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Comprehensive Review

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Preface

The field of **Computer Engineering** is known for being highly competitive, and in order to succeed, aspiring engineers must have a thorough understanding of the subject matter. One critical component of this process is taking **Council Examinations** and other competitive exams. To perform at their best, individuals must be well-prepared. This book is a **Comprehensive MCQ (multiple choice questions)** bank that has been specifically designed to assist aspiring computer engineers in their preparation for these important exams.

The book is designed to cover a wide range of topics in **Computer Engineering, Information Technology Engineering**, and **Software Engineering**. These three disciplines are interconnected and share many common principles and practices, so it is important for students to have a strong understanding of all three.

This book contains over **10,000 MCQs** covering a wide range of sub-disciplines, offering a comprehensive evaluation of the reader's knowledge. The questions have been carefully crafted to reflect the format and level of difficulty of **Council Examinations** and other competitive exams. By practicing with these questions, the reader can familiarize themselves with the types of questions they will likely encounter and gain confidence in their abilities.

Moreover, the book offers detailed explanations of the related theory for each question. This helps the reader to understand not only which answer is correct but also why it is correct. Therefore, the book is an excellent resource for individuals who wish to improve their understanding of **Computer Engineering Syllabus (ACtE), Information Technology Engineering Syllabus (AItE)**, and **Software Engineering Syllabus (ASoE)**. It is also a valuable tool for anyone who wants to enhance their exam-taking skills. We have taken great care to create a balanced mix of easy and challenging questions, ensuring that readers of all levels of experience will find the book useful.

Whether you are a student preparing for **Council Examinations** or other competitive exams like **PSC** and **MSc Entrance Examinations**, a practicing engineer seeking to advance your career, or someone simply interested in expanding your knowledge of **Computer Engineering, Information Technology Engineering,** and **Software Engineering**, this book is an essential resource. We are confident that this book will serve as a valuable tool for anyone looking to succeed in the field of Engineering and perform their best in **Council Exams** and **Other Competitive Exams**.

Er. Suvash Chandra Gautam

Er. Ramesh Raj Subedi

Er. Rupak Gyawali

Er. Ganesh Paudel

Er. Roshan Kumar Nandan

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Computer Engineering Syllabus (ACtE)

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(AALL0104)

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CONCEPT OF BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (AExE01)

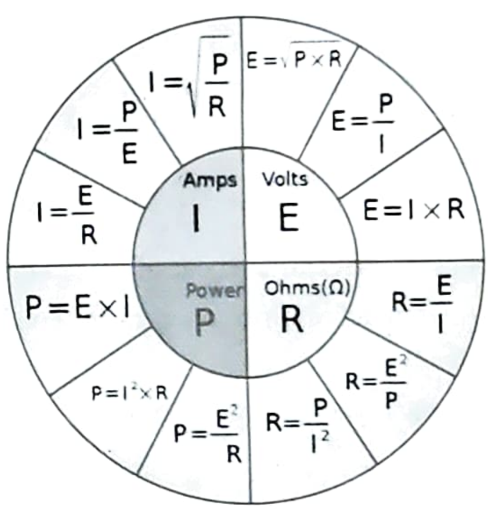
1.1 BASIC CONCEPT

Ohm's law

- Ohm's law states the relationship between electric current and potential difference. **The current that flows through most conductors is directly proportional to the voltage applied to it.**
- Ohm's law states that the **"voltage across a conductor is directly proportional to the current flowing through it"**, provided all physical conditions and temperatures remain constant.
- Mathematically, this current-voltage relationship is written as,

$$V = IR$$

- In the equation, the constant of proportionality, R, is called Resistance and has units of ohms, with the symbol Ω.



Electric voltage

- Electric voltage (V) is a measure of the electric potential difference between two points, which drives electric current (I) to flow in a conductor.

Electric current

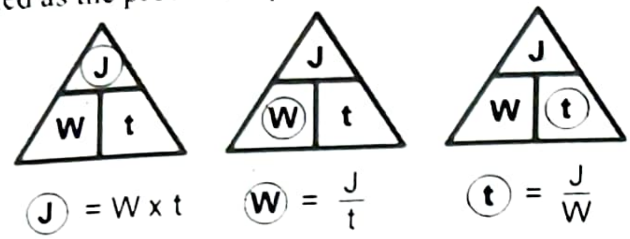
- It is the flow of electric charge in a circuit, and is measured in units of amperes (A). It represents the rate at which electric charge flows through a circuit.
- The relationship between voltage, current, and resistance (R) in an electrical circuit is described by Ohm's law: V = IR.

Electric power (P)

- The rate at which energy is transferred in an electrical circuit, measured in watts (W).
- Power is calculated as the product of voltage and current in a circuit, P = VI.

Electric energy (E)

- The amount of energy transferred in an electrical circuit over a given period of time, measured in joules (J).
- Energy is calculated as the product of power and time, E = PT.



Conducting materials

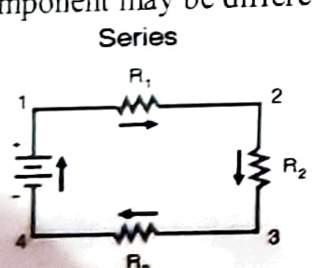
- **These are materials that allow electric current to flow easily through them due to their low resistance.**
- Examples of conducting materials include metals such as copper and aluminum.

Insulating materials

- **These are materials that resist the flow of electric current and do not allow electric charge to move easily.**
- Examples of insulating materials include rubber, plastic, and air. These materials are used to electrically separate different components in electrical circuits, prevent short circuits, and protect against electrical hazards.

Serial Circuit

- In a serial circuit, components are connected one after the other in a single path.
- The electric current flows through each component in sequence and the same current flows through all components.
- The voltage across each component may be different.



Resistance

The total resistance of a series circuit is equal to the sum of all the individual resistances in the circuit.

$$R_T = R1 + R2 + R3...$$

Current

The total current in a series circuit is the same as the current through any resistance of the circuit.

$$I_T = I1 = I2 = I3...$$

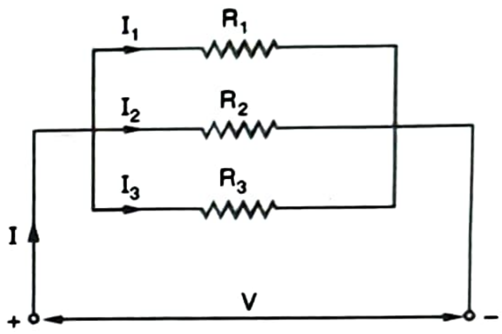
Voltage

The total voltage in a series circuit is equal to the sum of all the individual voltage drops in the circuit.

$$E_T = E1 + E2 + E3...$$

Parallel Circuit

- In a parallel circuit, components are connected so that they are all connected to the same two points in the circuit, usually the positive and negative terminals of a power supply.
- Each component has its own path for the electric current and the same voltage is applied across each component.
- The total current in the circuit is equal to the sum of the individual currents flowing through each component.



Voltage

Total voltage of a parallel circuit has the same value as the voltage across each branch.

This relationship can be expressed as:

$$E_T = E1 = E2 = E3...$$

Current

Total current in a parallel circuit is the sum of the individual branch currents.

This relationship in a parallel circuit is expressed as:

$$I_T = I1 + I2 + I3...$$

Resistance

The net resistance of a parallel circuit is always less than any of the individual resistance values.

The overall resistance is commonly determined using the reciprocal equation:

$$1/R_T = 1/R1 + 1/R2 + 1/R3...$$

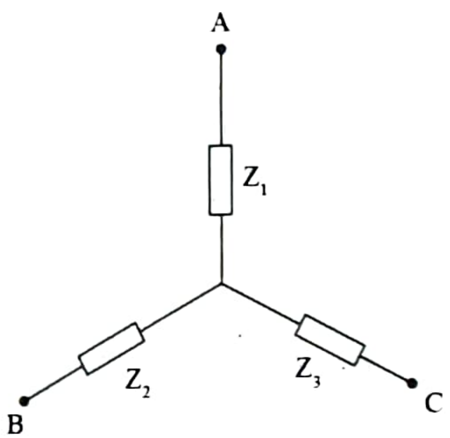
Series vs Parallel Circuit Review

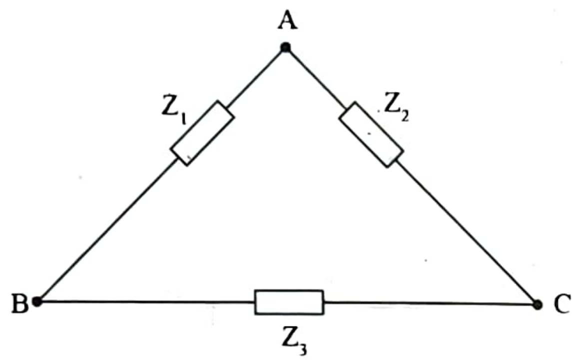
- In a series circuit, all components are connected end-to-end, forming a single path for current flow.
- In a parallel circuit, all components are connected across each other, forming exactly two sets of electrically common points. A "branch" in a parallel circuit is a path for electric current formed by one of the load components (such as a resistor).

Star to Delta and Delta to Star Conversion

- The conversion or transformation or replacement of the star connected load network to a Delta connected network and similarly, a delta connected network to a star network is done by Star to Delta or Delta to Star Conversion.

Star to Delta Conversion





- In star to delta conversion, the star-connected load is to be converted into delta connection.
- Suppose we have a star connected load as shown in the figure above, and it has to be converted into a delta connection as shown in figure B.
- The following Delta values are as follows:

$$Z_1 = \frac{Z_A Z_B + Z_B Z_C + Z_C Z_A}{Z_C} = \frac{\Sigma Z_A Z_B}{Z_C}$$

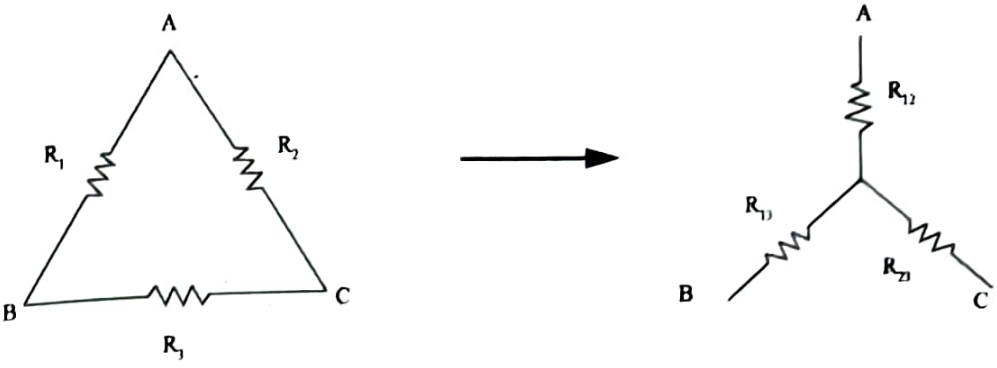
$$Z_2 = \frac{Z_A Z_B + Z_B Z_C + Z_C Z_A}{Z_B} = \frac{\Sigma Z_A Z_B}{Z_B}$$

$$Z_3 = \frac{Z_A Z_B + Z_B Z_C + Z_C Z_A}{Z_A} = \frac{\Sigma Z_A Z_B}{Z_A}$$

- Hence, if the values of ZA, ZB and ZC are known, therefore by knowing these values and by putting them in the above equations, you can convert a star connection into a delta connection.

Delta to Star Conversion

Delta to Star Transformation



- Similarly, a delta connection network is given as shown above, in figure B and it has to be transformed into a star connection, as shown above, in the figure A.
- The following formulas given below are used for the conversion:

$$Z_A = \frac{Z_1 Z_2}{Z_1 + Z_2 + Z_3}$$

$$Z_B = \frac{Z_2 Z_3}{Z_1 + Z_2 + Z_3}$$

$$Z_C = \frac{Z_1 Z_3}{Z_1 + Z_2 + Z_3}$$

- If the values of Z1, Z2 and Z3 are given, then by putting these values of the Impedances in the above equations, the conversion of delta connection into star connection can be performed.

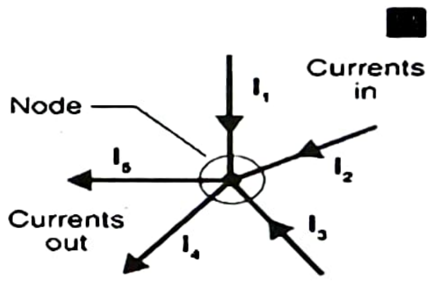
Kirchhoff's Laws

- Law that deal with the conservation of current and energy within electrical circuits.
- These two laws are commonly known as Kirchhoff's Voltage and Current Law.
- These laws help calculate the electrical resistance of a complex network or impedance in the case of AC and the current flow in different network streams

Kirchhoff's First Law or Kirchhoff's Current Law

- According to Kirchhoff's Current Law, the total current entering a junction or a node is equal to the charge leaving the node as no charge is lost.

Currents entering the node equals current leaving the node



$$I_1 + I_2 + I_3 + (-I_4 + -I_5) = 0$$

- In the above figure, the currents I1, I2 and I3 entering the node is considered positive, likewise, the currents I4 and I5 exiting the nodes is considered negative in values.
- This can be expressed in the form of an equation:

$$I1 + I2 + I3 - I4 - I5 = 0$$

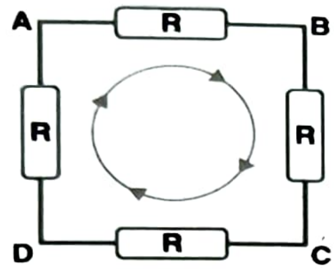
- A node refers to a junction connecting two or more current-carrying routes like cables and other components.
- Kirchhoff's current law can also be applied to analyses parallel circuits.

Kirchhoff's Second Law or Kirchhoff's Voltage Law

- According to Kirchhoff's Voltage Law, **the voltage around a loop equals the sum of every voltage drop in the same loop for any closed network and equals zero.**

The sum of all the voltage drops around the loop is equal to zero

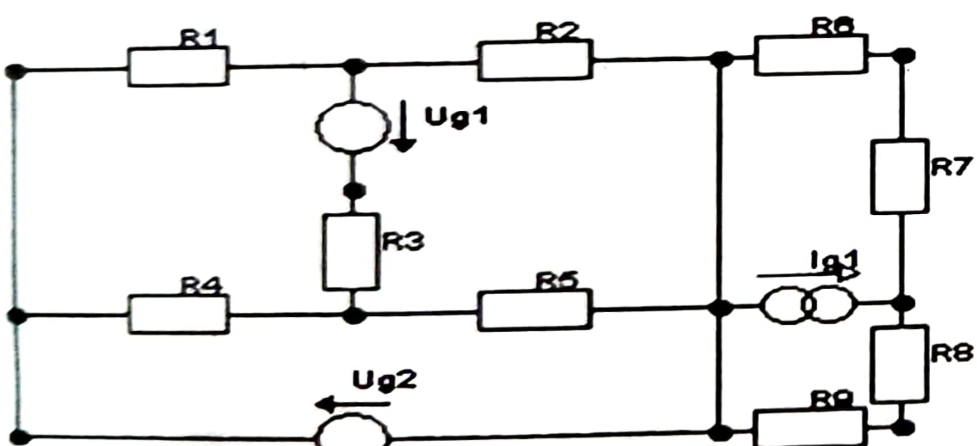
$$V_{AB} + V_{BC} + V_{CD} + V_{DA} = 0$$



- When you begin at any point of the loop and continue in the same direction, note the voltage drops in all the negative or positive directions and returns to the same point.
- It is essential to maintain the direction either counter clockwise or clockwise; otherwise, the final voltage value will not be zero.
- The voltage law can also be applied in analyzing circuits in series.

