1. **What is charge?**
The charge is an electrical property of the atomic particles of which matter consists. The unit of charge is the coulomb.

2. **Define current?**
The flow of free electrons in a metal is called electric current. The unit of current is the ampere. Current (I) = Q/t, Where Q is total charge transferred & T is time required for transfer of charge.

3. **What is voltage?**
The potential difference between two points in an electric circuit called voltage. The unit of voltage is volt. It is represented by V OR v.
Voltage = W/Q = work done/Charge

4. **Define power.**
The rate of doing work of electrical energy or energy supplied per unit time is called the power. The power denoted by either P of p. It is measured in Watts. (W).
Power = work done in electric circuit/Time
P = dw/dt = dw/dq dq/dt
P = VI

5. **What is network?**
Interconnection of two or more simple circuit elements is called an electric network.

6. **Distinguish between a branch and a node of a circuit.**
A part of the network which connects the various points of the network with one another is called a branch. A point at which two or more elements are jointed together is called node.

7. **Distinguish between a mesh and a Loop of a circuit.**
A mesh is a loop that does not contain other loops. All meshed are loops. But all loops are not meshes. A loop is any closed path of branches.

8. **Define active and passive elements.**
The sources of energy are called active element.
Example: voltage source, current source.
The element which stores or dissipates energy is called passive element.
Example: Resistor, Inductor, Capacitor.

9. **Define unilateral and bilateral elements.**
In unilateral element, voltage – current relation is not same for both the direction.
Example: Diode, Transistors.
In bilateral element, voltage – current relation is same for both the direction.
Example: Resistor

If the element obeys superposition principle, then it is said to be linear elements.

Example: Resistor.
If the given network is not obeying superposition principle then it is said to be non linear elements.

Example: Transistor, Diode.

11. Define Lumped and distributed elements.
Physically separable elements are called Lumped element. Example : Resistor, Capacitor, Inductor.
A distributed element is one which is not separable for electrical purpose. Example : Transmission line has distributor resistance, capacitance and inductance.

12. How are the electrical energy sources classified?
The electrical energy sources are classified into:
1. Ideal voltage source
2. Ideal current source.

13. Define an ideal voltage source.
The voltage generated by the source does not vary with any circuit quantity. It is only a function of time.
Such a source is called an ideal voltage source.

14. Define an ideal current source.
The current generated by the source does not vary with any circuit quantity. It is only a function of time.
Such a source is called an ideal current source.

15. What are independent source?
Independent sources are those in which, voltage and current are independent and are not affected by other part of the circuit.

16. What are dependent sources?
Dependent sources are those in which source voltage or current is not fixed, but is dependent on the voltage or current existing at some other location in the circuit.

17. What are the different types of dependent or controlled sources?
1. Voltage Controlled Voltage Sources (VCVS)
2. Current Controlled Voltage Sources (CCVS)
3. Voltage Controlled Current Sources (VCCS)
4. Current Controlled Current Sources (CCCS)

18. What is resistance?
It is the property of a substance which opposes the flow of current through it. The resistance of element is denoted by the symbol “R”. It is measured in Ohms.

\[ R = \frac{PL}{A} \ \Omega \]


<table>
<thead>
<tr>
<th>Circuit Element</th>
<th>Voltage</th>
<th>Current</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance</td>
<td>( V = iR )</td>
<td>( i = \frac{V}{R} )</td>
<td>( P = vi )</td>
</tr>
<tr>
<td>Inductance</td>
<td>$V = L \frac{di}{dt}$</td>
<td>$i = \frac{1}{L} \int v dt$</td>
<td>$P = Li \frac{di}{dt}$</td>
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</tr>
<tr>
<td>Capacitance</td>
<td>$V = \frac{1}{C} \int i dt$</td>
<td>$i = C \frac{dv}{dt}$</td>
<td>$P = CV \frac{dv}{dt}$</td>
</tr>
</tbody>
</table>

