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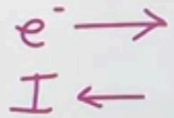
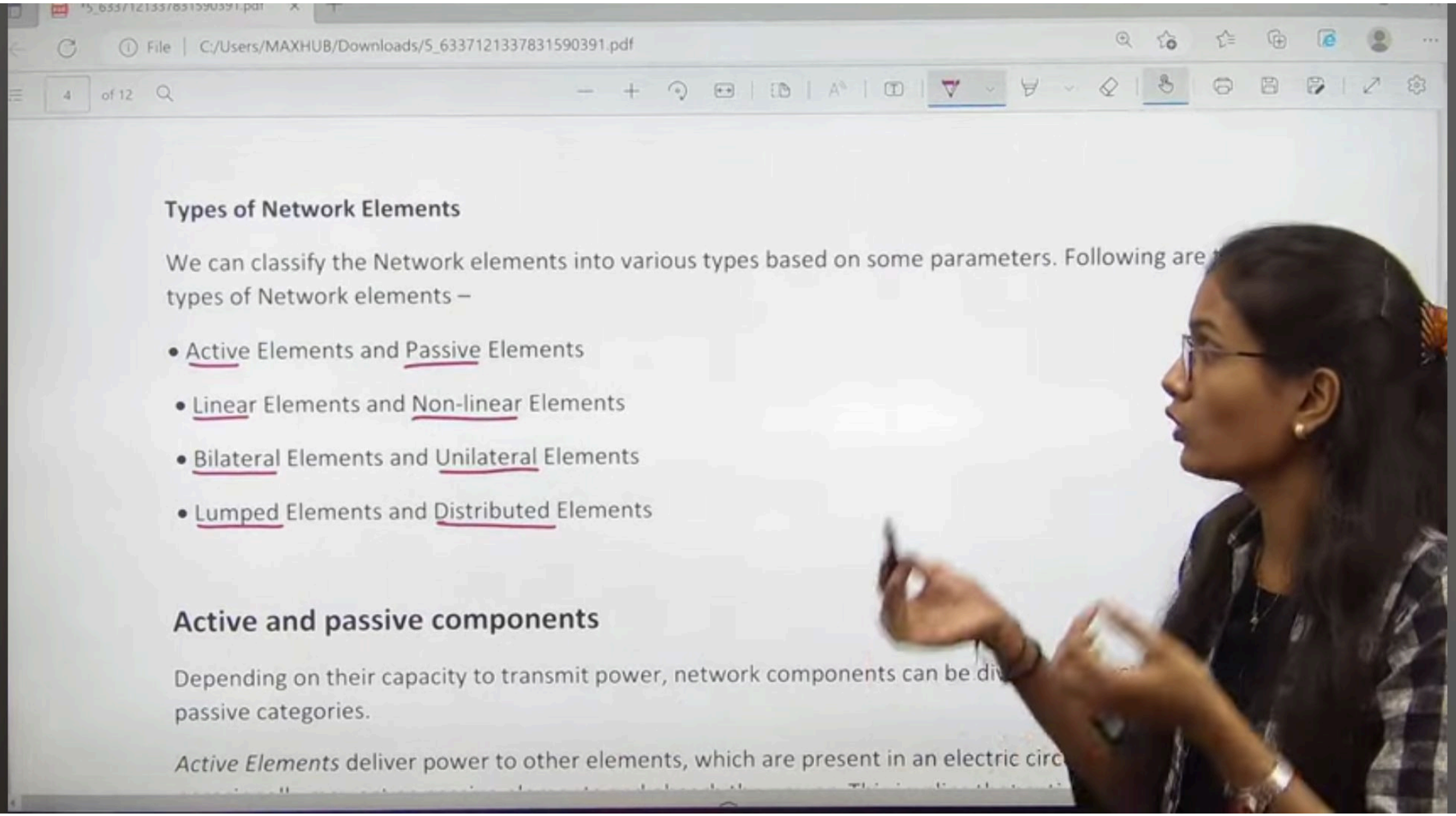
Electrical Network:

An electrical network is any potential arrangement of different electric components (such as a resistor, inductor, capacitor, voltage source, and current source) connected in any way at all. We may classify circuit elements in two categories, passive and active elements.

Electric Circuit:

An electric circuit contains a closed path for providing a flow of electrons from a voltage source or current source. The elements present in an electric circuit will be in series connection, parallel connection, or in any combination of series and parallel connections.