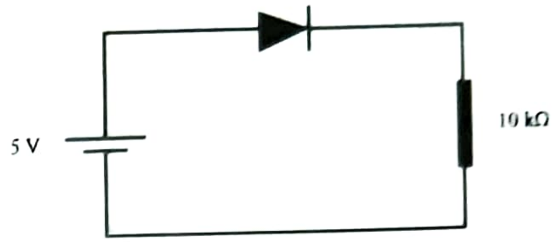
Linear Circuits

- Simply we can say that the linear circuit is an electric circuit and the parameters of this circuit are resistance, capacitance, inductance and etc. are constant.
- **Parameters of the circuits are not changed with respect to the voltage and current is called the linear circuit.**



Non-Linear Circuits

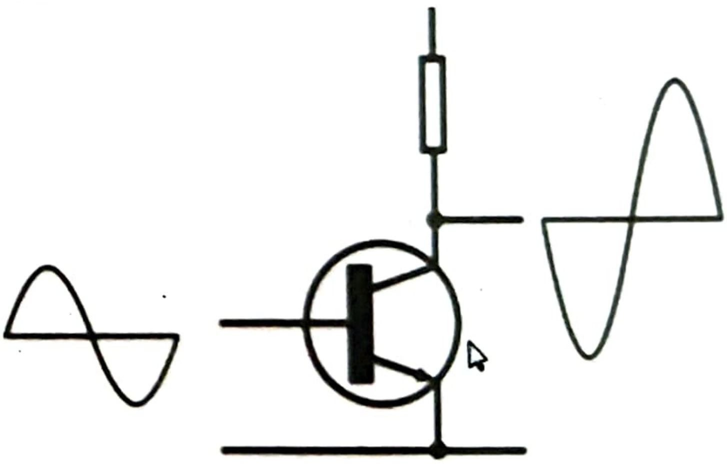
- **The non-linear circuit is also an electric circuit and the parameters of this circuit differ with respect to the current and the voltage.**
- The parameters like waveforms, resistance, inductance and etc. are not constant is called as Non- linear circuit.



Elements of Linear and Non-Linear Circuit

- In the non-linear circuit, the non-linear elements are an electrical element and it will not have any linear relationship between the current & voltage.
- The example of the nonlinear element is a diode and some of the nonlinear elements are not there in the electric circuit is called a linear circuit.
- Some other examples of the non-linear elements are transistors, vacuum tubes, other semiconductor devices, iron core inductors, and transformers
- In the linear circuits, the linear element is also an electrical element and there will be a linear relationship between the voltage and current.
- The examples of the linear elements are resistor is the most common element, capacitor, and air core inductors.
- **Examples of Linear circuits of Linear Elements:**
  Resistance and resistive circuit, inductor and inductive circuit and capacitor and capacitive circuit.
- **Examples of Non-Linear Circuits of Nonlinear Elements:**
  Diode, transformer, iron core, inductor, transistor.

Unilateral Circuits and Bilateral Circuits



Unilateral Circuits

- In unilateral circuits, when the circuit property changes at the same time direction of supply voltage or current also are changed.
- In other words, **the unilateral circuit allows the current flow only in one direction.**
- The diode rectifier is the main example of the unilateral circuit because it doesn't perform the rectification in both directions of supply.

Bilateral Circuits

- In bilateral circuits, when the circuit property didn't change, but the change in the direction of supply voltage or current takes place.
- In other words, **the bilateral circuit allows the current flow in both directions.**
- The transmission line is the main example of the bilateral circuit because if you give power supply from any direction, the circuit properties remain constant.

Active Circuits

- These are circuits that have at least one active component, such as a transistor or operational amplifier that can amplify the input signal.
- Active components generate an output signal that is larger in amplitude than the input signal, and can also change the shape and/or frequency of the signal.
- In general, active circuits are used in applications where amplification and signal processing are required.

Passive Circuits

- These are circuits that consist only of passive components, such as resistors, capacitors, and inductors, which do not have the ability to amplify the input signal.
- Passive components can only modify the signal by changing its magnitude and/or phase.
- Passive circuits are used in applications where signal modification is sufficient.
- Passive circuits are also simpler and more reliable than active circuits, and typically consume less power.

1.2 NETWORK THEOREMS

Concept of superposition theorem

- The superposition theorem is a circuit analysis theorem used to solve the network where **two or more sources are present and connected.**
- Superposition theorem states the following: **"In any linear and bilateral network or circuit having multiple independent sources, the response of an element will be equal to the algebraic sum of the responses of that element by considering one source at a time."**
- To calculate the individual contribution of each source in a circuit, the other source must be replaced or removed without affecting the final result.

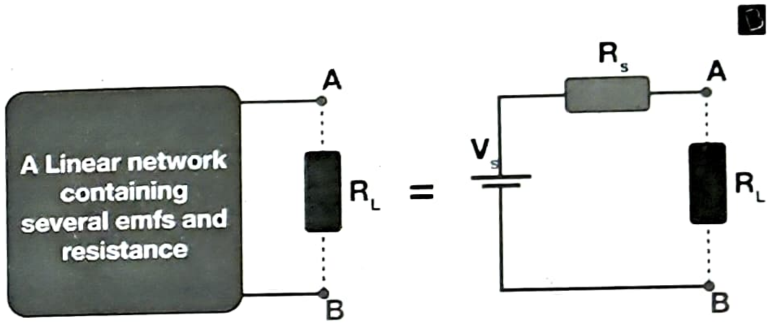
- This is done by **replacing the voltage source with a short circuit.**
- **While removing a voltage source, its value is set to zero.**
- **When removing a current source, its value is set to infinite.**
- **This is done by replacing the current source with an open circuit.**
- The superposition theorem is very important in circuit analysis because it converts a complex circuit into a Norton or Thevenin equivalent circuit.

Limitations of Superposition Theorem

- The theorem does not apply to non-linear circuits.
- The requisite of linearity indicates that the superposition theorem is only applicable to determine voltage and current but not power.
- Power dissipation is a nonlinear function that does not algebraically add to an accurate total when only one source is considered at a time.
- The application of the superposition theorem requires two or more sources in the circuit.

Thevenin's Theorem Explanation

- Thevenin's theorem states that **it is possible to simplify any linear circuit, irrespective of how complex it is, to an equivalent circuit with a single voltage source and a series resistance.**



- Thevenin's theorem can be applied to both AC and DC circuits.
- But it should be noted that this method can only be applied to AC circuits consisting of linear elements like resistors, inductors, capacitors.
- Like Thevenin's equivalent resistance, Thevenin's equivalent impedance is obtained by replacing all voltage sources with their internal impedances.

Thevenin's Theorem Procedures

1. Find and determine the terminal a-b where the parameter is asked or observed.
2. Remove the component at the terminal a-b, make it open circuit at that terminal and calculate the voltage across that terminal a-b ($V_{ab}=V_{oc}=V_{Th}$).
3. If there are only independent sources, then the resistance is measured at the terminal a-b when all of the sources are turned off and replaced by their inner resistance. We will get Thevenin equivalent resistance ($R_{ab} = R_{Th}$)
   - Replace voltage source with short circuit.
   - Replace current source with open circuit.

4. If there is dependent source, we use equation below to find the Thevenin equivalent resistance,

$$R_{Th} = \frac{V_{Th}}{I_{SC}}$$

5. In order to find the value of Isc (short circuit current), we make terminal a-b short-circuited and calculate the current flowing through that terminal ($I_{ab}=I_{sc}$).
6. Redraw the Thevenin equivalent circuit as a series circuit consists of:
   - The removed component we did on Step.(2).
   - Thevenin voltage/ open circuit voltage/ a-b voltage ($V_{Th}=V_{oc}=V_{ab}$)
   - Thevenin equivalent resistance (R_{Th}).
7. Solve the simplified circuit.

Thevenin Theorem Limitations

- Thevenin's theorem is used only in the analysis of linear circuits.
- The power dissipation of the Thevenin equivalent is not identical to the power dissipation of the real system.

Norton's Theorem

- This theorem is useful for representing the given electric circuit into its equivalent circuit in the simplified form.
- Norton's theorem states that **any 2-terminal linear and bilateral network or circuit having multiple independent and dependent sources can be represented in a simplified equivalent circuit known as Norton's equivalent circuit.**
- The theorem is based on the principle of equivalence and is used to simplify the analysis of linear circuits.
- The **current source (IN) represents the short-circuit** current of the network and the **resistor (RN) represents the equivalent impedance of the network** seen from the terminals.
- The theorem can also be used for calculating the performance of power electronic devices such as rectifiers, inverters, and DC-DC converters.
- The Norton's theorem formula is

$$I = I_N \frac{R_N}{R + R_N}$$

$$V = I_N \left(\frac{R \,.\, R_N}{R + R_N}\right)$$

$$V_{Th} = V_{OC}$$

$$I_N = i_{SC}$$

$$R_{Th} = \frac{V_{OC}}{i_{SC}} = R_N$$

Norton's Theorem Step by Step Procedure

1. Find and determine terminal a-b where a parameter is observed.
2. Remove the component on that terminal, make it short circuit to the terminal a-b, and calculate the current at that point a-b ($I_{ab}=I_{sc}=I_N$). This is known as I Norton or Norton equivalent current.
3. If all the sources are independent sources, then find the equivalent resistance when all the sources are turned off and replaced by their inner resistances ($R_{ab}=R_N=R_{Th}$):
   - Independent voltage source is replaced by a short circuit.
   - Independent current source is replaced by an open circuit.
4. If there is a dependent source, to find the Norton equivalent resistance we can use:

$$R_N = \frac{V_{OC}}{I_N}$$

5. In order to find the V_{oc} at terminal a-b, make that terminal open circuit and find the voltage across that terminal ($V_{ab}=V_{oc}$).
6. Redraw the Norton equivalent circuit consisting of the Norton equivalent current source, Norton equivalent resistance, and the component we remove in Step.(2).

Maximum Power Transfer Theorem

- Maximum Power Transfer Theorem explains that to generate maximum external power through a finite internal resistance (DC network), the resistance of the given load must be equal to the resistance of the available source.
- In other words, the resistance of the load must be the same as Thevenin's equivalent resistance.
- In the case of AC voltage sources, maximum power is produced only if the load impedance's value is equivalent to the complex conjugate of the source impedance.
- The maximum power transfer theorem states that, in an electrical circuit, the maximum power is transferred from the source to the load when the load resistance is equal to the source resistance (impedance), resulting in a transfer efficiency of 100%.
- The formula can be expressed as:

$$ZL = ZS$$

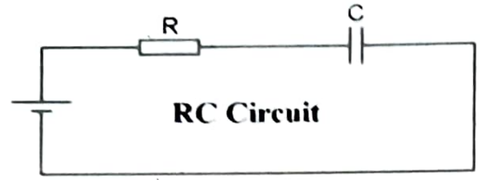
Where ZL is the load impedance and ZS is the source impedance.

RC, RL and RLC Circuits

RC circuit

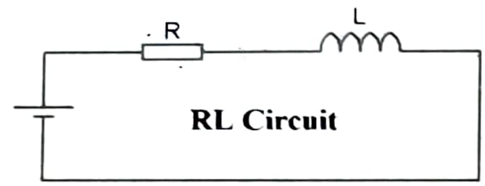
- The RC circuit (Resistor Capacitor Circuit) will consist of a Capacitor and a Resistor connected either in series or parallel to a voltage or current source.
- These types of circuits are also called as RC filters or RC networks since they are most commonly used in filtering applications.
- An RC circuit can be used to make some crude filters like low-pass, high-pass and Band-Pass filters.

- A first order RC circuit will consist of only one Resistor and one Capacitor.



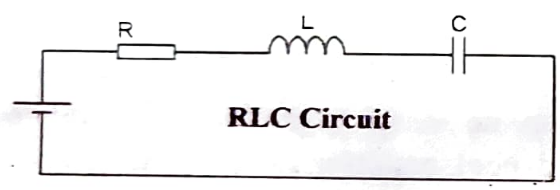
RL circuit

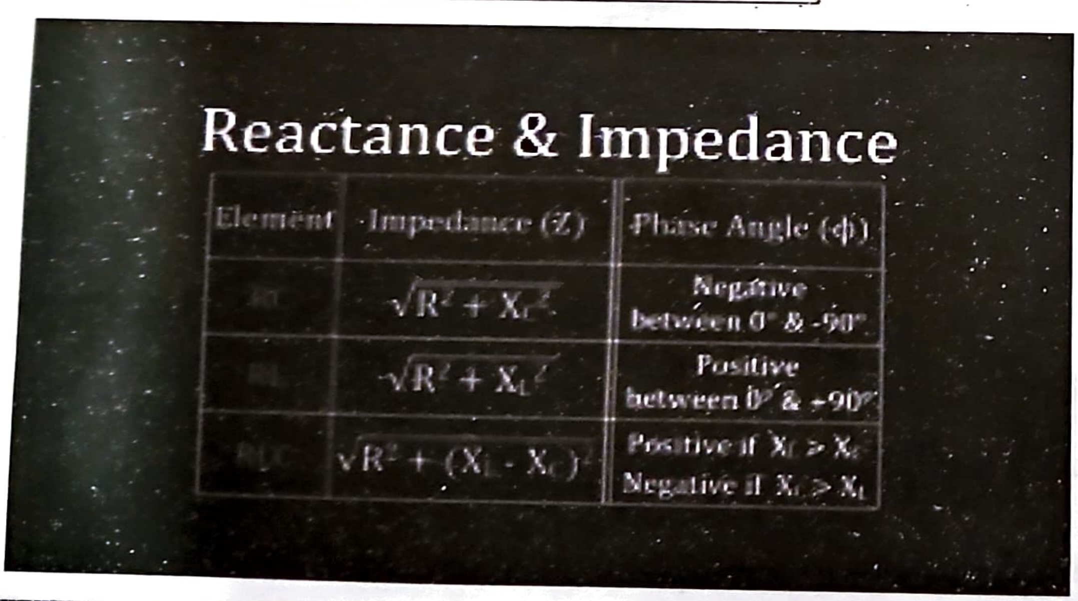
- The RL Circuit (Resistor Inductor Circuit) will consist of an Inductor and a Resistor again connected either in series or parallel.
- A series RL circuit will be driven by voltage source and a parallel RL circuit will be driven by a current source.
- RL circuit are commonly used in as passive filters, a first order RL circuit with only one inductor and one capacitor.



RLC Circuit

- A RLC circuit as the name implies will consist of a Resistor, Capacitor and Inductor connected in series or parallel.
- The circuit forms an Oscillator circuit which is very commonly used in Radio receivers and televisions.
- RLC circuit is also called as series resonance circuit, oscillating circuit or a tuned circuit.





Reactance & Impedance

Element	Impedance (Z)	Phase Angle (ϕ)
[illegible]	$\sqrt{R^2 + X_C^2}$	Negative between 0° & -90°
[illegible]	$\sqrt{R^2 + X_L^2}$	Positive between 0° & +90°
RLC	$\sqrt{R^2 + (X_L - X_C)^2}$	Positive if $X_L > X_C$ Negative if $X_C > X_L$

Applications:

- Communication systems
- Voltage/Current magnification
- RF amplifiers
- Variable tunes circuits
- Filtering circuits
- Signal Processing
- Radio wave transmitters
- Resonant LC circuit
- Oscillator circuits

Resonance in Series-Parallel Circuits

- In a series-parallel circuit, resonance occurs when the impedance of the circuit is at a minimum, resulting in maximum current flow.
- Resonant frequency in a series-parallel circuit is achieved when the reactance of the inductors (XL) and the reactance of the capacitors (XC) are equal and opposite, resulting in a net zero reactance.
- At this frequency, the total impedance is only resistive, leading to maximum power transfer to the load.
- The resonant frequency in a series-parallel circuit can be calculated using the formula:

$$f\_res = 1 / 2\pi\sqrt{(LC)},$$

Where L is the total inductance of the circuit and C is the total capacitance of the circuit.