20. What is average value?
It is defined as area under one complete cycle to period.
The average value of the sine wave is the total area under the half-cycle curve divided by
the distance of the curve.

$$\text{Average value} = \frac{\text{Area under one complete cycle}}{\text{Period}}$$

The r.m.s value may be determined by taking the mean of the squares of the instantaneous value of
current over one complete cycle.

$$\text{RMS} = \frac{(\text{Area under hatched line})^2}{\text{Period}}$$

22. Define form factor.
The ratio of RMS value to the average value is called the Form factor.

$$\text{Form factor (Kf)} = \frac{\text{RMS value}}{\text{Average Value}}$$

23. Define peak factor.
Peak factor is defined as the ratio of the maximum value to the r.m.s value.

$$\text{Peak Factor (Kp)} = \frac{\text{Maximum value}}{\text{RMS value}}$$

24. Define Ohm’s law.
The current flowing through the electric circuit is directly proportional to the potential difference across
the circuit and inversely proportional to the resistance of the circuit, provided the temperature remains
constant.

25. Define Kirchoff’s current law.
Kirchhoff’s current law states that in a node, sum of entering current is equal sum of leaving current.

$$\sum I \text{ at junction point} = 0$$

26. Define Kirchoff’s voltage law.
Kirchhoff’s Voltage Law (KVL) states that the algebraic sum of the voltages around any closed path is
zero.

$$\sum V = 0.$$
27. Two resistances with equal value of “R” are connected in series and parallel. What is the equivalent resistance?

Resistance in series
\[ R_{eq} = R_1 + R_2 \]

Resistance in parallel
\[ R_{eq} = \frac{R_1 R_2}{R_1 + R_2} \]

28. Two inductors with equal value of “L” are connected in series and parallel what is the equivalent inductance?

Inductance in series
\[ L_{eq} = L_1 + L_2 \]

Inductance in parallel
\[ L_{eq} = \frac{L_1 L_2}{L_1 + L_2} \]

29. Two capacitors with equal value of “C” are connected in series and parallel. What is the equivalent capacitance?

Capacitance in series
\[ C_{eq} = \frac{C_1 C_2}{C_1 + C_2} \]

Capacitance in parallel
\[ C_{eq} = C_1 + C_2 \]

30. Write down the formula for a star connected network is converted into a delta network?

\[ R_{AB} = R_A + R_B + \frac{R_A R_B}{R_C} \]
\[ R_{BC} = R_B + R_C + \frac{R_B R_C}{R_A} \]
\[ R_{AC} = R_A + R_C + \frac{R_A R_C}{R_B} \]

31. Write down the formula for a delta connected network is converted into a star network?

\[ R_A = \frac{R_{AB} R_{AC}}{\sum R_{AB}} \]
\[ R_B = \frac{R_{BC} R_{AB}}{\sum R_{AB}} \]
\[ R_C = \frac{R_{BC} R_{AC}}{\sum R_{AB}} \]

\[ \sum R_{AB} = R_{AB} + R_{BC} + R_{AC} \]

32. Write few advantages of sinusoidal waveform?

1. The response of the sinusoidal input for second order system is sinusoidal.
2. The wave form can be written in terms of sinusoidal function according to fourier theorem.
3. The derivatives and integral also sinusoidal.
4. Easy for analyses.
5. Easy to generate.
6. More useful in power industry.

Sufficient knock or pull these electrons from their position in the crystal and convert them in to conduction electrons. Thus zener break down voltage decreases with temperature.
33. Distinguish between a cycle, time periods and frequency.
One complete set of positive and negative instantaneous values of the voltage or current is called cycle. The time taken by an alternating quantity to complete one cycle is called time period (T).

\[
\text{Time period (T)} = \frac{2\pi}{\omega}
\]
The number of cycle that an alternating quantity completed per second is known as frequency. It is measured in HZ.

\[
\text{Frequency (f)} = \frac{1}{T}
\]

34. What is instantaneous value?
The value of an alternating current, at any particular moment is called its instantaneous value.

