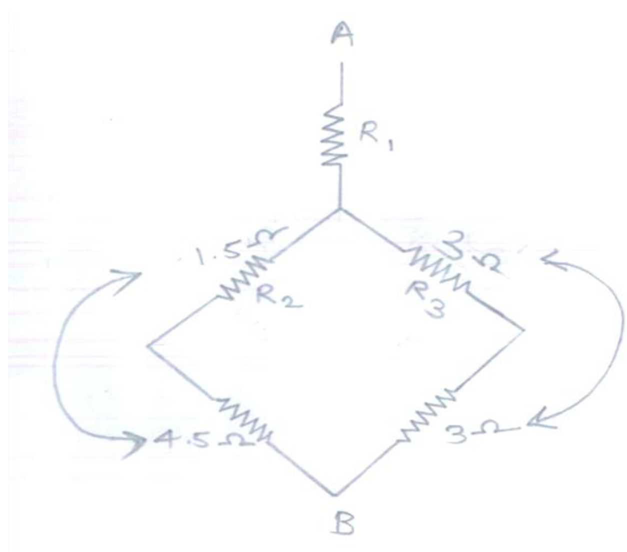
$= 1\ \Omega$

$R2 = 3 \times 9 / 3 + 6 + 9$

$= 1.5\ \Omega$

$R3 = 6 \times 9 / 3 + 6 + 9$

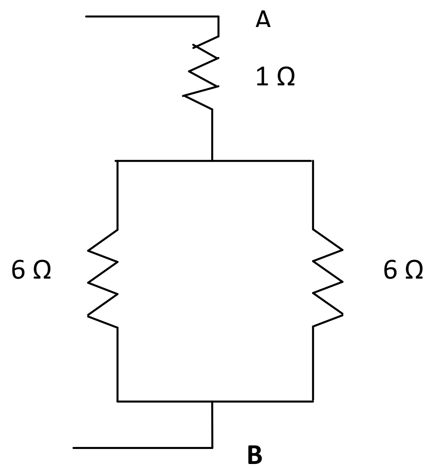
$= 3\ \Omega$



R in series

= 1.5 + 4.5

= 6 Ω



R in series

= 3 + 3

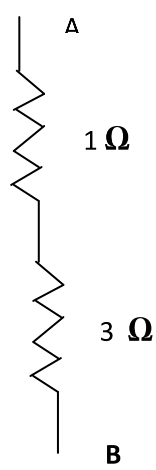
= 6 Ω

R in Parallel

= 6 x 6 / 6 + 6

= 36 / 12

= 3 Ω



R in series

= 1 + 3

= 4 Ω

[Equivalent resistance R_{AB} = 4 Ω]

d) Show that power consumed in purely inductive circuit is zero. When ac is applied.

(4 Marks)

Ans: With v= Vm Sin ωt and I = Im Sin ($\omega t - \frac{\pi}{2}$)

Instantaneous power , P = v i

$$= V_m I_m \sin(\omega t - \frac{\pi}{2})$$

$$= - V_m I_m \sin \omega t . \cos \omega t$$

$$= \frac{-V_m I_m}{2} \sin 2\omega t$$

Thus the power curve is a sine curve of frequency double that of voltage and current waves Its mean value taken over a cycle will be Zero.

❖ Average power, p = Average of($\frac{-Vm\ Im}{2}$ sin 2 ωt) = 0

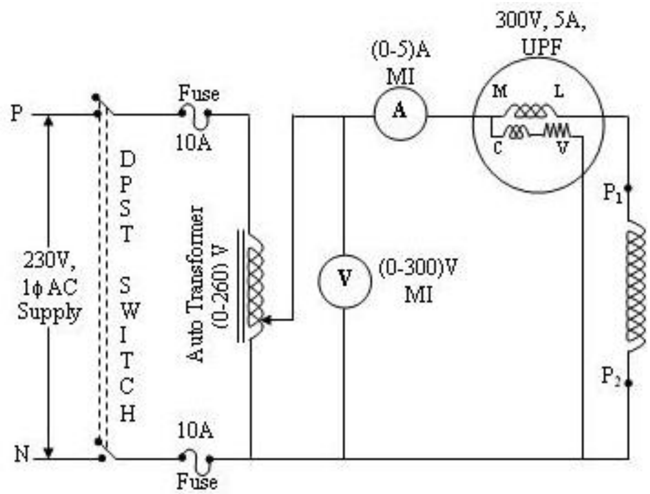
This will be also clear if the total energy supplied to the circuit during a cycle is considered. the shaded areas under the power curve of represent energy. During the parts of the cycle when power is positive, the energy is stored in the magnetic field established due to increasing current This energy is represented by area of the positive loop. When power is negative, the same energy is returned back to the supply due to collapse of the magnetic field as current decreases. The areas of the negative loops represent the energy returned back to the supply. The areas of the positive loop are exactly equal to the areas of negative loops Therefore; total energy supplied over a cycle is Zero. Hence.