Active Power

- **The power which is actually consumed or utilized in an AC Circuit is called True power or Active power or Real power.**
- **It is measured in kilowatt (kW) or MW. It is the actual outcomes of the electrical system which runs the electric circuits or load.**

Active component of the current

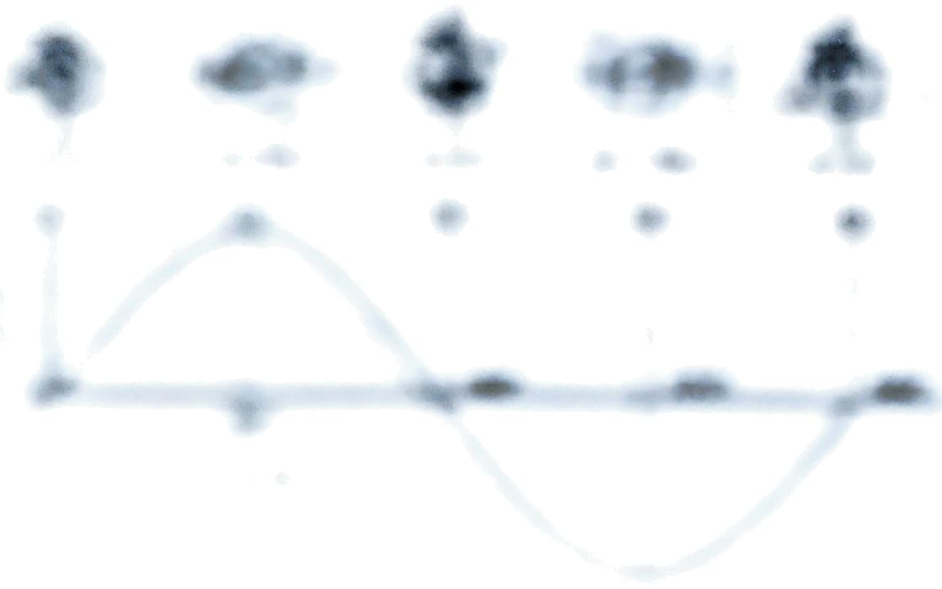
- The current component, which is in phase with the circuit voltage and contributes to the active or true power of the circuit, is called an active component or watt-full component or in-phase component of the current.

Reactive Power

- **The power which flows back and forth that means it moves in both the directions in the circuit or reacts upon itself, is called Reactive Power.**
- **The reactive power is measured in kilo volt-ampere reactive (kVAR) or MVAR.**

Reactive component of the current

- The current component, which is in quadrature or 90 degrees out of phase to the circuit voltage and contributes to the reactive power of the circuit, is called a reactive component of the current.



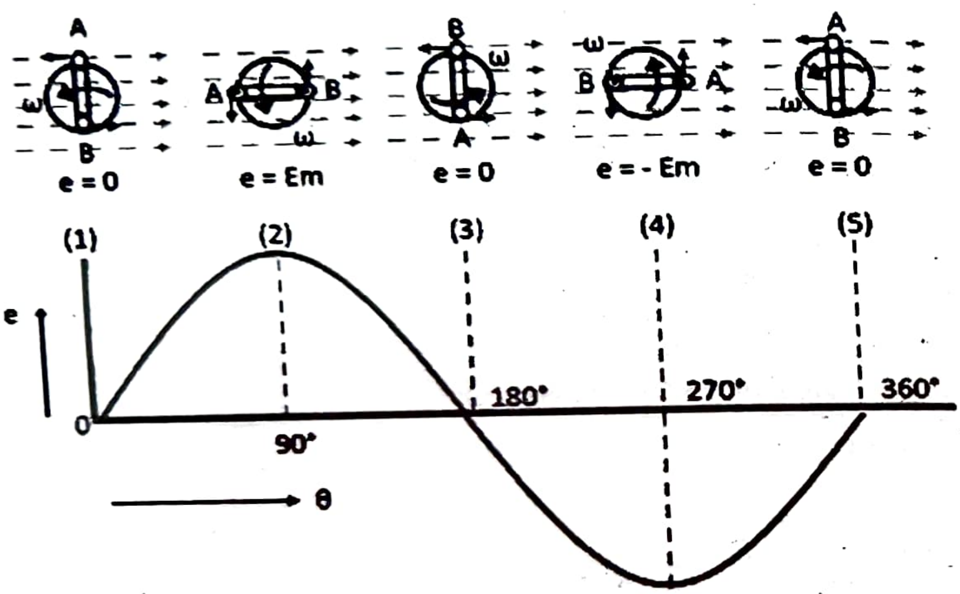
1.3 ALTERNATING CURRENT FUNDAMENTALS

Generation of Alternating Voltage

- The voltage which changes polarity at regular interval of time is known as the alternating voltage.
- The one complete cycle of an alternating quantity consists two half cycles, and the direction of a half cycle changes after every particular interval of time.
- The machine which generates the alternating voltage is known as the alternator.
- The alternating voltage is generated in two ways.
- By rotating the coil inside the uniform magnetic field at constant speed
- By rotating the magnetic field around the stationary coil at the constant speed.

Process of Generating Alternating Voltage

- Consider the stationary coil places inside the uniform magnetic field.
- The load is connected across the coil with the help of brushes and the slip rings.
- When the coil rotates in the anticlockwise direction at constant angular velocity ω the electromotive force induces in the coil.
- The cross-sectional view of the coil at the different position is shown in the figure below.



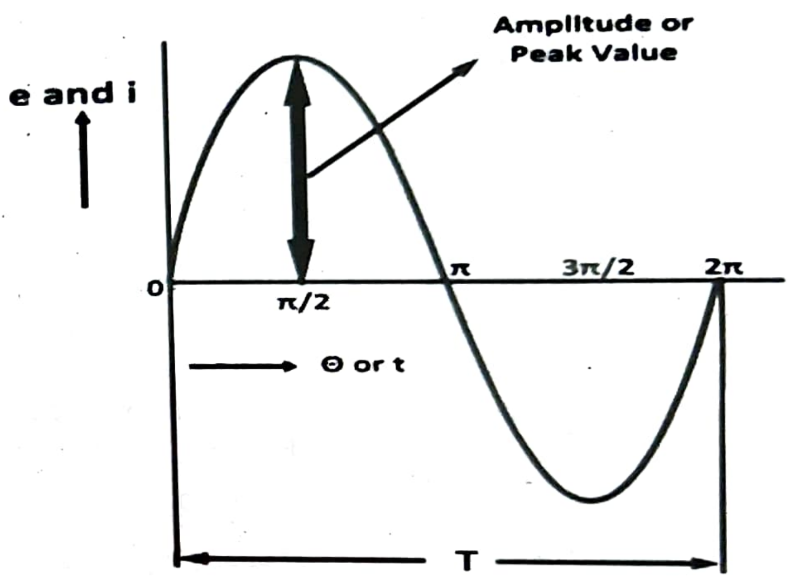
- The magnitude of the emf induced in the coil depends on the rate of the flux cut by the conductor.
- The figure below shows that the no current induces in the coil when they are parallel to the magnetic line of forces. i.e., at the position (1), (2) and (3). And the total flux cut by the conductor becomes zero.
- The magnitude of the induces emf becomes maximum when the conductor becomes perpendicular to the magnetic line of force. The conductor cuts the maximum flux at this position.
- The direction of the emf induces in the conductor is determined by Fleming's right-hand rule.

- When the coil is at position (2) the emf induces in the outward direction of the conductor whereas at position (4) the direction of the inducing emf becomes inward.
- In other words, the direction of emf induces in the conductor at position (2) and (4) becomes opposite to each other.

Peak Value, Average Value and RMS Value

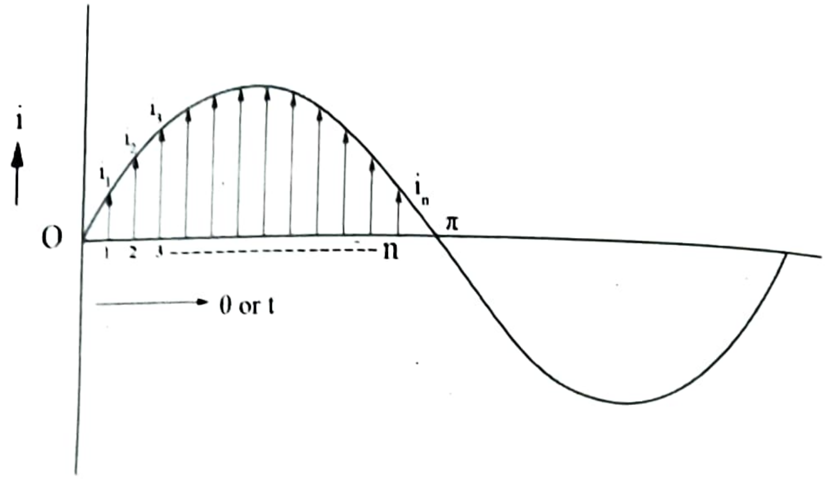
Peak Value

- The maximum value attained by an alternating quantity during one cycle is called its Peak value.
- It is also known as the maximum value or amplitude or crest value.
- The sinusoidal alternating quantity obtains its peak value at 90 degrees as shown in the figure below.
- The peak values of alternating voltage and current is represented by Em and Im respectively.



Average Value

- The average of all the instantaneous values of an alternating voltage and currents over one complete cycle is called Average Value.
- If we consider symmetrical waves like sinusoidal current or voltage waveform, the positive half cycle will be exactly equal to the negative half cycle. Therefore, the average value over a complete cycle will be zero.
- The work is done by both, positive and negative cycle and hence the average value is determined without considering the signs.
- So, the only positive half cycle is considered to determine the average value of alternating quantities of sinusoidal waves.

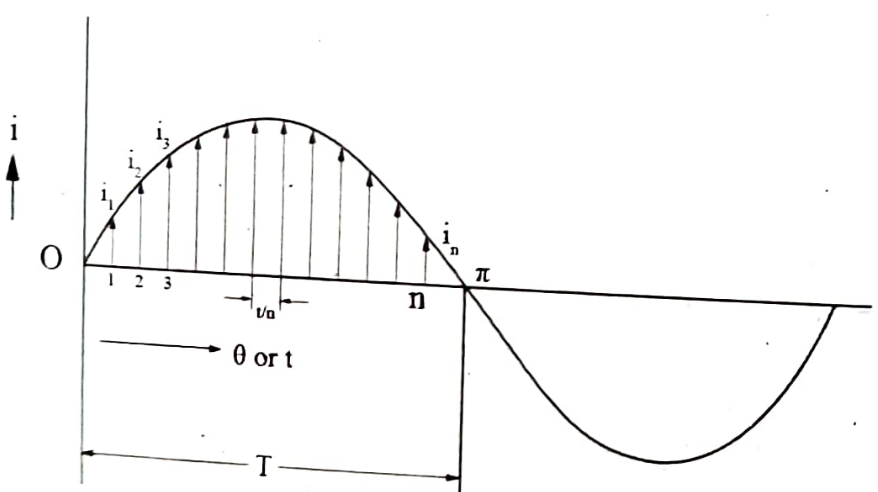


- Divide the positive half cycle into (n) number of equal parts as shown in the above figure
- Let i1, i2, i3........ in be the mid ordinates
- The Average value of current Iav = mean of the mid ordinates

$$I_{av} = \frac{i_1 + i_2 + i_3 + \dots\dots\dots + i_n}{n} = \frac{Area\ of\ alternation}{Base}$$

R.M.S Value

- That steady current which, when flows through a resistor of known resistance for a given period of time than as a result the same quantity of heat is produced by the alternating current when flows through the same resistor for the same period of time is called R.M.S or effective value of the alternating current.
- In other words, the R.M.S value is defined as the square root of means of squares of instantaneous values.
- Let I be the alternating current flowing through a resistor R for time t seconds, which produces the same amount of heat as produced by the direct current (Ieff).
- The base of one alteration is divided into n equal parts so that each interval is of t/n seconds as shown in the figure below.



- Let i1, i2, i3, ... in be the mid ordinates. Then the heat produced in

$$First\ interval = \frac{i_1^2 Rt}{Jn}\ calories$$

$$Second\ interval = \frac{i_2^2 Rt}{Jn}\ calories$$

$$Third\ interval = \frac{i_3^2 Rt}{Jn}\ calories$$

$$n^{th}\ interval = \frac{i_n^2 Rt}{Jn}\ calories$$

$$Total\ heat\ produced = \frac{Rt}{J}\left(\frac{i_1^2 + i_2^2 + i_3^2 + \dots \dots + i_n^2}{n}\right) calories \dots \dots \dots (1)$$

- Since Ieff is considered as the effective value of this current, then the total heat produced by this current will be

$$\frac{I^2_{eff}Rt}{J}\ calories \dots \dots \dots (2)$$

Now, equating equation (1) and (2) we will get

$$\frac{I^2_{eff}Rt}{J} = \frac{Rt}{J}\left(\frac{i_1^2 + i_2^2 + i_3^2 + \dots \dots + i_n^2}{n}\right) or$$

$$I_{eff} = \sqrt{\frac{i_1^2 + i_2^2 + i_3^2 + \dots \dots + i_n^2}{n}}$$

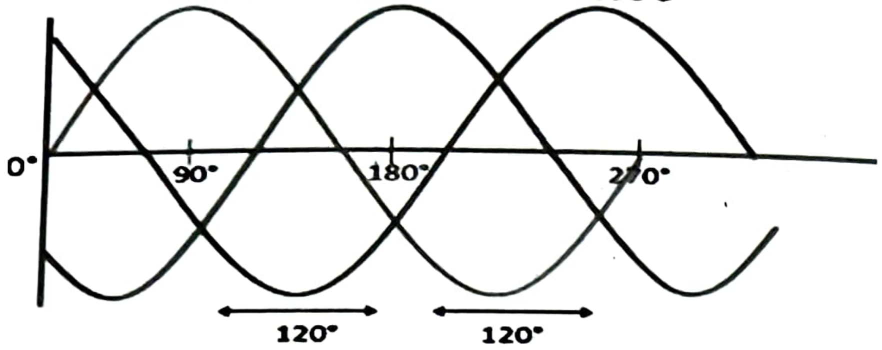
$$I_{eff} = \sqrt{mean\ of\ squares\ of\ instantaneous\ value}$$

Ieff = square root of mean of squares of instantaneous values = R.M.S value

Three Phase System

- The system which uses three wires for generation, transmission and distribution is known as the three phase system.
- The three phase system is also used as a single phase system if one of their phase and the neutral wire is taken out from it.
- The sum of the line currents in the 3-phase system is equal to zero, and their phases are differentiated at an angle of 120°.
- The three-phase system has four wire, i.e., the three current carrying conductors and the one neutral.
- The cross section area of the neutral conductor is half of the live wire.
- The current in the neutral wire is equal to the sum of the line current of the three wires and consequently equal to √3 times the zero phase sequence components of current.
- The three-phase system has several advantages like it requires fewer conductors as compared to the single phase system.
- The three-phase system has higher efficiency and minimum losses.

- It provides an uninterruptible power, i.e., if one phase of the system is disturbed, then the remaining two phases of the system continue supplies the power.
- The magnitude of the current in one phase is equal to the sum of the current in the other two phases of the system.



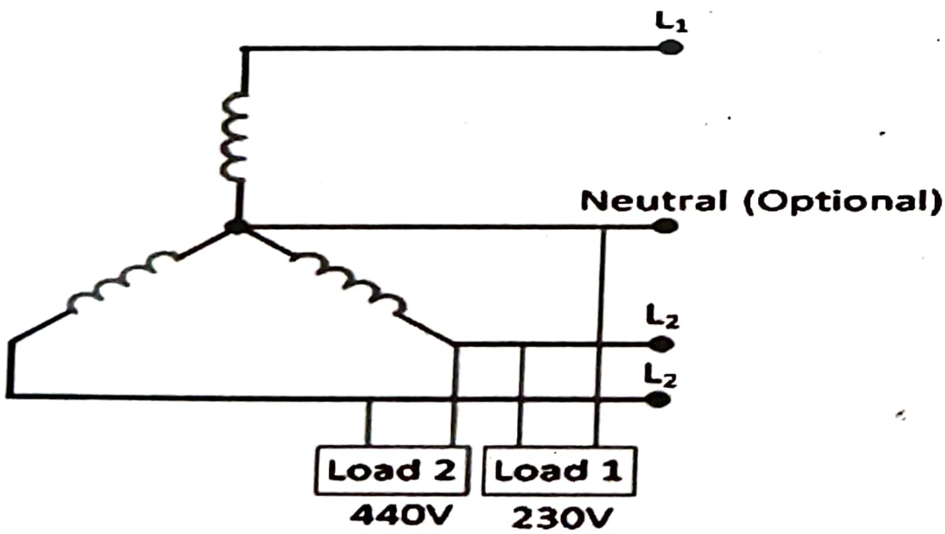
- The 120° phase difference of the three phases is must for the proper working of the system. Otherwise, the system becomes damaged.

Types of Connections in Three-Phase System

- The three-phase systems are connected in two ways, i.e., the star connection and the delta connection.