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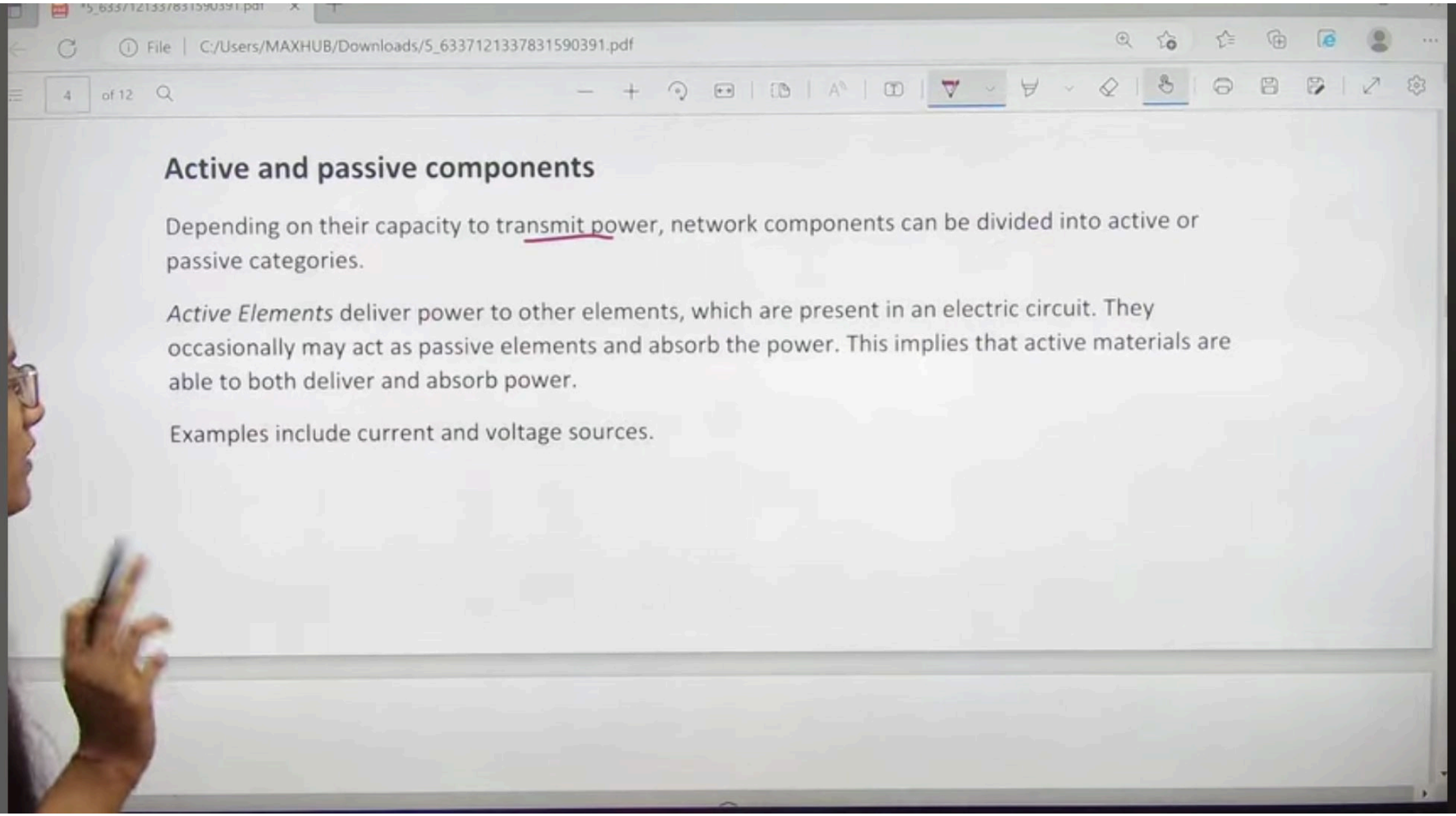
Types of Network Elements
We can classify the Network elements into various types based on some parameters. Following are
types of Network elements –
• Active Elements and Passive Elements
• Linear Elements and Non-linear Elements
• Bilateral Elements and Unilateral Elements
• Lumped Elements and Distributed Elements
Active and passive components
Depending on their capacity to transmit power, network components can be di
passive categories.
Active Elements deliver power to other elements, which are present in an electric circ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Active and passive components
Depending on their capacity to transmit power, network components can be divided into active or passive categories.
Active Elements deliver power to other elements, which are present in an electric circuit. They occasionally may act as passive elements and absorb the power. This implies that active materials are able to both deliver and absorb power.
Examples include current and voltage sources.