35. What are peak value and peak to peak value?
The peak value of the sine wave during positive or negative half only. The sum of positive and negative value is called a peak to peak value. The peak to peak value of a sinusoidal alternating voltage is equal to two times the peak value.

36. What is average value?
The average value of the sine wave is the total area under the half-cycle curve divided by the distance of the curve.

\[
V_{av} = \frac{1}{T} \int_{0}^{T} V(t) \, dt
\]

37. Define effective value or RMS value of a sinusoidal voltage.
The R.M.S value may be determined by taking the mean of the squares of the instantaneous value of current over one complete cycle. This is often known as the effective value.

\[
V_{rms} = \sqrt{\frac{1}{T} \int_{0}^{T} V(t)^2 \, dt}
\]

38. Define phasor.
Graphical representation of phasors \( V = V_m < \phi \) and \( I = I < - \theta \) known phasor.

39. Define phase angle.
The angle between voltage and current is called phase angle. It is denoted by \( \phi \).

40. What is impedance?
The ratio of the phasor voltage to the phasor current is called impedance.

\[
\text{Impedance (Z)} = \frac{V}{I}
\]

41. Obtain the equivalent impedance and reactances for series and parallel connections.
Impedance in series $Z_{eq} = Z_1 + Z_2$
Impedance in parallel $Z_{eq} = Z_1 Z_2 / (Z_1 + Z_2)$
Reactances in series $jX_{eq} = j (X_1 + X_2)$
Reactances in parallel $jX_{eq} = j (X_1 X_2 / (X_1 + X_2))$

**41. Define admittance.**
The reciprocal of impedance is called admittance. It is denoted as $Y$ and it is measured in siemens (S).

$$\text{Admittance (} Y \text{)} = 1/Z = 1/V$$

**42. Obtain the equivalent admittance for series and parallel connections.**

Admittance in series $Y_{eq} = Y_1 Y_2 / Y_1 + Y_2$
Admittance in parallel $Y_{eq} = Y_1 + Y_2$

**43. Obtain the equivalent conductance and susceptance for series and parallel connections.**

Conductance in series $= G_1 G_2 / G_1 + G_2$
Conductance in parallel $= G_1 + G_2$
Susceptance in series $jB_{eq} = B_1 B_2 / G_1 + G_2$
Susceptance in parallel $jB_{eq} = j(B_1 B_2)$

**44. Define phasor diagram.**
The phasor diagram is a name given to a sketch in the complex plane showing the relationships of the phasor voltages and phasor currents throughout a specific circuit.

**45. What is instantaneous power?**
The power at any instant of time is known as instantaneous power.

$$P(t) = v(t) . I(t)$$

**46. What is average power?**
The average of the instantaneous power over one period is called average power. Average power is also defined as the product of voltage and current.

**47. What is apparent power?**
The product of $V_{rms}$ and $I_{rms}$ is known as the apparent power (s).

Apparent power $(S) = V_{Eff} I_{Eff}$ VA

**48. Define power factor.**
The ratio of the average power to the apparent power is called the power factor.

$$\frac{\text{Average power}}{\text{Apparent Power}}$$

**49. What is power triangle?**
A commonly employed graphical representation of complex power is known as the power triangle.

**50. Define complex power**
The product of the rms voltage phasor and the complex conjugate of the rms current phasor is known as complex power. It is denoted as $S$ and it is measured in volt-amperes (VA)
The complex power is $S = \frac{1}{2} V i^*$

51. **What is reactive power?**

It is defined as product of the applied voltage and the reactive component of the current. It is also called as imaginary component of the apparent power. It is represented by “Q” and it is measured in unit volt-ampere reactive (VAR).

$$Q = V_{Eff} I_{Eff} \sin \phi \text{ VAR}$$

52. **What is the equation for determining the number of independent loops in mesh current method?**

$L = b-n +1$

Where,

$L$ = number of loops

$B$ = number of branches

$N$ = number of nodes.

52. **On which law is the mesh analysis based?**

Mesh analysis is based on Kirchoff’s voltage law.