Star Connection

- The star connection requires four wires in which there are three phase conductors and one neutral conductor.
- Such type of connection is mainly used for long distance transmission because it has a neutral point.
- The neutral point passes the unbalanced current to the earth and hence make the system balance.



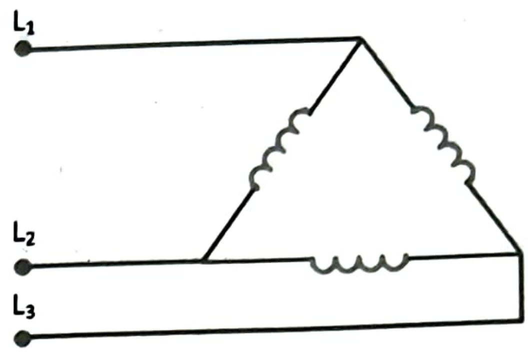
3 - phase Star Connected System

- The star connected three phase systems gives two different voltages, i.e., the 230 V and 440V.

- The voltage between the single phase and the neutral is 230V, and the voltage between the two phases is equal to the 440V.

Delta Connection

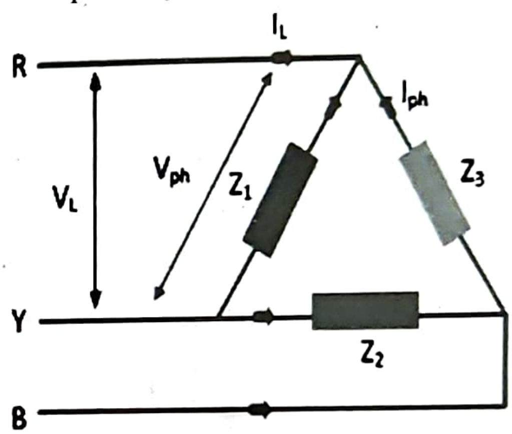
- The delta connection has three wires, and there is a no neutral point.
- The line voltage of the delta connection is equal to the phase voltage.



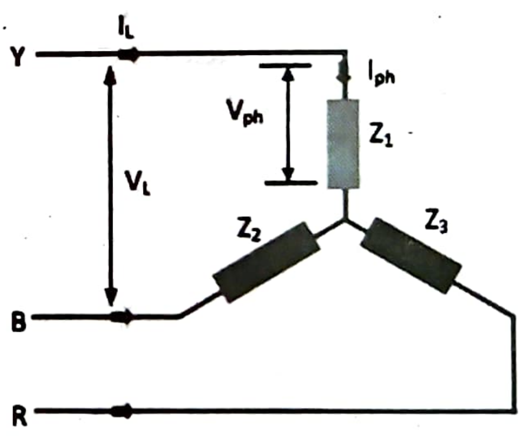
3 - Phase Delta Connection

Connection of Loads in Three Phase System

- The loads in the three-phase system may also connect in the star or delta.



3 - Phase Load Connected in Delta



3 - Phase Load Connected In Star

- The three phase load may be balanced or unbalanced.
- If the three loads (impedances) Z1, Z2 and Z3 has the same magnitude and phase angle then the three phase load is said to be a balanced load.
- Under balance condition, all the phases and the line voltages are equal in magnitude.

1.4 SEMICONDUCTOR DEVICES

- A semiconductor diode is a two-terminal electronic component made of a semiconductor material, typically silicon.
- It allow current to flow in one direction only (rectification).The characteristics of a semiconductor diode include:
- **Forward bias:** when a positive voltage is applied to the anode (A) and negative voltage to the cathode (K), the diode is said to be forward biased. This allows current to flow through the diode and is the operating mode of a rectifying diode.
- **Reverse bias:** when a negative voltage is applied to the anode and positive voltage to the cathode, the diode is said to be reverse biased. This blocks current flow and is used to protect other components in a circuit.
- **Forward voltage (Vf):** this is the minimum voltage required to forward-bias a diode and start current flow.
- **Reverse breakdown voltage (Vbr):** this is the maximum reverse voltage that a diode can withstand without breakdown.
- **Forward resistance (Rf):** this is the resistance offered by the diode when it is forward-biased and conducting.
- **Reverse resistance (Rr):** this is the resistance offered by the diode when it is reverse-biased and not conducting.

BJT Configuration and biasing

- A bipolar junction transistor (BJT) is a three-terminal electronic component used for amplification and switching in electronic circuits.
- The three terminals are the emitter (E), base (B), and collector (C).
- There are two basic configurations of a BJT: NPN and PNP.
- In an NPN configuration, the emitter is connected to the negative voltage supply, while in a PNP configuration, the emitter is connected to the positive voltage supply.
- Biasing of a BJT refers to the DC operating point or the steady-state
- DC voltage and current levels in the transistor, which determine its operating mode and performance.
- There are two main types of biasing in BJT circuits:

Fixed bias: a fixed voltage is applied to the base-emitter junction, and the emitter current is determined by the combination of this bias voltage and the transistor's current gain (hfe).

Self-biasing: also known as self-bias or emitter bias, the emitter current is fed back to the base-emitter junction through a resistor, creating a stable operating point for the transistor.

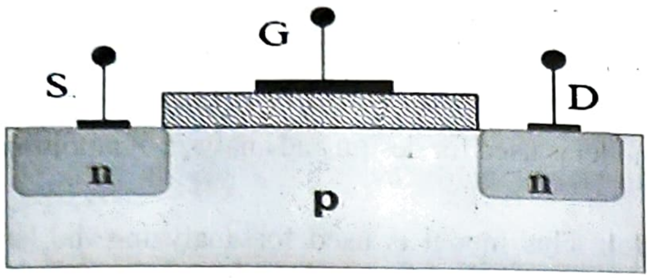
- A bipolar junction transistor (BJT) can be modeled in two ways depending on the magnitude of the input signal: the small-signal model and the large-signal model.
  Small-signal model: This model is used for analyzing the small-signal AC behavior of a BJT, such as its voltage gain, input impedance, and output impedance.
  In this model, the transistor is considered to operate in its active region, and the non-linear characteristics of the transistor are approximated as linear.
  The small-signal model is used for design and analysis of amplifiers, oscillators, and other linear circuits.
  Large-signal model: This model is used for analyzing the large-signal, or dynamic, behavior of a BJT, such as its saturation and cutoff regions.
  In this model, the transistor is considered to operate in its non-linear region and the transfer characteristic of the transistor is plotted as a function of the base current and collector current.
  The large-signal model is used for design and analysis of power amplifiers and switching circuits.
- Three operating regions
  - Linear – region operation:
    - Base – emitter junction forward biased
    - Base – collector junction reverse biased
  - Cutoff – region operation:
    - Base – emitter junction reverse biased
    - Base – collector junction reverse biased
  - Saturation – region operation:
    - Base – emitter junction forward biased
    - Base – collector junction forward biased
- Three operating regions of BJT
  - Cut off: VCE = VCC, IC ≅ 0
  - Active or linear: VCE ≅ VCC/2, IC ≅ IC max/2
  - Saturation: VCE ≅ 0, IC ≅ IC max

MOSFET: Working and Its Applications

- The MOSFET (Metal Oxide Semiconductor Field Effect Transistor) transistor is a semiconductor device that is widely used for switching purposes and for the amplification of electronic signals in electronic devices.
- A MOSFET is a four-terminal device having source(S), gate (G), drain (D) and body (B) terminals.
- The body of the MOSFET is in connection with the source terminal thus forming a three-terminal device such as a field-effect transistor.
- MOSFET is generally considered as a transistor and employed in both the analog and digital circuits.
- MOSFETs are particularly useful in amplifiers due to their input impedance being nearly infinite which allows the amplifier to capture almost all the incoming signal.

- The main advantage is that it requires almost no input current to control the load current and that's why we choose MOSFET over BJT.

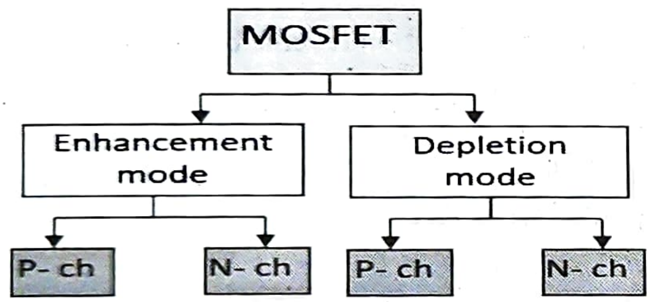
Structure:



MOSFET Structure

- It is a four-terminal device with Source (S), Drain (D), Gate (G), and body (B) terminals.
- The body (B) is frequently connected to the source terminal, reducing the terminals to three.
- It works by varying the width of a channel along which charge carriers flow (electrons or holes).
- The charge carriers enter the channel at the source and exit via the drain. The width of the channel is controlled by the voltage on an electrode called Gate which is located between the source and the drain.
- It is insulated from the channel near an extremely thin layer of metal oxide.

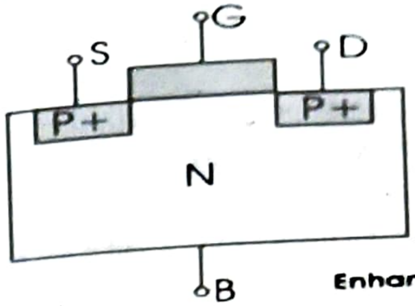
Different Types of MOSFET

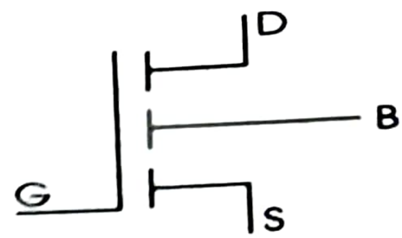


- P- ch = P- channel
- N- ch = N- channel

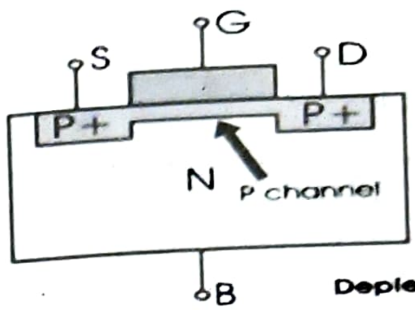
- Basically, MOSFET works in two modes-
  1) **Depletion Mode:** The transistor requires the Gate-Source voltage (VGS) to switch the device "OFF". The depletion-mode MOSFET is equivalent to a "Normally Closed" switch.
  2) **Enhancement Mode:** The transistor requires a Gate-Source voltage (VGS) to switch the device "ON". The enhancement-mode MOSFET is equivalent to a "Normally Open" switch.
- Now with respect to the working principle, MOSFET is classified as follows:
- P-Channel Depletion MOSFET
- P-Channel Enhancement MOSFET
- N-Channel Depletion MOSFET
- N-Channel Enhancement MOSFET

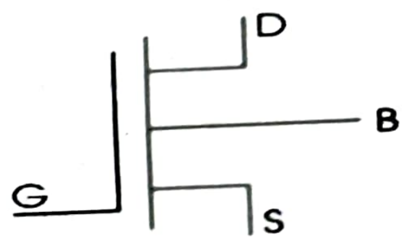
P-Channel MOSFET





Enhancement Mode

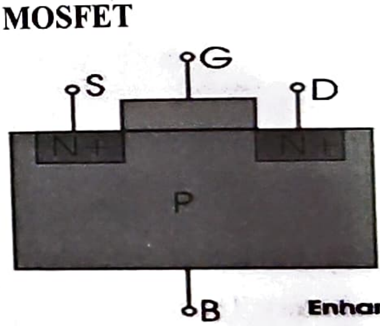


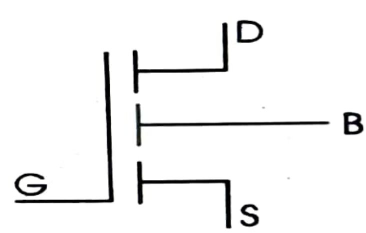


Depletion Mode

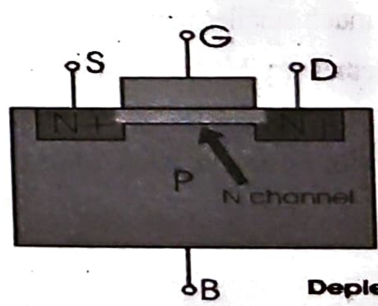
- The drain and source are heavily doped p+ region and the substrate is in n-type.
- The current flows due to the flow of positively charged holes, and that's why known as p-channel MOSFET.
- When we apply negative gate voltage, the electrons present beneath the oxide layer experience repulsive force and are pushed downward into the substrate, the depletion region is populated by the bound positive charges which are associated with the donor atoms.
- The negative gate voltage also attracts holes from the P+ source and drain region into the channel region.

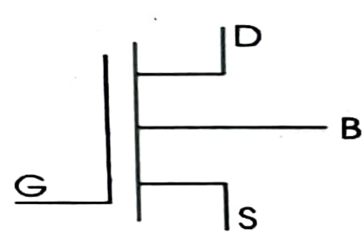
N-Channel MOSFET





Enhancement Mode





Depletion Mode

- The drain and source are heavily doped N+ region and the substrate is p-type.
- The current flows due to the flow of negatively charged electrons and that's why known as n-channel MOSFET.
- When we apply the positive gate voltage, the holes present beneath the oxide layer experience repulsive force, and the holes are pushed downwards into the bound negative charges which are associated with the acceptor atoms.
- The positive gate voltage also attracts electrons from the N+ source and drain region into the channel thus an electron reach channel is formed.

MOSFET Working Operation

- The working principle of a MOSFET depends upon the MOS capacitor.
- The MOS capacitor is the main part of MOS-FET.
- The semiconductor surface at the below oxide layer is located between the source and drain terminals.
- It can be inverted from p-type to n-type by applying positive or negative gate voltages.
- When we apply positive gate voltage, the holes present under the oxide layer experience a repulsive force, and holes are pushed downward with the substrate.
- The depletion region is populated by the bound negative charges which are associated with the acceptor atoms.
- The electrons reach the channel is formed. The positive voltage also attracts electrons from the n+ source and drain regions into the channel.
- Now, if a voltage is applied between the drain and source, the current flows freely between the source and drain and the gate voltage controls the electrons in the channel.
- If we apply negative voltage, a hole channel will be formed under the oxide layer.

Applications

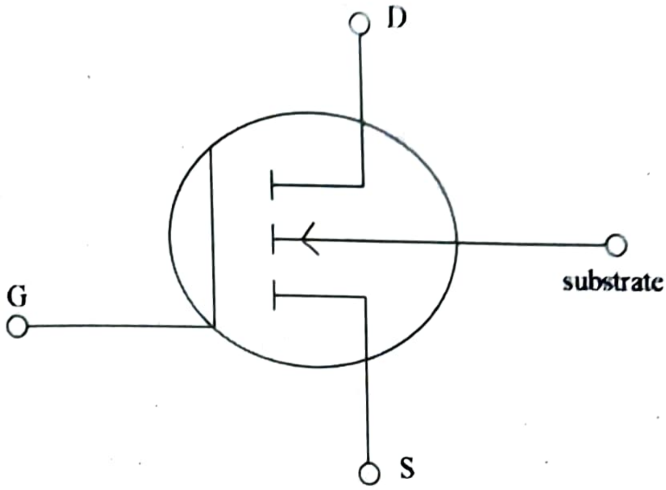
- Amplifiers
- Regulation for DC Motors
- Constructions of Chopper Amplifiers
- Switching and Amplifying Signals

CMOS: Working Principle & Its Applications

- The term CMOS stands for "Complementary Metal Oxide Semiconductor".
- CMOS (Complementary Metal Oxide Semiconductor): The main advantage of CMOS over NMOS and BIPOLAR technology is the much smaller power dissipation.
- Unlike NMOS or BIPOLAR circuits, a Complementary MOS circuit has almost no static power dissipation.
- Complementary Metal Oxide Semiconductor transistor consists of P-channel MOS (PMOS) and N-channel MOS (NMOS.