Average power, p = ($\frac{\text{Energy supplied over a cycle}}{\text{periodic time ,T}}$)= 0 Thus , the average demand for power in a purely inductive circuit over the whole period always Zero.

e) Draw circuit diagram for measurement of single phase power using dynamometer type wattmeter.

(*Correct diagram with label: 4 Marks*)

Ans:

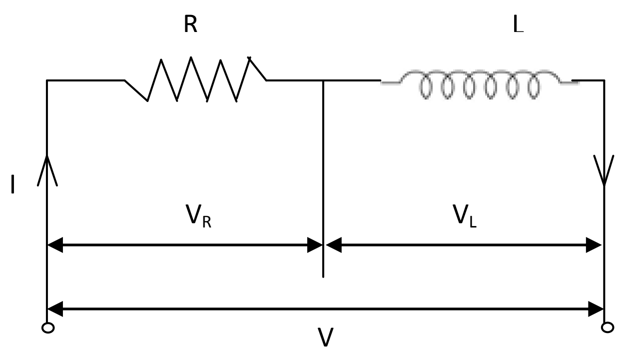


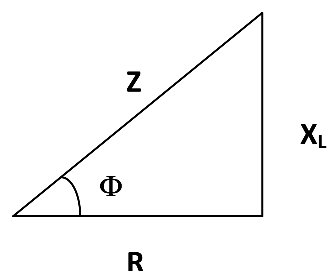
f) Draw series R-L circuit. Write its expression for impedance and show it on impedance triangle.

(Circuit diagram – 1 Marks, expression – 1 Marks, impedance triangle – 2 Marks)

Ans: Impedance Triangle: By dividing each side of the voltage triangle by I, a similar triangle as shown in fig. obtained. As sides of this triangle represent the resistance, reactance and impedance of the circuit, it is known as impedance triangle.

$$Z = \sqrt{R2 + XL2}$$





3. Attempt any FOUR of the following: Marks 16

a) State Faraday's laws of electromagnetic induction.

(*Each: 2 Marks*)

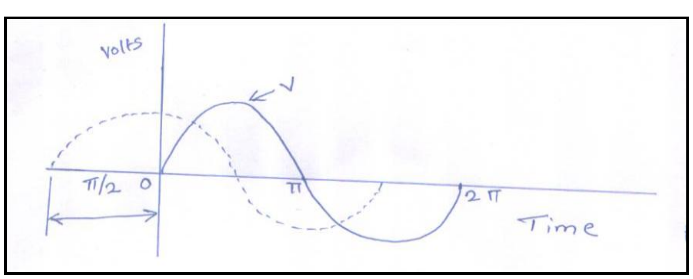
Ans: Faraday's First Law: Whenever a conductor cuts the magnetic lines of force or is cut by the magnetic lines of force or flux linking with conductor changes, an EMF is always induced in that particular conductor.

Faraday's Second Law: The magnitude of Induced EMF is directly proportional to the rate of change of flux.

$$e = -N\frac{d\Phi}{dt} \text{ volts}$$

b) Draw waveform, write voltage and current equation and draw phasor diagram for a.c. circuit containing capacitance only.

Ans: Waveform ***(1 Mark)***

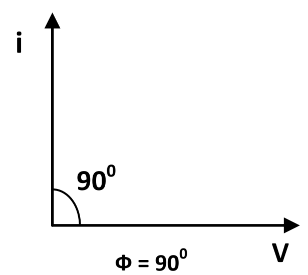


Voltage and current equation ***(2 Marks)***

Voltage $V = Vm \sin \omega t$

Current $I = Im \sin(\omega t + \pi/2)$

phasor diagram (1 Mark)



c) Find the form factor and peak factor of the sinusoidal alternating current.

Ans: **form factor**: It is defined an radio of RMS value to average value. ***(2 Marks)***

$$\text{form factor} = \frac{\text{RMS value}}{\text{Average value}}$$

$$\text{form factor} = \frac{\text{Max. value}/\sqrt{2}}{2 \text{ x Max. value}/\pi}$$

$$= \pi / \sqrt[2]{2}$$

=1.11 For sinusoidal waveform

Peak factor: Peak factor of alternating quality is defined an ratio of maximum value to rms value. ***(2 Marks)***

$$\text{Peak Factor} = \frac{\text{Max.value}}{R.M.S.value}$$

$$= \frac{\text{Max. value}}{\text{Max. value}/\sqrt{2}} = \sqrt{2}$$

= 1.414 For sinusoidal waveform

d) Write voltage equations and phasor relationships for the waveform show in fig. No. 3