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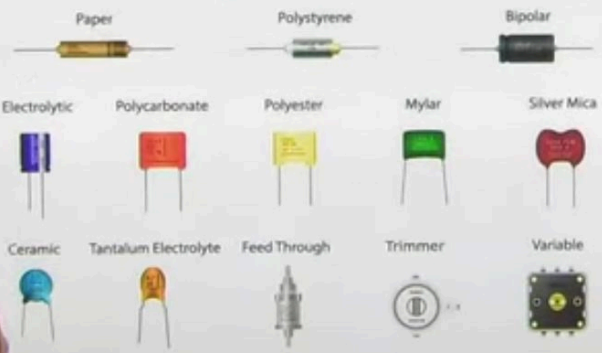
Passive Elements can only receive electrical energy; they cannot supply electrical energy to other elements. Meaning that these substances either release energy as heat (R) or store it as an electric (C) or magnetic field (L), respectively.

Examples include capacitors, inductors, and resistors.

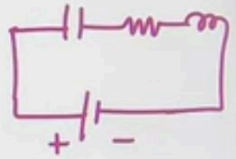
Capacitor Types



Inductor Types

Linear Elements and Non-Linear Elements

We can classify the network elements as linear or non-linear based on their characteristic to obey the property of linearity.

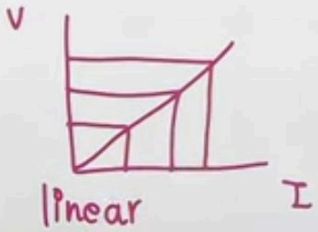


- Linear Elements are the elements that show a linear relationship between voltage and current.

Examples: Resistors, Inductors, and capacitors. follow ohm's law.

- Non-Linear Elements are those that do not show a linear relation between voltage and current.

Examples: Voltage sources and current sources.



Bilateral Elements and Unilateral Elements

Network elements can also be classified as either bilateral or unilateral based on the direction of current flows through the network elements