NMOS

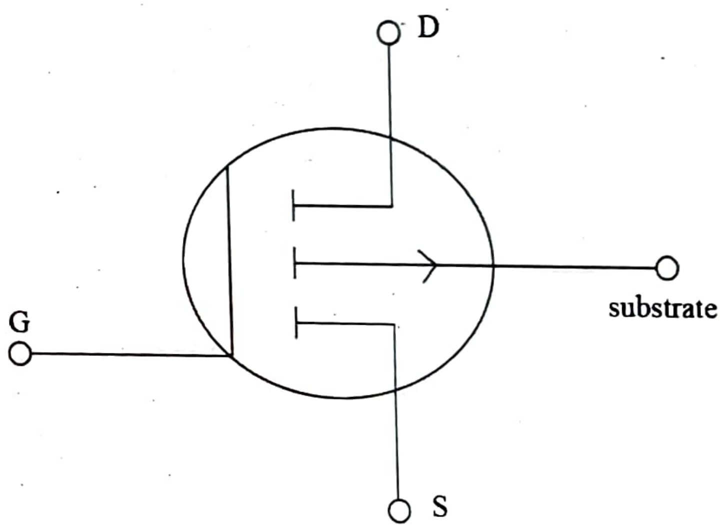
- The symbol of the NMOS transistor is shown below:



- The n-channel MOSFET is called NMOS.
- It has a substrate of p-type, which consists of majority carriers holes.
- The n-channel consists of majority carriers electrons.
- The flow of electrons is fast as compared to holes. Hence, NMOS transistors are more rapid than PMOS transistors.

PMOS

- The symbol of the PMOS transistor is shown below:



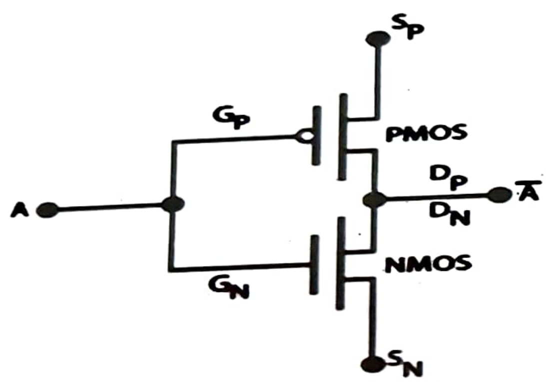
p-channel

- The p-channel MOSFET is called PMOS.
- It has a substrate of n-type, which consists of majority carriers electrons.
- When a negative voltage is applied to the gate end of the PMOS, it repels the electrons.
- The attraction of holes results in the formation of the channel called the p-channel.
- The channel is formed between the source and drain.
- The slow flow of holes makes the current controlled process of PMOS easy as compared to NMOS transistors.

CMOS Working Principle

- The structure as shown consists of the NMOS transistor inverted on the top of the PMOS transistor.
- The substrate is of the P-type, and three N++ regions.
- The two N++ regions are small and the third N++ region is large.
- The two smaller regions are a part of the NMOS transistor, while the third N++ region is a part of the PMOS transistor.
- The two P++ regions are diffused into the larger N++ region to form the PMOS transistor.
- The top surface is protected and covered using the Silicon dioxide layer (SiO2) with aluminum's metallization.
- CMOS has the least amount of power dissipation in the switching applications.
- It is because when one transistor is OFF, the other becomes ON. For example, if PMOS is ON, the NMOS transistor will be OFF.
- The value of VDD voltage is generally selected between 5V and 15V.

The symbol of CMOS is shown below:



CMOS Characteristics

- The most important characteristics of CMOS are :
  - Low static power utilization,
  - Huge noise immunity.

1.5 SIGNAL GENERATOR

Basic Principles of Oscillator

- An oscillator is a circuit that generates a periodic, repeating waveform (typically a sine wave or square wave). The basic principles of an oscillator include:

  Positive Feedback: A portion of the output waveform is fed back into the input in such a way that it reinforces the original waveform.

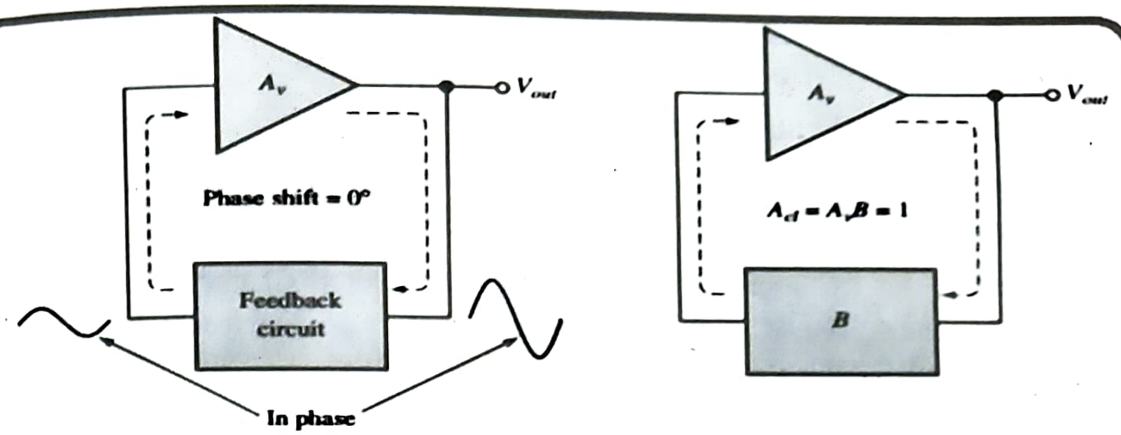
  Resonant Circuit: The oscillator circuit includes an LC (inductor-capacitor) resonant circuit that determines the frequency of oscillation.

Amplification: An amplifier is used to boost the strength of the oscillating signal.

Stability criteria: The circuit must meet stability criteria to ensure that the oscillation remains sustained.

Conditions Required for Oscillation

- The 2 conditions required for oscillation explained in the below figure.

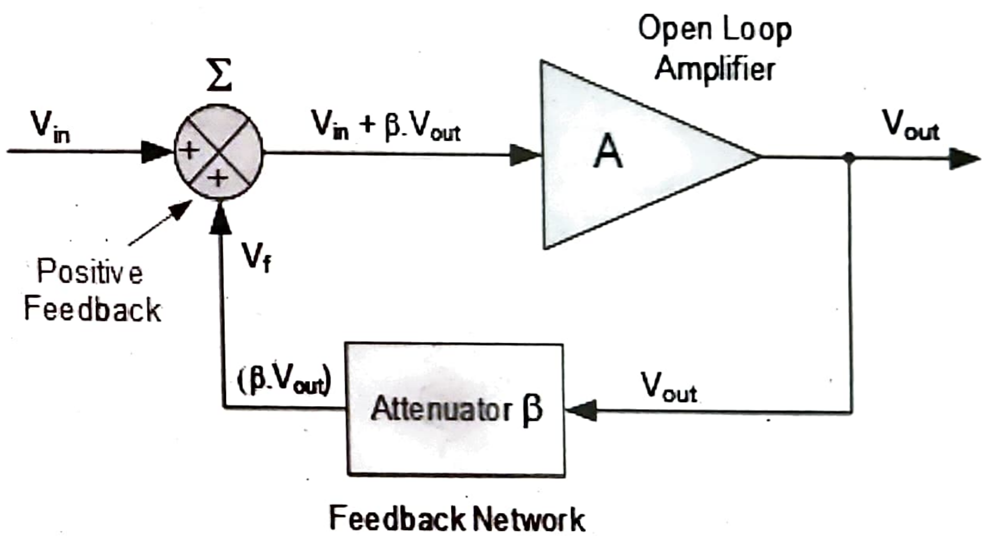


(a) The phase shift around the loop is 0°. (b) The closed loop gain is 1.

General conditions to sustain oscillation.

- The phase shift about the feedback loop should be at zero degrees.
- The value of voltage gain is Acl about the closed feedback loop should have value one.

Basic Oscillator Feedback Circuit



Where: β is a feedback fraction.

Oscillator Gain without Feedback

Gain, $A = \frac{V_{OUT}}{V_{IN}}$ A = *open loop voltage gain*

$\therefore$ $V_{OUT} = A \times V_{IN}$

Oscillator Gain with Feedback

$$A\left(V_{IN} + \beta V_{OUT}\right) = V_{OUT}$$

$$A \times V_{IN} + A\beta \times V_{OUT} = V_{OUT}$$

$$A \times V_{IN} = V_{OUT}\,(1 - A\beta)$$

$$\therefore \quad \frac{V_{OUT}}{V_{IN}} = Gv = \frac{A}{1 - A\beta}$$

β is the feedback fraction

Aβ = the voltage loop gain

1 - aβ = positive feedback factor

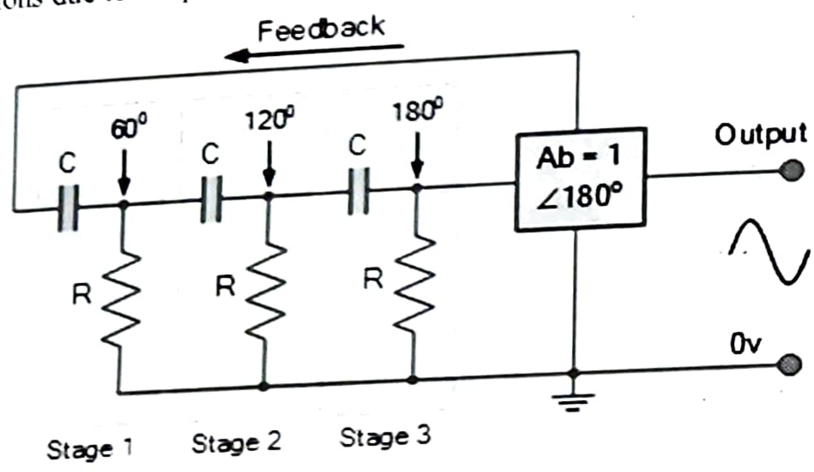
Gv = the closed loop voltage gain

RC, LC and Crystal Oscillators Circuits

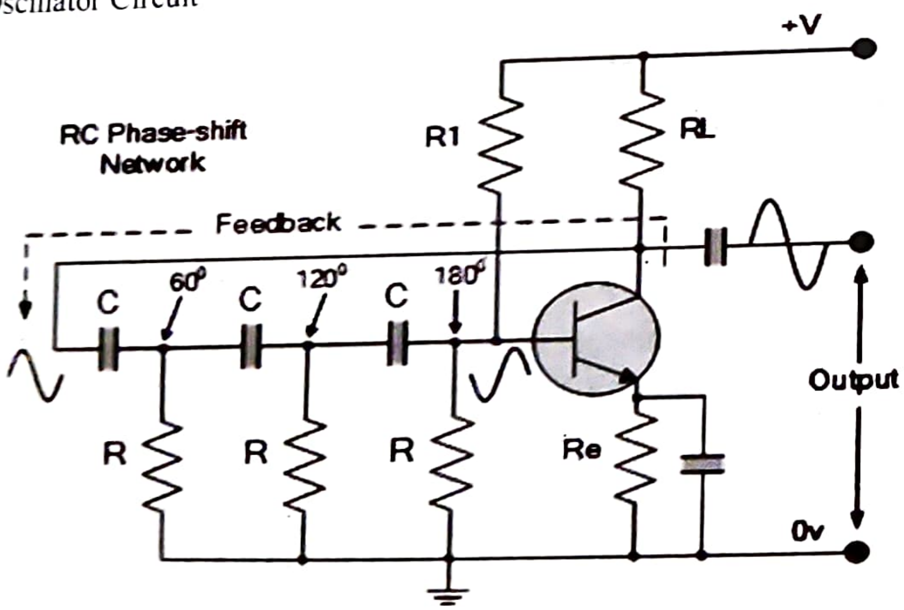
RC, LC, and crystal oscillators are three different types of oscillator circuits that generate a periodic waveform.

RC Oscillator: An RC oscillator uses a resistor-capacitor (RC) circuit to generate an oscillating waveform. The RC circuit provides the necessary positive feedback and resonant circuit to sustain the oscillation.

RC Oscillators use a combination of an amplifier and an RC feedback network to produce output oscillations due to the phase shift between the stages



Basic RC Oscillator Circuit



The basic **RC Oscillator** which is also known as a **Phase-shift Oscillator**, produces a sine wave output signal using regenerative feedback obtained from the resistor-capacitor (RC) ladder network.

- This regenerative feedback from the RC network is due to the ability of the capacitor to store an electric charge, (similar to the LC tank circuit).
- This resistor-capacitor feedback network produce a leading phase shift (phase advance network) or interchanged to produce a lagging phase shift (phase retard network) the outcome is still the same as the sine wave oscillations only occur at the frequency at which the overall phase-shift is 360°.
- By varying one or more of the resistors or capacitors in the phase-shift network, the frequency can be varied
- If the three resistors, R are equal in value, that is $R_1 = R_2 = R_3$, and the capacitors, C in the phase shift network are also equal in value, $C_1 = C_2 = C_3$, then the frequency of oscillations produced by the RC oscillator is simply given as:

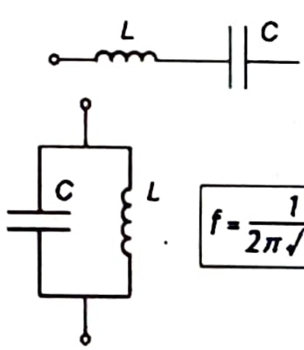
$$f_r = \frac{1}{2\pi RC\sqrt{2N}}$$

Where:

- f_r is the oscillators output frequency in Hertz
- R is the feedback resistance in Ohms
- C is the feddback capacitance in Farads
- N is the number of RC feedback stages.

- It could be assumed that the three phase shift sections are independent of each other but this is not the case as the total accumulative feedback attenuation becomes -1/29th ($V_o/V_i = \beta = -1/29$) across all three stages
- In order to produce a total loop gain of -1, in our three stage RC network above, the amplifier gain must be equal too, or greater than, 29 to compensate for the attenuation of the RC network.

LC Oscillator: An LC oscillator uses an inductor-capacitor (LC) circuit to generate an oscillating waveform. The LC circuit provides the necessary resonant circuit and positive feedback to sustain the oscillation. LC oscillators are often used to generate higher frequency waveforms than RC oscillators.



$$\boxed{f = \frac{1}{2\pi\sqrt{LC}}}$$

In LC oscillator the feedback network consists of inductor and capacitor .These LC component determines the frequency of oscillation.

- LC oscillators are also known as tuned oscillators. These oscillators can operate at high frequencies from 200 Khz to some Ghz.
- They are not suitable for low frequency operations because at low frequencies the value of inductor and capacitor is very large due to this the circuit becomes more bulky and expensive.
- Analysis of these type can revels that the following types of oscillators are obtained when the reactance elements are as designed.

Oscillator Type	**Reactance Element**
Colpitts Oscillator	C,C.L
Hartley Oscillator	L,L,C
clapp Oscillator	C,C,L and extra capacitor C
Tuned input and tuned output	LC,LC

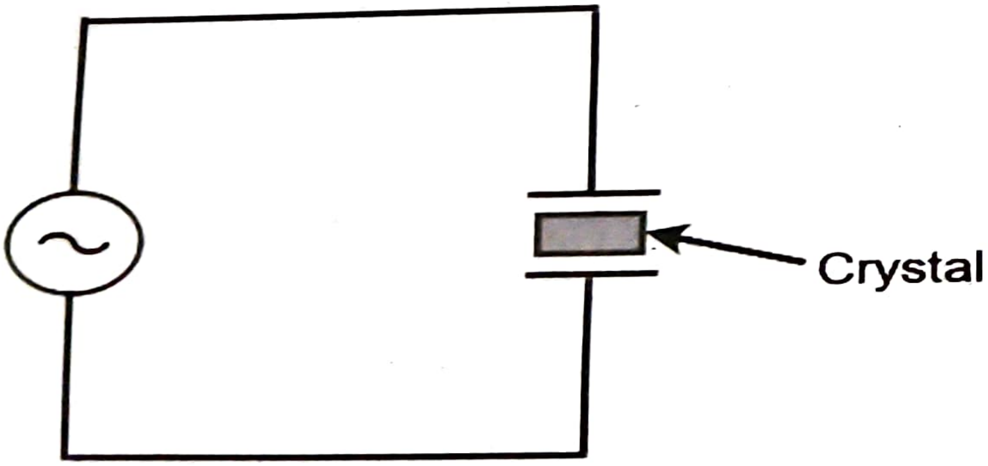
Crystal Oscillator

- A crystal oscillator uses a quartz crystal resonator to generate a precise, stable frequency.
- The principle of crystal oscillators depends upon the **Piezo electric effect**
- The crystal resonator provides the necessary resonant circuit and the accompanying oscillator circuit provides the necessary positive feedback and amplification to sustain the oscillation.
- Crystal oscillators are widely used for precise frequency generation in applications such as clocks, timing circuits, and radio communication.