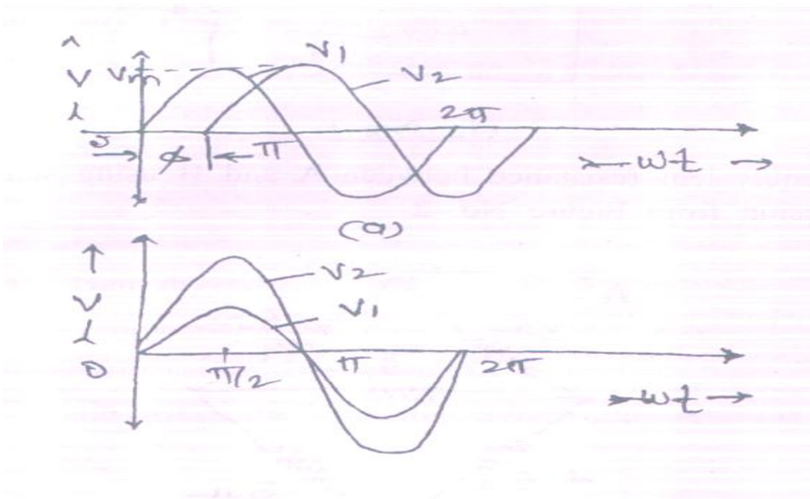
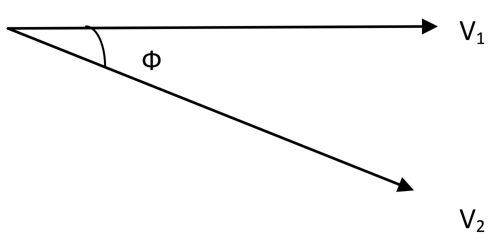


Fig. No. 3

(Voltage equation – 1 Mark, Phasor relation – 1 Mark for each wave form)

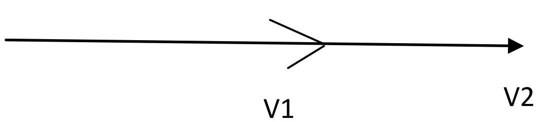
Ans: **Voltage equation $V_1 = V_{m1} \sin w t$**

Voltage equation $V2 = V_{m2} \sin (wt - \Phi)$



Voltage equation $V_1 = V_{m1} \sin w t$

Voltage equation $V2 = V_{m2} \sin wt$



e) Explain statically and dynamically induced emf with its one application each.

Ans: **statically induced emt:** Emt produced in conductors where in magnetic field around them changes with the conductors being stationary. ***(1 Marks)***

For coils 'e' = $- N\, d\phi/dt$ (V) where

N is number of turns in coil

ϕ is the changing tlux wrt time 't'.

Application: 1) Transformer ***(1 Mark)***

Dynamically induced emt: Emf Produced in conductors due to relative motion of conductors with respect to magnetic fields (Volts) = e = $B\, l\, V \sin\theta$ (volts) ***(1 Mark)***

where B = flux density (T)

l = Effective length of conductor in magnetic field, $V \sin\theta$ = relative velocity of conductor wrt the magnetic field.

θ = angle between velocity of flux lines.

Application – 1) Motor ***(1 Mark)***

f) State type of power. Give their expressions and show them on power triangle.

(Types – 1 ½ Marks, Expression- 1 ½ Marks, Power triangle- 1 Mars)