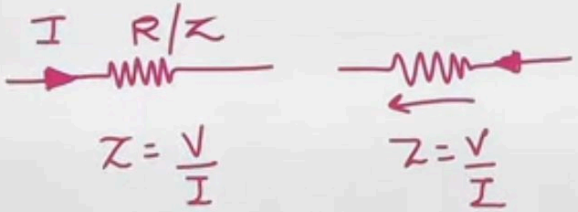
linear non linear

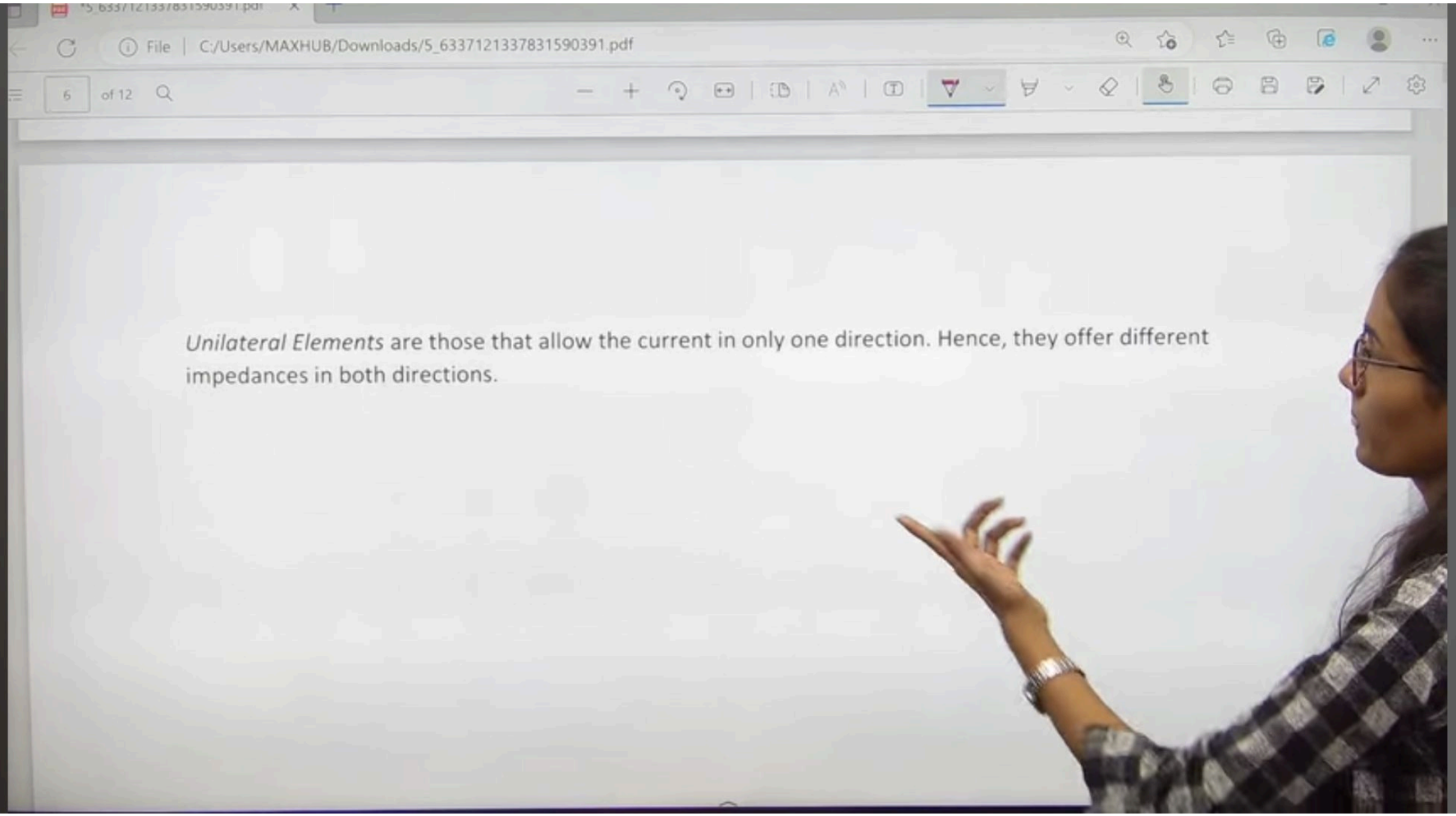
Bilateral Elements and Unilateral Elements

Network elements can also be classified as either bilateral or unilateral based on the direction of current flows through the network elements.

Bilateral Elements are the elements that allow the current in both directions and offer the same impedance in either direction of current flow.

Examples: Resistors, Inductors and capacitors.

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Unilateral Elements are those that allow the current in only one direction. Hence, they offer different impedances in both directions.

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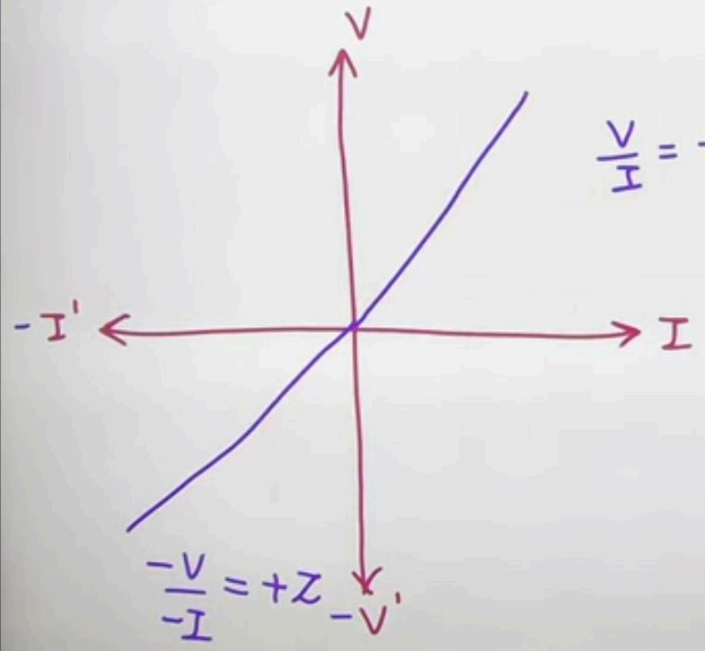

Step 1 : The VI graph is a straight line.
It is linear element.

Step 2 : Since ratio of V/I in both quadrant is +ve
It is passive element.

Step 3 : It is bilateral element.

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Lumped and Distributed Elements

Lumped elements are those elements which are very small in size & in which simultaneous actions takes place. Typical lumped elements are capacitors, resistors, inductors.

Distributed elements are those which are not electrically separable for analytical purposes. For example, a transmission line has distributed parameters along its length and may extend for hundreds of miles.