53. **On which law is the nodal analysis based?**

Nodal analysis is based on Kirchoff’s current law and Ohm’s law.

54. **What is mesh analysis?**

Mesh analysis is one of the basic techniques used for finding current flowing through the loop in a network. Mesh analysis is applicable if the given network contains voltage sources. If there exist current sources in a circuit, then it should be converted into equivalent voltage sources.

55. **What is nodal analysis?**

Nodal analysis is one of the basic techniques used to finding solution for voltage drop across the nodes in a given circuit. Nodal analysis is applicable if the given network contains current sources. If there exists voltage sources in the given circuit, then it can to be converted into equivalent current sources.

56. **When do we go for supermesh analysis.**

If the branches in the network has a current source, then it is slightly difficult to apply mesh analysis. One way to overcome this difficulty is by applying the supermesh technique. In this case we have to choose supermesh. A supermesh is constituted by two adjacent loops that have common current source.

57. **When do we, go for supernode analysis.**

If the branches in the network has a voltage source, then it is slightly difficult to apply nodal analysis. One way to overcome this difficulty is by applying the supernode technique. In this case, we have to choose super node. A supernode is constituted by two adjacent node that have common voltage source.

58. **State superposition theorem.**

Any electric circuit (linear, lumped, bilateral), is energized by two or more sources, the response in any element in the network is equal to the algebraic sum of the responses caused by individual sources acting separately.

59. **State Thevenin’s Theorem.**

A complex network having linear, bilateral, lumped elements with open circuited output terminals can be reduced by a simple circuit consisting of a single voltage source in series with a impedance.

60. **State Norton’s theorem.**
Any electrical network (linear, lumped, bilateral) with short circuited terminals can be reduced by a simple circuit consisting of a single current source in parallel with a Thevenin’s equivalent resistance.

**61. State Maximum power transfer theorem.**
Power transferred from source to load will be maximum, when source resistance is equal to load resistance looking back from its load terminals.

**62. Define duality.**
Two electrical network which are governed by the same type of equations are called duality.

**63. What is transient state?**
If a network contains energy storage elements, with change in excitation, the current and voltages change from one state to other state. The behaviour of the voltage or current when it is changed from one state to another state is called transient state.

**64. What is transient time?**
The time taken for the circuit to change from one steady state to another steady state is called transient time.

**65. What is natural response?**
If we consider a circuit containing storage elements which are independent of sources, the response depends upon the nature of the circuit, it is called natural response.

**66. What is transient response?**
The storage elements deliver their energy to the resistances, hence the response changes with time, gets saturated after sometime, and is referred to the transient response.

**67. Define Laplace transform function.**
The laplace transform of any time dependent function \( f(t) \) is given by \( F(s) \).
Where \( S = \sigma + j\omega \)

\[
F(S) = L\{f(t)\} = \int_0^\infty f(t) e^{-st} dt
\]

**68. What is inverse Laplace transform?**
Inverse Laplace Transform permits going back in the reverse direction i.e. from s domain to time domain.

\[
L^{-1}\{F(s)\} = f(t) = \frac{1}{2\pi j} \int_{\sigma - j\infty}^{\sigma + j\infty} F(s) e^{st} ds
\]

**69. Define time constant or RL Circuit.**
The time taken to reach 63.2% of final value in a RL Circuit is called the time constant of RL circuit.

Time constant \((t) = \frac{L}{R}\)

**70. Define time constant of RC Circuit.**
The time taken to reach 36.8% of initial current in an RC circuit is called the time constant of RC circuit.

Time constant \((t) = RC\).

**71. What is meant by natural frequency?**
If the damping is made zero then the response oscillates with natural frequency without any opposition, such a frequency is called natural frequency of oscillations, denoted as $\omega_n$.