Ans: **Types of power**

i) True power

ii) Reactive power

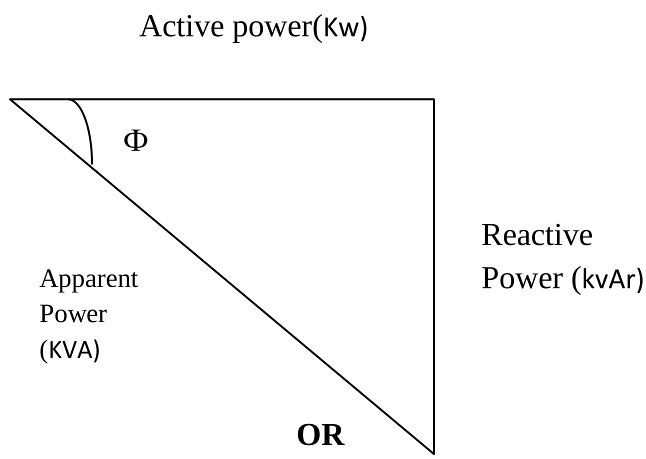
iii) Apparent power

Expression – Active power / True Power = $VI \cos \Phi$

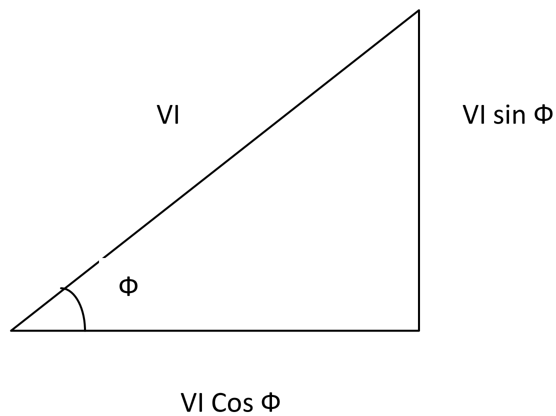
Reactive Power = $VI \sin \Phi$

Apparent Power = VI

Power Triangle:



OR



4. Attempt any FOUR of the following: Marks 16

a) Calculate the rms value, average, value peak factor and form factor of a sinusoidal voltage by E=170 sin 314*t*.

(R.M.S. value -1 Mark, Average value- 1 Mark, Peak Factor – 1 Mark, Form factor – 1 Mark)

Ans: E = 170 Sin 314 t

VM = 170, w= 314 = 2πt

1) **R.M.S. Value of voltage V_{RMS}** $= 170/\sqrt{2}$
$= 120.5V$

2) **Average Value** = 0.637 x Vm

= 0.637 x 170

= 108.29 V

3) **Peak factor** $= \frac{\text{Maximum Value}}{\text{Rms Value}}$

= 170 / 120.5

= 1.41

4) **Form factor** $= \frac{\text{Rms Value}}{\text{Average value}}$

$= \frac{120.5}{108.29}$

= 1.11

b) The voltage applied to a circuit is V=100 sin (wt+ 30°) and current flowing in the circuit is *i* =15 sin (wt + 60)°

Determine:

i) Impedance

ii) Phase angle between V and I

iii) Active power

iv) Power Factor.

(Each parameter – 1 Mark)

Ans: R.M.S. value of voltage Vm= 100 x 0.707 = 70.7 V

R.M.S. value of current Im= 15 x 0.707 = 10.605 Amp

i) **Impedance** $Z = \frac{V}{I}$

$= \frac{70.7}{10.605}$

$= 6.66 \angle -30\ \Omega$

ii) Phase angle between V and I:

Phase Angle between V and I is 30^0

iii) **Active Power** = VI cos ϕ

$= 70.7 \times 10.605 \times \cos(30)$

= 649.32 watts

iv) **Power factor** = Cos ϕ

= cos (30)

= 0.86

c) Define power factor and state its significance.

(Definition- 2 Marks, Its Significance – 2 Marks)

Ans: Power factor is defined an cosine of phase angle (ϕ) between voltage and current of circuit i.e. cosϕ

$\cos\phi = \frac{\text{True Power}}{\text{Apparent Power}}$

$= \frac{\text{VI}\cos\Phi}{\text{VI}}$

Significance: Higher its value more is the capacity utilization of power supply system as useful or active power (VI cos ϕ). For a rated V and Z system higher cos ϕ means that active power is higher

d) A coil having a resistance of 12Ω and an inductance of 0.1H is connected across a 100V, 50 Hz supply. Calculate:

i) Impedance of coil

ii) The current

iii) Active power

iv) Apparent power

(Each parameter- 1 Mark)

Ans: R=12, L=0.1H, f =50 Hz, V=100 v

XL= 2πfL

=31.41 Ω

i) Impedance of coil Z = R+jXL

$=\sqrt{R^2 + XL^2} \quad tan^{-1} \left({}^{XL}/_{R} \right)$

$=\sqrt{12^2} + 31.41^2 \quad tan^{-1} \left({}^{31.41}/_{12} \right)$

Z = 33.62 ∠ 69.09 Ω

ii) **Current** $I = \frac{V}{Z}$

$I = \frac{100}{33.62} \angle 69.09$

I = 2.97 ∠ 69.09 Amp

iii) **Active Power** = VI Cos ϕ

= 100 x 20.97 x Cos (69.09)

= 105.99 watts

iii) **Apparent power** S = VI

= 100 x 2.97

S = 297 VA

e) Define:

i) Efficiency

ii) Voltage regulation of transformer

(Each definition – 2 Marks)

Ans: **i) Efficiency:** It is the radio of output power to/the input power of transformer it is alnoted by in term of percentage.

$$\text{Efficiency } (\acute{\eta}) = \frac{\text{Output Power}}{\text{Input Power}} x\ 100$$

$$= \frac{\text{Output Power}}{\text{Output Powert +Losses}} \text{ x 100}$$

$$= \frac{V_2 I_2 \cos \varnothing_2}{(V_2 I_{2\ \cos \varnothing_2 + P1 + Pcu})} \text{ x 100}$$