Types of Sources

VI

Active Elements are the network elements that deliver power to other elements present in an electric circuit. So, active elements are also called as sources of voltage or current type.

We can classify these sources into the following two categories –

- Independent Sources
- Dependent Sources

Independent Sources As the name suggests, independent sources produce fixed values of voltage or current and these are not dependent on any other parameter. Independent sources can be further divided into the following two categories –

- Independent Voltage Sources

An independent voltage source produces a constant voltage across its two terminals. This voltage is independent of the amount of current that is flowing through the two terminals of voltage source.

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$V = IR$.

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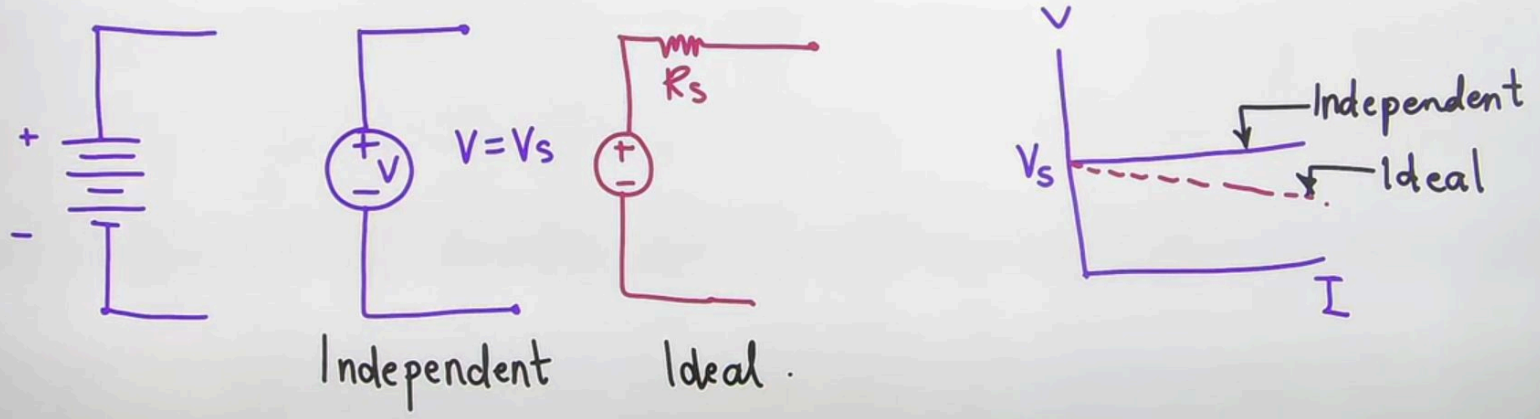
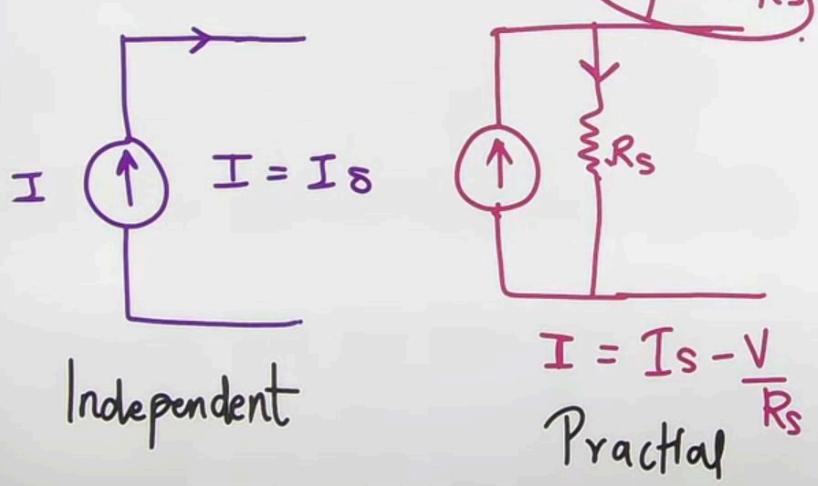
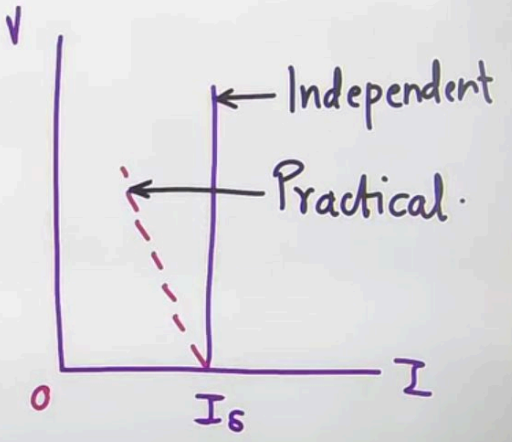


- Independent Current Sources

An independent current source produces a constant current. This current is independent of the voltag across its two terminals.