Working of a Quartz Crystal

- In order to make a crystal work in an electronic circuit, the crystal is placed between two metal plates in the form of a capacitor
- The ac voltage is applied in parallel to the crystal.

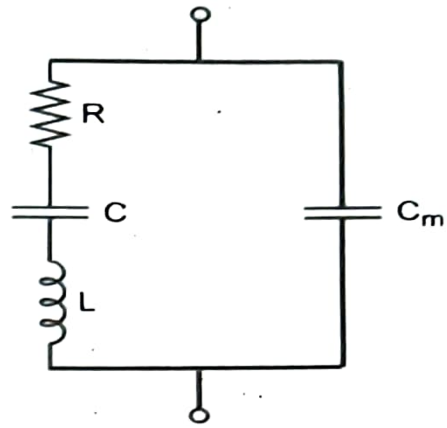
The circuit arrangement of a Quartz Crystal will be as shown below –



- If an AC voltage is applied, the crystal starts vibrating at the frequency of the applied voltage.
- However, if the frequency of the applied voltage is made equal to the natural frequency of the crystal, **resonance** takes place and crystal vibrations reach a maximum value. This natural frequency is almost constant.

Equivalent circuit of a Crystal

Symbol of a Crystal



Equivalent circuit of a crystal

- The above equivalent circuit consists of a series R-L-C circuit in parallel with a capacitance C_m.
- When the crystal mounted across the AC source is not vibrating, it is equivalent to the capacitance C_m.
- When the crystal vibrates, it acts like a tuned R-L-C circuit.

Waveform generators

A waveform generator is an electronic device that outputs various types of electrical waveforms, including sine waves, square waves, triangular waves, and sawtooth waves. The waveform generator can be used for various purposes such as testing, calibration, and demonstration of electronic circuits and systems. There are different types of waveform generators, including:

Function Generators: These are versatile waveform generators that can produce sine, square, triangular, and sawtooth waveforms. They are often used for testing and development in electronics and engineering.

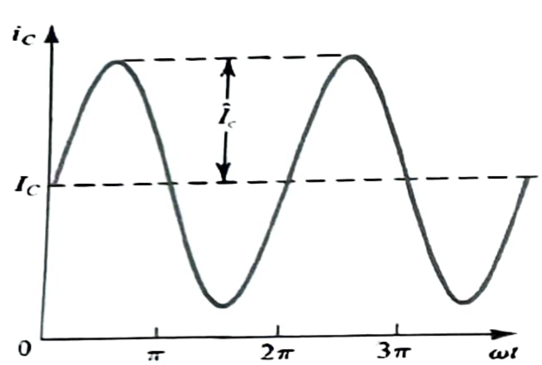
Arbitrary Waveform Generators: These waveform generators can produce any desired waveform. They are often used for testing and simulation in communication systems, digital signal processing, and instrumentation applications.

Pulse Waveform Generators: These waveform generators produce pulses, which are short bursts of electrical energy. They are often used for testing and development in high-speed digital circuits, such as memory and logic devices.

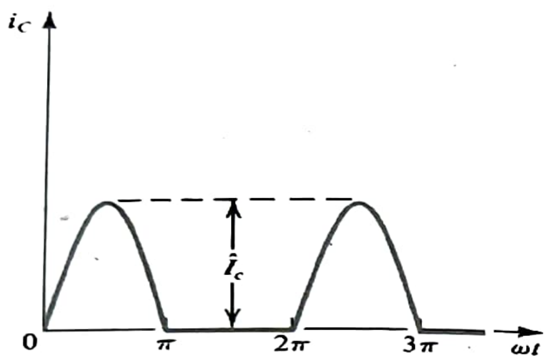
Digital Waveform Generators: These waveform generators use digital signal processing techniques to generate waveforms. They are often used in applications such as audio and video testing, as well as in data communication systems.

Classification of Output Stages

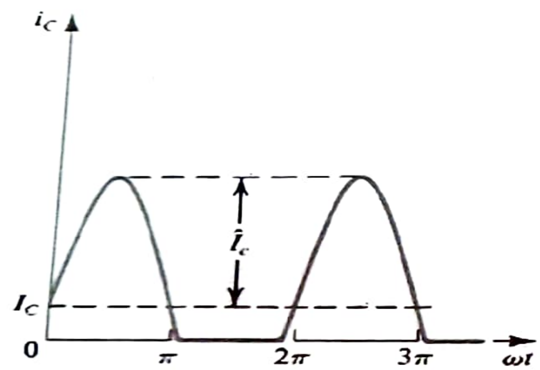
- Output stages are classified according to the collector current waveform that results when an input signal is applied.
- The class A stage, whose associated waveform is shown in Fig.(a), is biased at a current IC greater than the amplitude of the signal current, . Thus the transistor in a class A stage conducts for the entire cycle of the input signal; that is, the conduction angle is 360°.
- In contrast, the class B stage, whose associated waveform is shown in Fig.(b),is biased at zero dc current. Thus a transistor in a class B stage conducts for only half the cycle of the input sine wave, resulting in a conduction angle of 180.



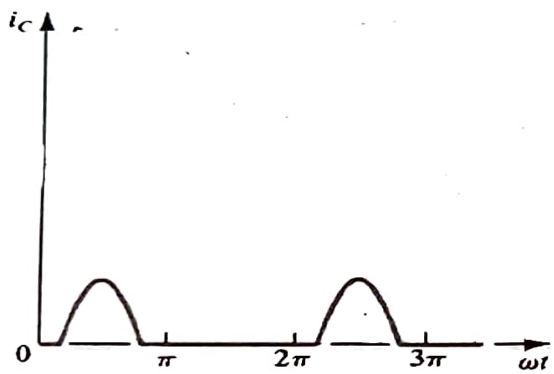
(a)



(b)



(c)



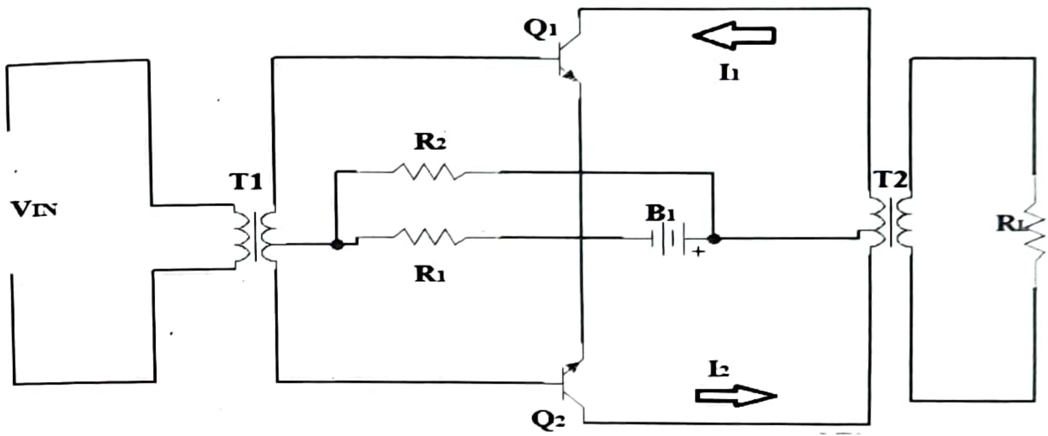
(d)

- The negative halves of the sinusoid will be supplied by another transistor that also operates in the class B mode and conducts during the alternate half-cycles.
- An intermediate class between A and B, appropriately named class AB, involves biasing the transistor at a nonzero dc current much smaller than the peak current of the sine-wave signal.
- As a result, the transistor conducts for an interval slightly greater than half a cycle, as illustrated in Fig.(c).

- The resulting conduction angle is greater than 180° but much less than 360°.
- The class AB stage has another transistor that conducts for an interval slightly greater than that of the negative half-cycle, and the currents from the two transistors are combined in the load.
- It follows that, during the intervals near the zero crossings of the input sinusoid, both transistors conduct. Figure(d) shows the collector-current waveform for a transistor operated as a class C amplifier.

Transformer-Coupled Push-Pull Stages

- Transformer-coupled push-pull stages refer to a type of circuit configuration used in electronic amplification. In this design, two or more transistors are used in a push-pull configuration, with one transistor handling the positive half-cycle of the input signal and the other handling the negative half-cycle.
- The transformers serve to isolate and balance the two halves of the circuit, improving overall performance and reducing distortion. This configuration is commonly used in high-power audio amplifiers, RF power amplifiers, and other applications requiring high gain and efficiency.



- The Class-A amplifier contains two identical transistors Q1 and Q2.
- The emitter terminals of these two transistors are connected together.
- Resistors R1 and R2 are used for biasing the transistors. One transistor has to be forward-biased during the positive half-cycle of the signal while the other during negative half-cycle.

Tuned Amplifier

These amplifiers are one kind of amplifier that selects the particular range of frequencies and rejects the undesired frequencies by employing a tuned circuit at its load. The selective range of frequencies can be amplified by using these amplifiers. We can define the tuned circuit in different ways. These are helpful to amplify the higher frequencies or radio frequencies. These amplifiers include the tuned circuits at its load part to select the desired frequencies. Tuning can be done by a tuned circuit. Tuning means selecting particular frequencies. The tuning circuit can be built with various components like inductor (L) and capacitor (C). The parallel combination of the inductor and capacitor is called a tuned circuit. Tuned circuit efficiency defines the performance of this amplifier. Below figure 1 shows the basic diagram of an amplifier circuit.

Types of Tuned Amplifiers

These amplifiers mainly have three types. They are

- Single tuned
- Double tuned
- Stagger tuned

Advantages

The advantages of this amplifier include the following.

- There is a minimum power loss in tuned circuits because in the tuned circuit they use only inductor and capacitor reactive components.
- It provides high selectivity.
- SNR at the output level is good.

Applications

- These amplifiers are used to select a particular range of frequencies like in dish, radio, etc.
- These amplifiers are used to amplify the desired signal to a high level.
- These amplifiers are preferable in wireless communication systems.
- Radio and television broadcastings are very helpful to select a particular range of frequencies.

MULTIPLE CHOICE QUESTIONS

1. **Resistance of a wire is yΩ. The wire is stretched to triple its length, then the resistance becomes_____**

   A. y/3 B. 3y
   C. 6y D. y/6

2. **Consider a circuit with two unequal resistances in parallel, then _______**

   A. Large current flows in large resistor
   B. Current is same in both
   C. Smaller resistance has smaller conductance
   D. Potential difference across each is same

3. **In which of the following cases is Ohm's law not applicable?**

   A. Electrolytes
   B. Arc lamps
   C. Insulators
   D. Vacuum ratio values

4. **Which of the following bulbs will have high resistance?**

   A. 220V, 60W B. 220V,100W
   C. 115V,60W D. 115V,100 W

5. **Ohm's law is not applicable to ______**

   A. DC circuits
   B. High currents
   C. Small resistors
   D. Semi-conductors

6. **Conductance is expressed in terms of____**

   A. mho B. mho/m
   C. ohm/m D. m/ohm

7. **Delta connection is also known as____**

   A. Y-connection
   B. Mesh connection
   C. Either Y-connection or mesh connection
   D. Neither Y-connection nor mesh connection

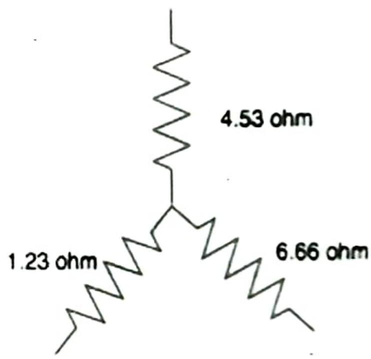
8. **Ra is resistance at A, Rb is resistance at B, Rc is resistance at C in star connection. After transforming to delta, what is resistance between B and C?**

   A. Rc+Rb+Rc*Rb/Ra
   B. Rc+Rb+Ra*Rb/Rc
   C. Ra+Rb+Ra*Rc/Rb
   D. Rc+Rb+Rc*Ra/Rb

9. **Ra is resistance at A, Rb is resistance at B, Rc is resistance at C in star connection. After transforming to delta, what is resistance between A and C?**

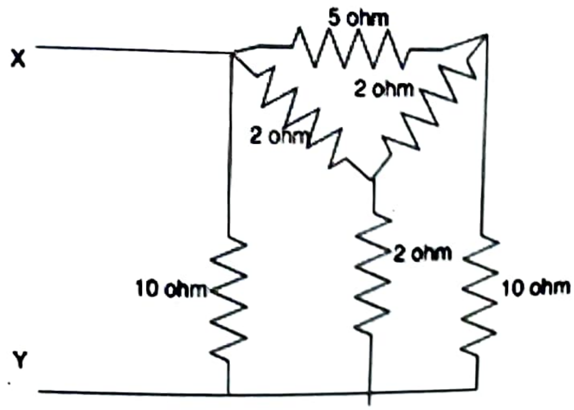
   A. Ra+Rb+Ra*Rb/Rc
   B. Ra+Rc+Ra*Rc/Rb
   C. Ra+Rb+Ra*Rc/Ra
   D. Ra+Rc+Ra*Rb/Rc

10. **Find the equivalent delta circuit.**



   A. 9.69 ohm, 35.71 ohm, 6.59 ohm
   B. 10.69 ohm, 35.71 ohm, 6.59 ohm
   C. 9.69 ohm, 34.71 ohm, 6.59 ohm
   D. 10.69 ohm, 35.71 ohm, 7.59 ohm

11. **Find the equivalent resistance between X and Y.**



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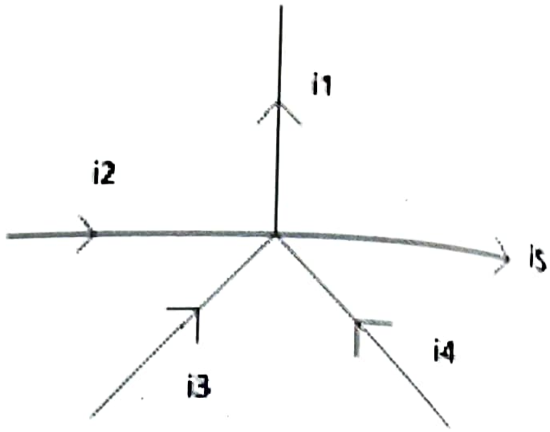

A. $i_1=i_2=i_3=i_4=i_5$ B. $i_1+i_4+i_3=i_5+i_2$

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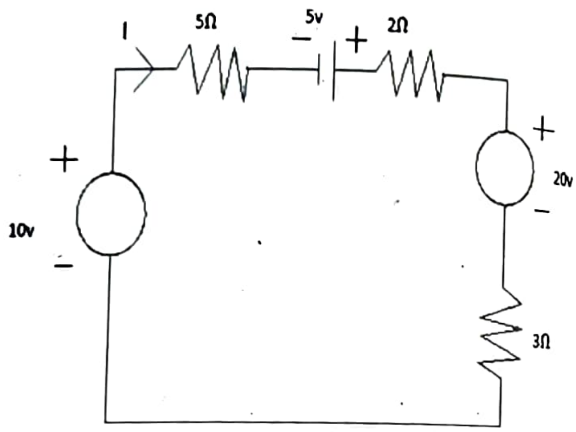
16. **Solve and find the value of I.**



A. -0.5A B. 0.5A

C. -0.2A D. 0.2A

17. **All ______ are loops but ______ are not meshes**

A. Loops, Meshes

B. Meshes, loops

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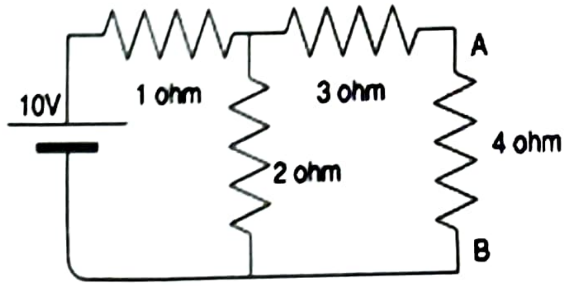