Pi = Iron loss, Pc=Copper loss of Transformer

ii) **Voltage Regulation of transformer:** The ratio of the change in Secondary Terminal Voltage from No load to full Load (V_{FL}) to no load voltage.(V_{NL})

The Regulation is usually expressed in percentage of no load Secondary terminal Voltage.

$$\text{So Voltage Regulation} = \frac{V_{NL}-V_{FL}}{V_{NL}} \text{ x 100}$$

V_{NL} = No Load Secondary voltage

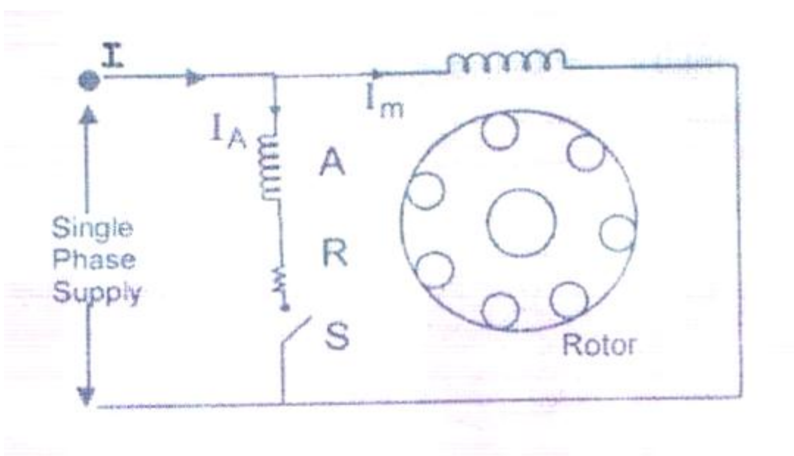
V_{FL} = Full Load Secondary voltage

f) Explain with suitable diagram working of resistance split phase induction motor.

(Explanation- 2 Marks, Circuit Diagram – 2 Marks)

Ans: Resistance Split phase Motors:

Below Figure shows the schematie representation of this motor. It consists of two windings main winding or running winding (M) and Auxiliary or starting winding. (A) They are 90^o electrical degrees a part. The main winding (M) and auxiliary winding (A) are connected across the supply as shown. in fig. Auxiliary winding has high resistance (R) in series. When the supply is given current flows through the windings as I_m & I_A which are approximately 90^o phase difference. Hence the flux produced due to these currents is displaced in space & produces rotating magnetic field there by producing rotation in rotor. Once the motor is started the auxiliary winding is disconnected with the help of centrifugal switch (S) at about 75 to 80% of synchronous speed



5. Attempt any FOUR of the following: Marks 16

a) The equation of an alternation current is *i* =62.35 sin 628 *t*.

Determine:

i) Frequency

ii) Time period

iii) Maximum value

iv) Angular velocity

(Each parameter – 1 Mark)

Ans: Given $i = 62.350 \sin 628t$

i) Frequency→ $\omega = 2\Pi f$

Thus, $f = \frac{\omega}{2\Pi}$

$= \frac{628}{2\Pi} = 99.94 \approx 100Hz$

ii) Time period $= \frac{1}{f} = \frac{1}{100} = 0.01s$

iii) Maximum value = 62.35 A (Given in equation)

iv) Angular Velocity = ω= 628 rad/sec (Given in equation)

b) State any four advantages of three phase circuit over single phase circuit.

(Any four -4 Marks)

Ans: Advantages of three phase circuit over single phase circuit are as follows:

iii) The output of three phase circuit is greater than single phase circuit.

iv) The output of three phase circuit is more stable than single phase circuit.

v) The output power is more at less voltage with smaller gauge conductors than single phase circuits.

vi) Transmission Efficiency is more than single phase circuits.

vii) It is more economical.

viii) Easy to maintain and repair.

ix) Three phase circuit is cheaper, lighter than single phase circuits of the same rating.

x) Parallel operations can be possible in three phase circuits.

c) State relation between phase and line current and voltages in balanced star and delta connections.

Ans: For Star connected system ***(2 Marks)***

$V_L = \sqrt{3}V_{Ph}$ i.e Line voltage =√3 phase voltage

$I_L = I_{Ph}$ i.e Line current = phase current.

For Delta connected system *(2 Marks)*

$V_L = V_{Ph}$ i.e Line voltage = phase voltage

$I_L = \sqrt{3} I_{Ph}$ i.e Line current =√3 phase current.

d) Give expression for e.m.f. equation, voltage ratio and transformation ratio of transformer.