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Dependent Sources : As the name suggests, dependent sources produce the amount of voltage or current that is dependent on some other voltage or current. Dependent sources are also called as controlled sources. Dependent sources can be further divided into the following two categories –

- Dependent Voltage Sources

A dependent voltage source produces a voltage across its two terminals. The amount of this voltage is dependent on some other voltage or current. Hence, dependent voltage sources can be further classified into the following two categories –

- Voltage Dependent Voltage Source (VDVS)
- Current Dependent Voltage Source (CDVS)

Dependent voltage sources are represented with the signs '+' and '-' inside a diamond shape. The magnitude of the voltage source can be represented outside the diamond shape.

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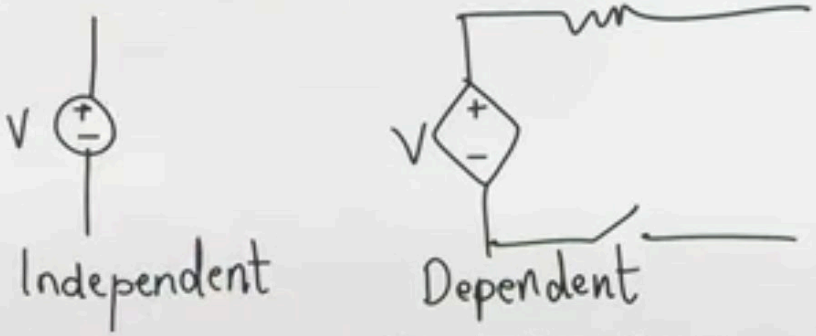


- Dependent Current Sources

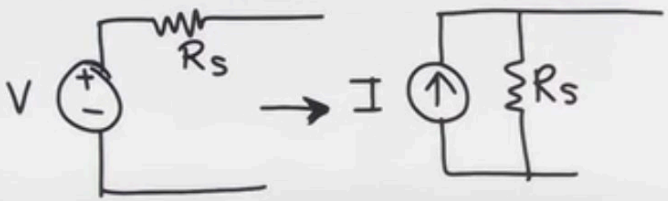
A dependent current source produces a current. The amount of this current is dependent on some other voltage or current. Hence, dependent current sources can be further classified into the following two categories –

We know that there are two practical sources, namely, voltage source and current source.

We can transform (convert) one source into the other based on the requirement, while solving network problems. The technique of transforming one source into the other is called as source transformation technique.

Following are the two possible source transformations –

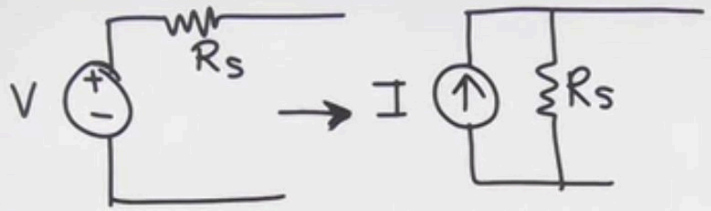
- Practical voltage source into a practical current source



$$I = \frac{V}{R_s}$$

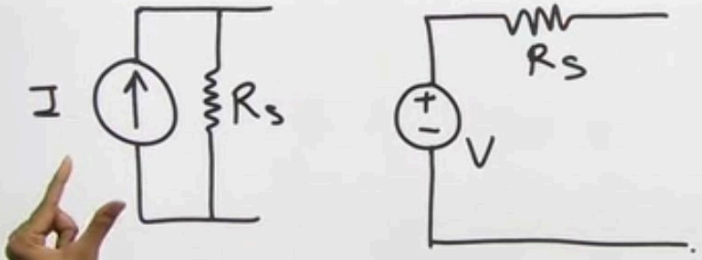
- Practical current source into a practical voltage source

- Practical voltage source into a practical current source



$$I = \frac{V}{R_s}$$

- Practical current source into a practical voltage source



$$V = IR_s$$

Kirc ff's Laws

ork elements can be either of active or passive type. Any electrical circuit or network contains one these two types of network elements or a combination of both. Now, let us discuss about the following two laws, which are popularly known as Kirchhoff's laws.