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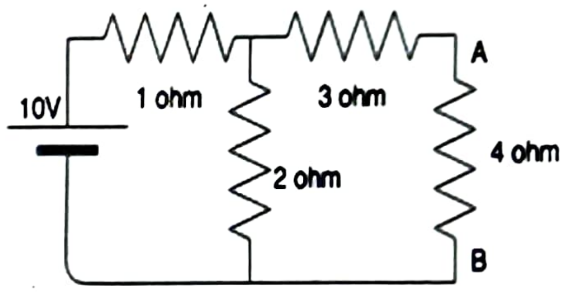

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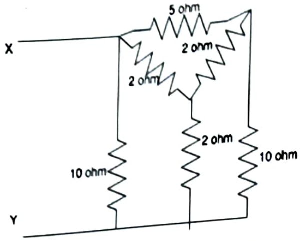

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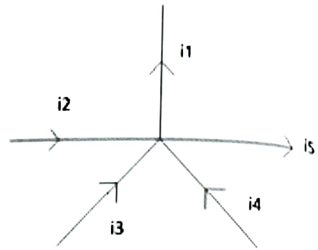

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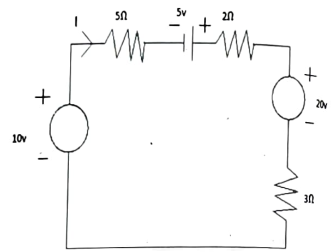

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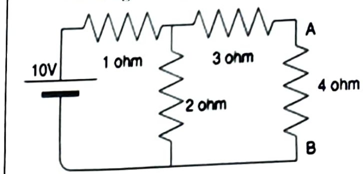

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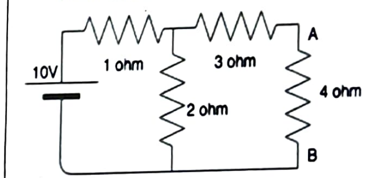

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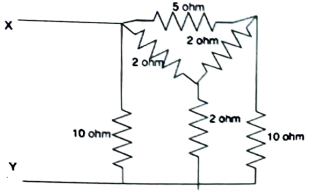

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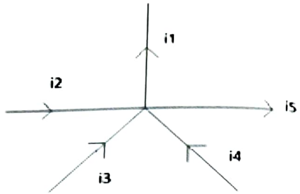

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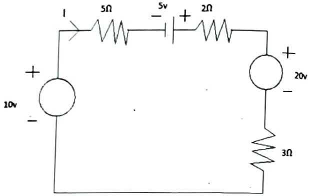

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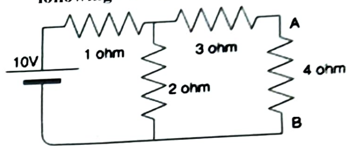

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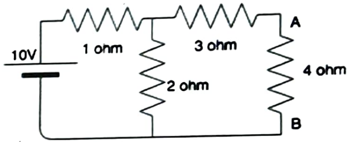

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28. **Thevenin's theorem is true for _____**

A. Linear networks

B. Non-Linear networks

C. Both linear networks and nonlinear networks

D. Neither linear networks nor non-linear networks

29. **In Thevenin's theorem Vth is _____**

A. Sum of two voltage sources

B. A single voltage source

C. Infinite voltage sources

D. 0

30. **Which of the following is also known as the dual of Thevenin's theorem?**

A. Norton's theorem

B. Superposition theorem

C. Maximum power transfer theorem

D. Millman's theorem

31. **The Norton current is the_______**

A. Short circuit current

B. Open circuit current

C. Open circuit and short circuit current

D. Neither open circuit nor short circuit current

32. **Norton resistance is found by?**

A. Shorting all voltage sources

B. Opening all current sources

C. Shorting all voltage sources and opening all current sources

D. Opening all voltage sources and shorting all current sources

33. **Norton's theorem is true for _______**

A. Linear networks

B. Non-Linear networks

C. Both linear networks and nonlinear networks

D. Neither linear networks nor non-linear networks

34. **In Norton's theorem ISC is_______**

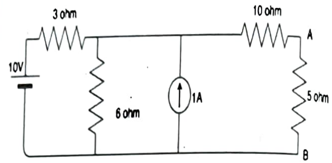
A. Sum of two current sources

B. A single current source

C. Infinite current sources

D. 0

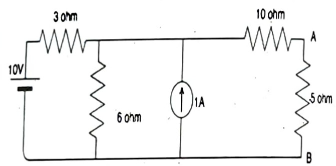
35. **Calculate the Norton resistance for the following circuit if 5 ohm is the load resistance.**



A. 10 ohm B. 11 ohm

C. 12 ohm D. 13 ohm

36. **Find the current in the 5 ohm resistance using Norton's theorem.**



A. 1A B. 1.5A

C. 0.25A D. 0.5A

37. **Which of the following is also known as the dual of Norton's theorem?**

A. Thevenin's theorem

B. Superposition theorem

C. Maximum power transfer theorem

D. Millman's theorem

38. **The maximum power drawn from source depends on _________**

A. Value of source resistance

B. Value of load resistance

C. Both source and load resistance

D. Neither source or load resistance

39. **The maximum power is delivered to a circuit when source resistance is _______ load resistance.**

A. Greater than

B. Equal to

C. Less than

D. Greater than or equal to

40. **The maximum power is delivered to a circuit when source resistance is _____ load resistance.**

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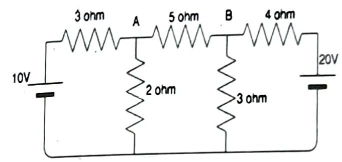
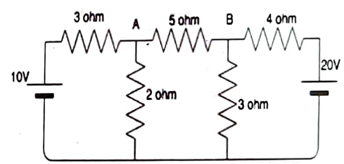
41. **Calculate Eth.**



A. 3.43V B. 4.57V

C. 3.23V D. 5.34V

42. **Calculate the maximum power transferred.**



A. 1.79W B. 4.55W

C. 5.67W D. 3.78W

43. **Under the condition of maximum power efficiency is?**

A. 100% B. 0%

C. 30% D. 50%

44. **When a sinusoidal voltage is applied across R-L series circuit having R= XL , the phase angle will be**

A. 90° B. 45° lag

C. 45° lead D. 90° leading

45. **A unit step voltage is applied at t = 0 to a series R-L circuit with zero initial conditions**

A. It is possible for the current to be oscillatory

B. The voltage across the resistor at $t = 0^+$ is zero

C. The energy stored in the inductor in the steady-state is zero

D. The resistor current eventually falls to zero

46. **At ....frequencies the parallel R-L circuit behaves as purely resistive.**

A. Low B. Very low

C. High D. Very high

47. **The voltage applied across an R-L circuit is equal to..........of VR and VL**

A. Phasor sum

B. Arithmetic sum

C. Sum of the squares

D. Algebraic sum

48. **In a parallel R-C circuit, the current always ....the applied voltage**

A. Lags

B. Leads

C. Remains in phase with

D. None of the above

49. **At very low frequencies a series R-C circuit behaves as almost purely .... circuit**

A. Resistive

B. Inductive

C. Capacitive

D. None of the above

50. **In a series of resonant circuit, with an increase in L**
A. Resonant frequency will decrease
B. Band width will decrease
C. Q will increase
D. All of the above

51. **In a series resonant circuit with the increase in the value of C**
A. Resonant frequency will decrease
B. Q will decrease
C. Band width will increase
D. Both A and B

52. **In series as well as parallel resonance circuit, increase in resistance would cause**
A. Increase in bandwidth of both the circuits
B. Decrease in bandwidth of both the circuits
C. Decrease in bandwidth in series circuit and increase in bandwidth in parallel circuit
D. Increase in bandwidth in series circuit and decrease in bandwidth in parallel circuit

53. **In order to tune a parallel resonant circuit to a lower frequency, the capacitance must**
A. Be increased
B. Be decreased
C. Be zero
D. Remain the same

54. **The dynamic resistance of a parallel resonant circuit is given by**
A. LC/R_L B. LCR_L
C. C/LR_L D. L/CR_L

55. **A parallel AC circuit in resonance will**
A. Have current in each section equal to the line current
B. Have a high voltage developed across each inductive and capacitive section
C. Act like a resistor of low value
D. Have a high impedance

56. **Higher the Q of a series circuit**
A. Broader its resonance curve
B. Narrower its pass band
C. Greater its bandwidth
D. Sharper its resonance

57. **A high Q coil has**
A. Large bandwidth
B. High losses
C. Low losses
D. Flat response

58. **The power factor at resonance in R-L-C parallel circuit is**
A. Zero B. 0.08 lagging
C. 0.8 leading D. Unity

59. **Magnitude of current at resonance in R-L-C circuit**
A. Depends upon the magnitude of R
B. Depends upon the magnitude of L
C. Depends upon the magnitude of C
D. Depends upon the magnitude of R, L and C

60. **In a R-L-C circuit**
A. Power is consumed in resistance and is equal to a I2R
B. Exchange of power takes place between Inductor and supply line
C. Exchange of power takes place between Capacitor and supply line
D. Exchange of power does not take place between resistance and the supply line
E. All of the above

61. **The quality factor of R-L-C circuit will increase if**
A. R increases
B. R decreases
C. Impedance increases
D. Voltage increases

62. **Power in a Three Phase Circuit = ____.**
A. $P = 3\ V_{Ph}\ I_{Ph}\ Cos\Phi$
B. $P = \sqrt{3}\ V_L\ I_L\ Cos\Phi$
C. Both A & B.
D. None of The Above

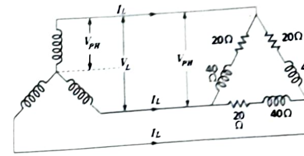
63. **In a three phase AC circuit, the sum of all three generated voltages is ____?**
A. Infinite (∞)
B. Zero (0)
C. One (1)
D. None of the above

64. **For a star connected three phase AC circuit ———**
A. Phase voltage is equal to line voltage and phase current is three times the line current
B. Phase voltage is square root three times line voltage and phase current is equal to line current
C. Phase voltage is equal to line voltage and line current is equal to phase current
D. None of the above

65. **In a three phase, delta connection —**
A. Line current is equal to phase current
B. Line voltage is equal to phase voltage
C. None of the above
D. Line voltage and line current is zero

66. **For a star connection network, consuming power of 1.8kW and power factor 0.5, the inductance and resistance of each coil at a supply voltage of 230 Volts, 60 Hz is ____?**
A. 0.1H, 8 Ohms
B. 0.5H, 10 Ohms
C. 0.3H, 7.4 Ohms
D. 1H, 7 Ohms

67. **For a three-phase delta connected load, fed from a star connected network, the power transferred to the load is ____?**



A. 3 kW B. 4.7 kW
C. 5 kW D. 7 kW

68. **For a polyphase system, the number of Wattmeter required to measure power is equal to ——**
A. Number of wires
B. One less than number of wires
C. Number of phases
D. None of the above

69. **A polyphase system is generated by—**
A. Having two or more generator windings separated by equal electrical angle.
B. Having generator windings at equal distances
C. None of the above
D. A and C

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C. One
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B. Line voltage is equal to phase voltage
C. None of the above
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72. In case of Short Circuit, ______ Current will flow in the Circuit.
A. Zero B. Very Low
C. Normal D. Infinite

73. Ω (Ohm) is the Unit of ________?
A. Resistance (R)
B. Inductive Reactance (X_L)
C. Capacitive Reactance (XC.
D. All of the above

74. Siemens or Mho (℧) is the unit of___?
A. Conductance
B. Admittance
C. Both A & B
D. None of the above

75. Which of the following elements of electrical engineering cannot be analyzed using Ohm's law?
A. Capacitors B. Inductors
C. Transistors D. Resistance

76. Which of the following is a correct representation of peak value in an AC Circuit?
A. RMS value/Peak factor
B. RMS value*Form factor
C. RMS value/Form factor
D. RMS value*Peak factor

77. How many cycles will an AC signal make in 2 seconds if its frequency is 100 Hz?
A. 50 B. 100
C. 150 D. 200

78. What kind of quantity is an Electric potential?
A. Vector quantity
B. Tensor quantity
C. Scalar quantity
D. Dimensionless quantity

79. Which of the following is a correct representation of average value in an AC Circuit?
A. RMS value/Form factor
B. RMS value*Form factor
C. RMS value/Peak factor
D. RMS value*Peak factor

80. How does a semiconductor behave at absolute zero?
A. Conductor
B. Insulator
C. Semiconductor
D. Protection device

81. Semiconductor acts as an insulator in the presence of impurities.
A. True
B. False

82. How is the resistance of semi-conductor classified?
A. High resistance
B. Positive temperature co-efficient
C. Negative temperature co-efficient
D. Low resistance

83. What are the charge carriers in semiconductors?
A. Electrons and holes
B. Electrons
C. Holes
D. Charges

84. What type of material is obtained when an intrinsic semiconductor is doped with pentavalent impurity?
A. N-type semiconductor
B. Extrinsic semiconductor
C. P-type semiconductor
D. Insulator

85. What type of material is obtained when an intrinsic semiconductor is doped with trivalent impurity?
A. Extrinsic semiconductor
B. Insulator
C. N-type semiconductor
D. P-type semiconductor

86. When a pure semiconductor is heated, its resistance ....
A. Goes up
B. Goes down
C. Remains the same
D. Can't say

87. As the doping to a pure semi-conductor increases, the bulk resistance of the semi-conductor .....
A. Remains the same
B. Increases
C. Decreases
D. None of the above

88. The reverse current in a diode is of the order of ....
A. kA B. mA
C. μA D. A

89. The forward voltage drop across a silicon diode is about ....
A. 2.5 V B. 3 V
C. 10 V D. 0.7 V

90. A zener diode has ....
A. One pn junction
B. Two pn junctions
C. Three pn junctions
D. None of the above

91. A zener diode is used as ....
A. An amplifier
B. A voltage regulator
C. A rectifier
D. A multivibrator

92. Why is there a sudden increase in current in Zener diode?
A. Due to the rupture of ionic bonds
B. Due to rupture of covalent bonds
C. Due to viscosity
D. Due to potential difference

93. What is the semiconductor diode used as?
A. Oscillator
B. Amplifier
C. Rectifier
D. Modulator

94. What is a Zener diode used as?
A. Oscillator B. Regulator
C. Rectifier D. Filter

95. When a junction diode is reverse biased, what causes current across the junction?
A. Diffusion of charges
B. Nature of material
C. Drift of charges
D. Both drift and diffusion of charges

96. When transistors are used in digital circuits they usually operate in the:
A. Active region
B. Saturation and cutoff regions
C. Breakdown region
D. Linear region

97. A current ratio of IC/IE is usually less than one and is called:
A. Alpha B. Beta
C. Theta D. None of above

98. In a C-E configuration, an emitter resistor is used for:
A. Stabilization
B. Ac signal bypass
C. Collector bias
D. Higher gain

99. **Voltage-divider bias provides:**
A. An unstable Q point
B. A stable Q point
C. A Q point that easily varies with changes in the transistor's current gain
D. A Q point that is stable and easily varies with changes in the transistor's current gain

100. **The C-B configuration is used to provide which type of gain?**
A. Voltage B. Current
C. Resistance D. Power

101. **A transistor may be used as a switching device or as a:**
A. Fixed resistor
B. Tuning device
C. Rectifier
D. Variable resistor

102. **Which is beta's current ratio?**
A. I_C/I_B B. I_C/I_E
C. I_B/I_E D. I_E/I_B

103. **Most of the electrons in the base of an NPN transistor flow:**
A. Out of the base lead
B. Into the collector
C. Into the emitter
D. Into the base supply

104. **In a transistor, collector current is controlled by:**
A. Collector voltage
B. Base current
C. Collector resistance
D. All of the above

105. **Total emitter current is:**
A. $I_E - I_C$ B. $I_C + I_E$
C. $I_B + I_C$ D. $I_B - I_C$

106. **What is the collector current for a C-E configuration with a beta of 100 and a base current of 30 μA?**
A. 30 μA B. .3 μA
C. 3 mA D. 3 MA