(E.M.F. equation with notation – 2 Marks, Voltage ratio – 1 Mark, Transformer ratio – 1 Mark)

Ans: E.M.F equation of transformer is given by

E.M.F= $4.44 \Phi_m f N$

Where $\Phi_{m=}$ Maximum Value of alternation flux link with primary and secondary Winding.

f = frequency of applied ac signal

N= number of turns on primary or on secondary.

Turns on primary can be given by N_1

Turns on primary can be given by N_2

E.M.F= voltage induced in either primary or secondary winding.

Voltage induced in primary = e_1

Voltage induced in primary = e_2

Voltage ratio = $\frac{e1}{e2} = \frac{V1}{V2}$

Transformation Ratio = $\frac{V2}{V1} = \frac{N2}{N1} = \frac{I1}{I2}$ = K

e) A balanced star connected load with impedance (12 +*j*16) ohm/phase is connected to a 400V, 3ϕ supply Determine:

i) Line current

ii) Phase voltage

iii) Phase current

iv) Total power.

(Each parameter – 1 Mark)

Ans: Given: Z=12+j16 Ω/phase ,

V= 400V, 3Φ supply

Formulae to be used:$= \sqrt{R^2 + X^2}$

, for Star $V_L = \sqrt{3\,Vph}$, $I_L = I_{Ph}$, $P = \sqrt{3\,VL\,IL\cos\theta}$

Z=12+j16 Ω/phase

$Z = \sqrt{R^2 + X^2} = \sqrt{12^2 + 16^2} = \sqrt{144 + 256} = \sqrt{400}$

Z = 20 Ω

$\Theta = \tan^{-1}\frac{X}{R} = \tan^{-1}\frac{16}{12} = 53.13^0$

Thus power factor = cos Θ =0.6

for Star $V_L = \sqrt{3V_{Ph}}$

thus, $400 = \sqrt{3V_{Ph}}$

V_{Ph}= 400/√3= 230.94

$I_{Ph} = \frac{VPh}{ZPh} = \frac{230.94}{20} = 11.54$ A

I_{Ph} =11.54 A

$I_L = I_{Ph}$ = 11.54 A

Total power= P= $\sqrt{3\ V_L\ I_L \cos\Theta}$

Thus P =$\sqrt{3 * 400 * 11.54 * 0.6}$ = 4797.08 watts = 4.79 Kwatts.

Total power= P=4797.08watts= 4.79Kwatts.

f) Define the term:

i) Phase sequence

ii) Balanced load.

(Each definition – 2 Marks)

Ans: i) **Phase Sequence**: The order in which the voltages in three phases reach their maximum Positive values is called the phase sequence.

ii) **Balance Load**: If all phase impedances of the three phase load are exactly identical in respect of magnitude and their nature, it is said to be a balanced load .

6. Attempt any FOUR of the following: Marks 16

a) For the circuit given in Figure No. 4. Calculate:

i) X_L

ii) X_c

iii) Z

iv) Current

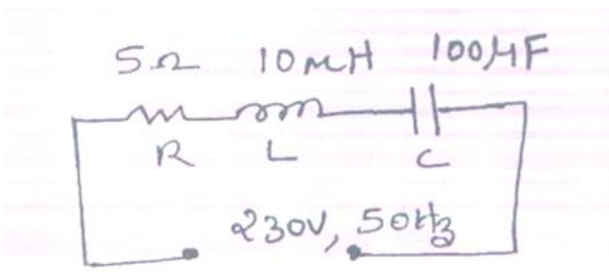


Fig. No. 4

(Each Parameter – 1 Mark)

Ans: Given: R=5 Ω , L= 10mH , C=100μF , V=230V,50Hz

i) $X_L = 2\Pi fL = 2 \times \Pi \times 50 \times 10 \times 10^{-3} = 3.14\ \Omega$

X_L=3.14 Ω

ii) $X_C = \frac{1}{2\Pi fC} = \frac{1}{2*\Pi*f*100*10^{-6}} = 31.83\ \Omega$

X_C =31.83 Ω

iii) $Z = \sqrt{R^2 + (XL - XC)^2} = \sqrt{5^2 + (3.14 - 31.83)^2} = 29.12\ \Omega$