**72. Define damping ratio.**
It is the ratio of actual resistance ($R$) in the circuit to the critical resistance ($R_{cr}$). It is denoted by greek letter Zeta ($\xi$).

$$\Xi = \frac{R}{R_{cr}} = \frac{R}{2\sqrt{\frac{C}{L}}}$$

**73. Define initial value theorem.**
The initial value theorem states that if $f(t)$ and $f'(t)$ both are Laplace transformable, then

$$\lim_{t \to 0} f(t) = \lim_{s \to \infty} F(s)$$

**74. Define final value theorem.**
The final value theorem states that, if $f(t)$ and $f'(t)$ both are Laplace transformable, then

$$\lim_{t \to \infty} f(t) = \lim_{s \to 0} F(s)$$

**75. What is driving point impedance?**
The ratio of the Laplace transform of the voltage at the point to the laplace transform of the current at the same port is called driving point impedance. The driving point impedance of the network is defined as

$$Z(S) = \frac{V(s)}{I(s)}$$

**76. What is transfer point impedance?**
It is defined as the ratio of voltage transform at one port to the current transform at the other port. It is defined by

$$V(s)$$

$$Z_{21}(s) = \frac{V_2(s)}{I_1(s)}$$

and

$$V(s)$$

$$Z(s) = \frac{V_1(s)}{I_2(s)}$$

**77. Define resonant circuit.**
The circuit that treat a narrow range of frequencies very differently than all other frequencies. These are referred to as resonant circuit. The gain of a highly resonant circuit attains a sharp maximum or minimum as its resonant frequency.

**78. When the circuit is said to be in resonance?**
1. A network is in resonance when the voltage and current at the network input terminals are in phase.
2. If inductive reactance of a network equals capacitive reactance then the network is said to be resonance.

**79. What is resonant frequency?**
The frequency at which resonance occurs is called resonance frequency.

$$F_r = \frac{1}{2\pi\sqrt{LC}}$$

**80. Define bandwidth.**
The bandwidth (BW) is defined as the frequency difference between upper cut-off frequency (f2) and lower cut-off frequency (f1)

\[ \text{Bandwidth} = f_2 - f_1 \]

Where \( f_2 \rightarrow \text{upper cut-off frequency} \)
\( F \rightarrow \text{lower cut-off frequency} \)

81. Define selectivity.
Selectivity is defined as the ratio of bandwidth to the resonant frequency of resonant circuit.

\[ \text{Selectivity} = \frac{\text{Bandwidth}}{\text{Resonant frequency}} \]

82. Define quality factor.
The quality factor is defined as the ratio of maximum energy stored to the energy dissipated per cycle.

\[ \text{Quality factor} (Q) = \frac{2\pi \cdot \text{Maximum energy stored per cycle}}{\text{Energy dissipated per cycle}} \]

83. Define half power frequencies?
The frequencies at which the power is half the maximum power are called half power frequencies.

Lower half power frequency, \( f_1 = f_r - \frac{R}{4\pi L} \)

Upper half power frequency, \( f_2 = f_r + \frac{R}{4\pi L} \)

84. Write down the formula for inductive reactance and capacitive reactance?
Inductive reactance is given by \( X_L = \frac{2\pi f L}{1} \)

Capacitive reactance is given by \( X_C = \frac{1}{2\pi f C} \)

Where
\( F \) supply frequency
\( L \) Inductance of the coil
\( C \) Capacitance of the capacitor.

85. Give the expression for quality factor of series RLC Circuit.
Quality factor is \( Q = 1 / R \sqrt{L / C} \)

86. Give the expression for quality factor of parallel RLC Circuit.
Quality factor is \( Q = R \sqrt{C / L} \)

87. What is the formula to find the power factor in a three phase circuits.
\( \tan \phi = \sqrt{3} \frac{(W_2 - W_1)}{(W_1 + W_2)} \)

88. What is the formula to find the reactive power in three phase circuits.
89. What is the formula to find the power in a three phase circuits.

Power=$\sqrt{3}E_I I_L \cos \phi$

90. What is the advantage of using three phase rather than using three single phase circuits.

Three phase system have uniform torque and self starting.