107. **Which of the following condition is true for cut-off mode?**
A. The collector current is zero
B. The collector current is proportional to the base current
C. The base current is non zero
D. All of the mentioned

108. **For a pnp transistor in the active region the value of Vce (potential difference between the collector and the base) is**
A. Less than 0.3V
B. Less than 3V
C. Greater than 0.3V
D. Greater than 3V

109. **Where should be the bias point set in order to make transistor work as an amplifier?**
A. Cut off
B. Active
C. Saturation
D. Cut off and Saturation

110. **Q point can be set to work on active region requires particular conditions. What are they?**
A. BE reverse biased and BC forward biased
B. BE reverse biased and BC reverse biased
C. BE forward biased and BC reverse biased
D. BE forward biased and BC forward biased

111. **For a fixed bias circuit having RC=4.7KΩ and RB=1KΩ, VCC=10V, and base current at Bias point was found to be 0.2μA, Find β?**
A. 100 B. 106
C. 125 D. 0

112. **For a Voltage divider bias circuit, having R1=R2=10KΩ, RC=4.7 KΩ, RE=1 KΩ, What is the value of collector current at saturation if VCC=10V?**
A. 1A B. 10mA
C. 0.87mA D. 1ma

113. **For a Voltage divider circuit having RC=R1=R2=RE=1KΩ, if VCC=20V, find IC when Vce = VCC?**
A. 1mA B. 2mA
C. 20mA D. 0

114. **What is Stability factor?**
A. Ratio of change in collector current to change in a current amplification factor
B. Ratio of change in collector current to change in base current
C. Current amplification factor
D. Ratio of base current to collector current

115. **The collector current (IC. that is obtained in a collector to base biased transistor is_________**
A. $(V_{CC}-V_{BE})/R_B$
B. $(V_{CC}+V_{BE})/R_B$
C. $(V_{CE}-V_{BE})/R_B$
D. $(V_{CE}+V_{BE})/R_B$

116. **The demerit of a collector to base bias is_________**
A. Its need of high resistance values
B. Its dependence on β
C. Its independence on β
D. The positive feedback produced by the base resistor

117. **For emitter feedback bias, to make IC independent of DC current gain, which of the following condition is required?**
A. $R_C >> R_B$/dc current gain
B. $R_E >> R_B$/dc current gain
C. $R_B >> R_C$/dc current gain
D. $R_e >> R_C$/dc current gain

118. **In order to make an amplifier which of the following biasing technique is used more?**
A. Fixed bias
B. Self bias
C. Collector to base bias
D. Emitter feedback bias

119. **What will be the temperature changes effects on the emitter feedback circuit?**
A. Increases voltage gain
B. Increases current gain
C. Does not affect the gain
D. Decreases both current and voltage gain

120. **Which of the following statement is the main disadvantage of emitter feedback bias?**
A. Reduces the gain
B. Positive feedback
C. Design is difficult
D. High output impedance

121. **The thermal runway is avoided in a self-bias because_________**
A. of its independence of β
B. of the positive feedback produced by the emitter resistor
C. of the negative feedback produced by the emitter resistor
D. of its dependence of β

122. **The stability factor for a self-biased transistor is_________**

A. $1 - R_{TH}/R_E$

B. $1 + R_{TH}/R_E$

C. $1 + R_E/R_{TH}$

D. $1 - R_E/R_{TH}$

123. **Which of the following terminals does not belong to the MOSFET?**

A. Drain B. Gate

C. Base D. Source

124. **Choose the correct statement**

A. MOSFET is a uncontrolled device

B. MOSFET is a voltage controlled device

C. MOSFET is a current controlled device

D. MOSFET is a temperature controlled device

125. **Choose the correct statement**

A. MOSFET is a unipolar, voltage controlled, two terminal device

B. MOSFET is a bipolar, current controlled, three terminal device

C. MOSFET is a unipolar, voltage controlled, three terminal device

D. MOSFET is a bipolar, current controlled, two terminal device

126. **The controlling parameter in MOSFET is**

A. Vds B. Ig

C. Vgs D. Is

127. **How does the MOSFET differ from the JFET?**

A. JFET has a p-n junction

B. They are both the same

C. JFET is small in size

D. MOSFET has a base terminal

128. **The N-channel MOSFET is considered better than the P-channel MOSFET due to its**

A. Low noise levels

B. TTL compatibility

C. Lower input impedance

D. Faster operation

129. **Which factor/s play/s a crucial role in determining the speed of CMOS logic gate?**

A. Load capacitance

B. Supply voltage

C. Gain factor of MOS

D. All of the above

130. **What will be the phase shift of feedback circuit in RC phase shift oscillator?**

A. 360° phase shift

B. 180° phase shift

C. 90° phase shift

D. 60° phase shift

131. **How many RC stages are used in the RC phase shift oscillator?**

A. Six B. Two

C. Four D. Three

132. **Calculate the frequency of oscillation for RC phase shift oscillator having the value of R and C as 35Ω and 3.7μF respectively.**

A. 1230 Hz B. 204 Hz

C. 502Hz D. 673 Hz

133. **The condition for zero phase shift in wein bridge oscillator is achieved by**

A. Connecting feedback to non-inverting input terminal of op-amp

B. Balancing the bridge

C. Applying parallel combination of RC to the feedback network

D. All of the mentioned

134. **Only the condition βA = _________ must be satisfied for self-sustained oscillations to result.**

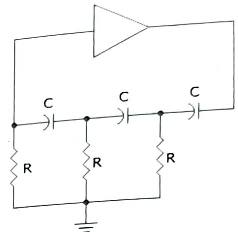
A. 0

B. –1

C. 1

D. None of the above

135. **This circuit is a _________ oscillator.**



A. Phase-shift B. Wien bridge

C. Colpitts D. Hartley

136. **The feedback signal in a(n) _________ oscillator is derived from an inductive voltage divider in the LC circuit.**

A. Hartley

B. Armstrong

C. Colpitts

D. All of the above

137. **For a phase-shift oscillator, the gain of the amplifier stage must be greater than _________.**

A. 19 B. 29

C. 30 D. 1

138. **What is the minimum frequency at which a crystal will oscillate?**

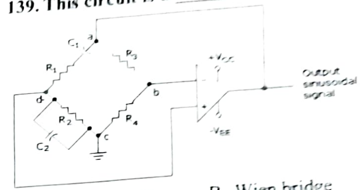
A. Seventh harmonic

B. Third harmonic

C. Fundamental

D. Second harmonic

139. **This circuit is a _________ oscillator.**



A. Phase-shift B. Wien bridge

C. Colpitts D. Hartley

140. **How a triangular wave generator is derived from square wave generator?**

A. Connect oscillator at the output

B. Connect Voltage follower at the output

C. Connect differential at the output

D. Connect integrator at the output

141. **Output of an integrator producing waveforms of unequal rise and fall time are called**

A. Triangular waveform

B. Sawtooth waveform

C. Pulsating waveform

D. Spiked waveform

142. **Which of the following is required for oscillation?**

A. βA > 1

B. The phase shift around the feedback network must be 180°.

C. Both βA > 1 and the phase shift around the feedback network must be 180°.

D. None of the above

143. **An oscillator converts ....**

A. c. power into d.c. power

B. c. power into a.c. power

C. Mechanical power into a.c. power

D. None of the above

144. **In an LC transistor oscillator, the active device is ....**
A. LC tank circuit
B. Biasing circuit
C. Transistor
D. None of the above

145. **In an LC circuit, when the capacitor is maximum, the inductor energy is.........**
A. Minimum
B. Maximum
C. Half-way between maximum and minimum
D. None of the above

146. **In an LC oscillator, the frequency of oscillator is .... L or C.**
A. Proportional to square of
B. Directly proportional to
C. Independent of the values of
D. Inversely proportional to square root of

147. **An oscillator produces.... oscillations**
A. Damped
B. Undamped
C. Modulated
D. None of the above

148. **An oscillator employs...... feedback**
A. Positive
B. Negative
C. Neither positive nor negative
D. Data insufficient

149. **Hartley oscillator is commonly used in.................**
A. Radio receivers
B. Radio transmitters
C. TV receivers
D. None of the above

150. **In a phase shift oscillator, we use .... RC sections**
A. Two
B. Three
C. Four
D. None of the above

151. **A Wien bridge oscillator uses ...... feedback**
A. Only positive
B. Only negative
C. Both positive and negative
D. None of the above

152. **The piezoelectric effect in a crystal is..............**
A. A voltage developed because of mechanical stress
B. A change in resistance because of temperature
C. A change in frequency because of temperature
D. None of the above

153. **If the crystal frequency changes with temperature, we say that crystal has .... temperature coefficient**
A. Positive
B. Zero
C. Negative
D. None of the above

154. **The crystal oscillator frequency is very stable due to .... of the crystal**
A. Rigidity
B. Vibrations
C. Low Q
D. High Q

155. **An oscillator differs from an amplifier because it ....**
A. Has more gain
B. Requires no input signal
C. Requires no D.C. supply
D. Always has the same input

156. **For an oscillator to properly start, the gain around the feedback loop must initially be**
A. 1
B. Greater than 1
C. Less than 1
D. Equal to attenuation of feedback circuit

157. **A class A power amplifier uses ______**
A. Two transistors
B. One transistor
C. Three transistors
D. Four transistors

158. **The maximum efficiency of resistance loaded class A power amplifier is ______**
A. 5%
B. 35%
C. 25%
D. 50%

159. **The maximum efficiency of transformer coupled class A power amplifier is ______**
A. 50%
B. 25%
C. 30%
D. 5%

160. **Power amplifiers handle ______ signals compare to voltage amplifiers**
A. Small
B. Large
C. Very small
D. Equal

161. **In class A operation, the operating point is generally located______ of the D.C. load line.**
A. At cut off point
B. At the middle
C. At saturation point
D. In active region

162. **A power amplifier has comparatively ______ β.**
A. Small
B. Large
C. Very large
D. Same

163. **A class A power amplifier is sometimes called ______ amplifier**
A. Reciprocating
B. Single – ended
C. Symmetrical
D. Differential

164. **When no signal is applied, the approximate collector efficiency of class A power amplifier is ______**
A. 25%
B. 10%
C. 0%
D. 50%

165. **The maximum A.C. power output from a class A power amplifier is 10 W. What should be the minimum power rating of the transistor used?**
A. 20W
B. 5 W
C. 25W
D. 50W

166. **The most costly coupling is ______ coupling**
A. Transformer
B. Impedance
C. RC
D. Direct

167. **Where does the Q point lie for class B amplifier?**
A. Active
B. Cut off
C. Saturation
D. Between saturation and active

168. **What happens when class B amplifier is in a quiescent state?**
A. No current flows through the transistor
B. Maximum current flows through the transistor
C. Half of the maximum current flows through the transistor
D. Quarter of the maximum current flows

169. What is the value of the maximum efficiency of the class B amplifier?

A. 25%

B. 35%

C. 35% to 50%

D. 50% to 70%

170. What kind of design is used to avoid transformer usage?

A. High resistance

B. Matched load

C. Complementary symmetry

D. Capacitive Model

171. What is cross over distortion?

A. Effect occurred during switching of transistor after every half cycle

B. Distortion occurred due to resistors

C. Distortion occurred due to Capacitors

D. Distortion occurred due to Inductors

172. How to avoid cross over distortion?

A. By using more resistance

B. By using more capacitance

C. By using more Inductance

D. By shifting the Q point above cut off

173. For a Class B amplifier, the utilized load power is 300W and the Dc power is 500W, find efficiency.

A. 30% B. 60%

C. 90% D. 100%

174. What is the conduction angle for Class B push-pull amplifier?

A. 0 B. 90

C. 180 D. 270

175. A power transistor is a ________

A. Three layer, three junction device

B. Three layer, two junction device

C. Two layer, one junction device

D. Four layer, three junction device

176. For a power transistor, if base current IB is increased keeping Vce constant, then______

A. I_C increases

B. I_C decreases

C. I_C remains constant

D. I_C changes sinusoidal

177. Insulated-gate bipolar transistor (IGBT) has combinational advantages of ______

A. BJTs and SITs

B. BJTs and MOSFETs

C. SITs and MOSFETs

D. FETs and BJTs

178. A Gate Turn Off (GTO) can be turned on by applying ________

A. Positive gate signal

B. Positive drain signal

C. Positive source signal

D. Negative source signal

179. The turn on time of an SCR with inductive load is 20 μs. The pulse train frequency is 2.5 KHz with a mark/space ratio of 1/10, and then SCR will ______

A. Turn On

B. Not turn on

C. Turn on if inductance is removed.

D. Turn on if pulse frequency is increased to two times

180. What are the three terminals of a power MOSFET called?

A. Collector, emitter, Gate

B. Drain, source, gate

C. Collector, emitter, base

D. Drain, emitter, base

181. A thyristor can be termed as ______

A. AC switch

B. DC switch

C. Wave switch

D. Square wave switch

182. In a series R-L-C circuit at resonance

A. $wLC = 1$ B. $wL^2C^2 = 1$

C. $w^2LC = 1$ D. $w^2L^2C = 1$

183. The power factor of a series R-L-C circuit at its half-power points is

A. Unity

B. Lagging

C. Leading

D. Lagging or leading

ANSWER SHEET

1.B	2.D	3.C	4.A	5.D	6.A	7.B	8.A	9.B	10.A
11.D	12.C	13.B	14.C	15.D	16.A	17.B	18.A	19.C	20.D
21.A	22.B	23.B	24.B	25.A	26.A	27.C	28.A	29.B	30.A
31.A	32.C	33.A	34.B	35.C	36.D	37.A	38.B	39.B	40.B
41.B	42.A	43.D	44.B	45.B	46.D	47.A	48.B	49.C	50.D
51.D	52.A	53.A	54.D	55.D	56.B	57.C	58.D	59.A	60.E
61.B	62.C	63.B	64.B	65.B	66.C	67.B	68.B	69.A	70.B
71.B	72.D	73.D	74.C	75.C	76.D	77.D	78.C	79.A	80.B
81.B	82.C	83.A	84.A	85.D	86.B	87.C	88.C	89.D	90.A
91.B	92.B	93.C	94.B	95.C	96.B	97.A	98.A	99.B	100.A
101.D	102.A	103.B	104.B	105.C	106.C	107.A	108.A	109.B	110.C
111.B	112.B	113.D	114.A	115.A	116.A	117.A	118.D	119.C	120.A
121.C	122.B	123.C	124.B	125.C	126.B	127.A	128.D	129.D	130.B
131.D	132.C	133.B	134.C	135.A	136.A	137.B	138.C	139.B	140.D
141.B	142.C	143.B	144.C	145.A	146.D	147.B	148.A	149.A	150.B
151.C	152.A	153.A	154.D	155.B	156.B	157.B	158.C	159.A	160.B
161.B	162.A	163.B	164.C	165.A	166.A	167.B	168.A	169.D	170.C
171.A	172.D	173.B	174.C	175.B	176.A	177.B	178.A	179.A	180.B
181.B	182.C	183.D							

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DIGITAL LOGIC & MICROPROCESSOR (AExE02)

2.1 DIGITAL LOGIC

Number System: A number system is a writing system for expressing numbers. There are several different number systems, including the following:

Number system is a basis for counting various items. On hearing word 'number', all of us immediately think of the familiar decimal number system with its 10 digits: 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9.

Number system refers to the digits, its arrangements, positional value and base of number system.

Introduction to positional and non-positional number system

In positional number system, each digit of a number has its unique positional weight or place value. Examples of positional number system are decimal, binary, octal, hexadecimal etc. In non-positional number system, each digit/symbol of a number has no positional weight or place value. Example of non-positional number system is Roman Number System.

There are basically two number systems

1. Non-positional Number System
2. Positional Number system

1. **Non-Positional Number System:**

   Non positional number systems were used in early days of human civilization. People used to count any things on fingers. When ten fingers were not adequate, stones, pebbles, or sticks were used to indicate the values. In this system the symbols such as

   I for 1, II for 2

   III for 3 IIII for 4

   IIIII for 5 etc....

2. **Positional Number System:**

   The positional number system is one in which the position of a number represents different values depending upon the position they occupy in the number. There are only few symbols are used. And the value of each digit is determined by three considerations.

   1. The digit itself
   2. The position of the digit in the number
   3. The base of the number system.