***Z* =29.12 Ω**

iv) $I = \frac{V}{Z} = \frac{230}{29.12} = 7.89A$

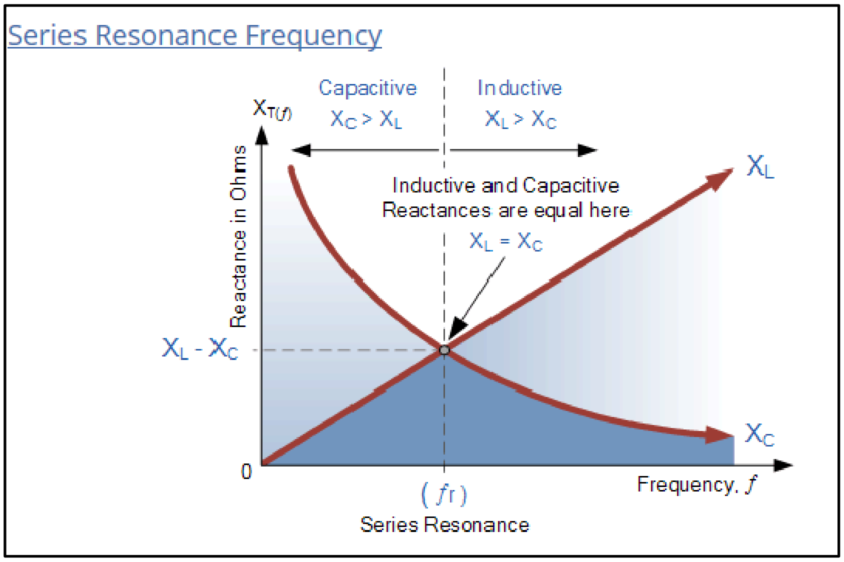
I = 7.89 A

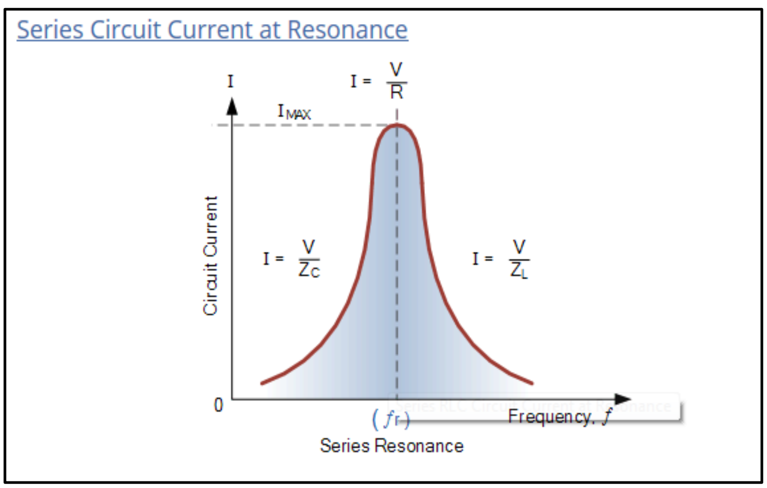
b) Explain resonance in series RCL circuit.

(Diagram – 1 Mark, Explanation – 3 Marks)

Ans: Resonance in R-L-C Series Circuit:

- When the applied voltage is maintained constant across series R-L-C circuit and frequency of applied voltage is gradually increased, the inductive reactance ((XL) increases and Capacitive reactance (XC) decreases from its large value.
- The point comes where XL= XC. Thus the total impedance reduced to value of R with unity power factor. Thus the total current reaches to maximum value. As shown in fig below.



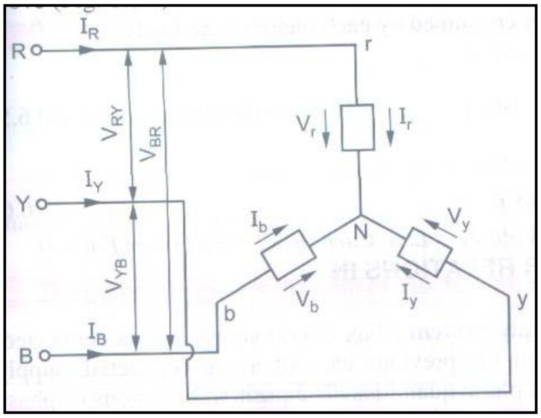


- This condition is known as series resonance and the frequency at which it occur is called Resonant frequency.
- Resonant frequency= fr = $\frac{1}{2\Pi\sqrt{LC}}$

c) Draw a neat sketch of three phase balanced star connected and delta connected systems mark line and phase voltages.

(Each diagram with proper marking of V_L and V_{ph} – 2 Marks)

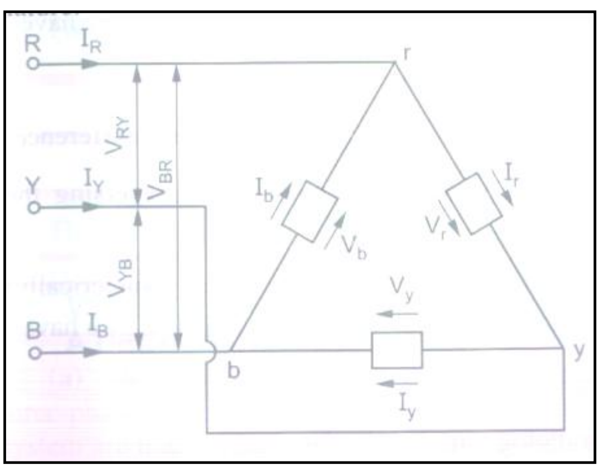
Ans: Three phase balanced Star connected load.



Line voltage = $V_L = V_{RY} = V_{YB} = V_{BR}$

Phase voltage = $V_{PH} = V_r = V_y = V_b$

Three phase balanced delta connected load.



Line voltage = $V_L = V_{RY} = V_{YB} = V_{BR}$

Phase voltage = $V_{PH} = V_r = V_y = V_b$

d) Give classification of transformer on the basis of:

i) Construction

ii) Supply system

ii) Power rating

iv) Applications.

(Each Point – 1 Mark)

Ans: **i)** **Construction:** Core type, shell type, berry type transformer

ii) **Supply system:** Single phase transformer, Three phase transformer

iii) **Power rating:** VA and KVA

iv) **Application:** Voltage Transformer, Power Transformer, RF Transformer, Pulse Transformer, Distribution Transformer

e) Explain construction and working of autotransformer.

(Construction (diagram) - 2 Marks, Working – 2 Marks)

Ans:

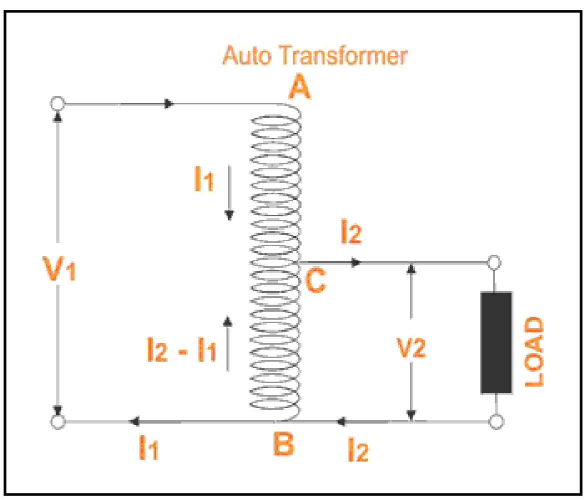


Fig. 1 Step Down auto transformer

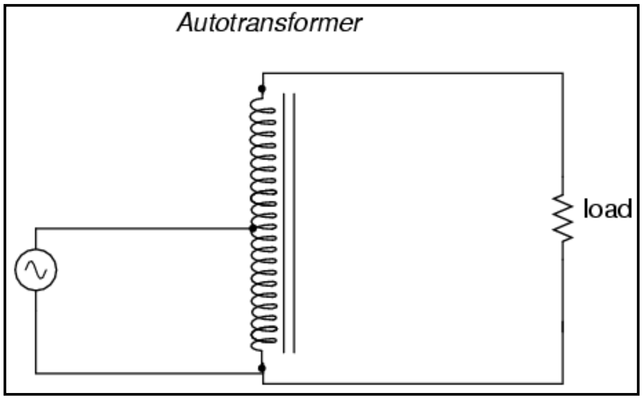


Fig. 2 Step Up auto transformer

An auto transformer has single winding which is used as primary and secondary winding. This winding is wound on laminated enameled magnetic core. As shown in fig. 1 the input is given to winding worked as primary and output is taken from the part of the same winding. Thus the one winding serves as primary and secondary. This transformer is known as step down auto transformer.

As shown in fig.2 the input is given to the part of winding and output is taken across the whole winding. So the part of winding acts as a primary winding and the whole winding acts as a secondary winding. With this construction we can step up the voltage. So this transformer known as step up auto transformer.

f) State any four precautions to be taken against electric shock.

(Any four-4 Marks (Considered any relevant precautions))

Ans: Precautions to be taken against electric shock are as follows;

- Ensure that your electrical installation fulfills all the safety regulations.
- Make sure that all parts of the circuit is well mounted and nothing can be moved accidentally.
- Make sure, all conductive and non-conductive objects are away from your circuit.

- Keep electrical equipment away from water or any other liquid, conductive or not.
- Always check electrical cords and connectors for fraying and signs of wear and defects, as well as any electrical equipment you are about to use.
- Use the special safety rubber gloves and rubber shoes.
- The floor you are standing on must be properly insulated from ground.
- Use only the correct cable sizes.
- Make sure you have read and understood all the safety procedures that comes with the electrical equipment you are about to use.
- Have extra circuit protection devices, such as fuses, circuit breakers, and ground-fault circuit interrupters just for your lab.
- All electrical equipment must be well-grounded.
- If water or any other chemical is spilled onto equipment or circuit, shut off power at the main switch immediately, or press the push-and-lock shutoff button.