

Outline

- Circuit theory is foundational course
- Electric circuit elements
- Voltage and current sources
- Ohm's law

Foundational course

The **electric circuit theory course** is the most important course for an electrical and related engineering student

Communication

Photo: <https://freesvg.org/soldier-with-walkie-talkie-radio-vector-image>

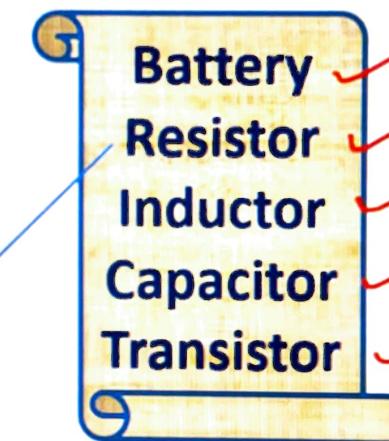
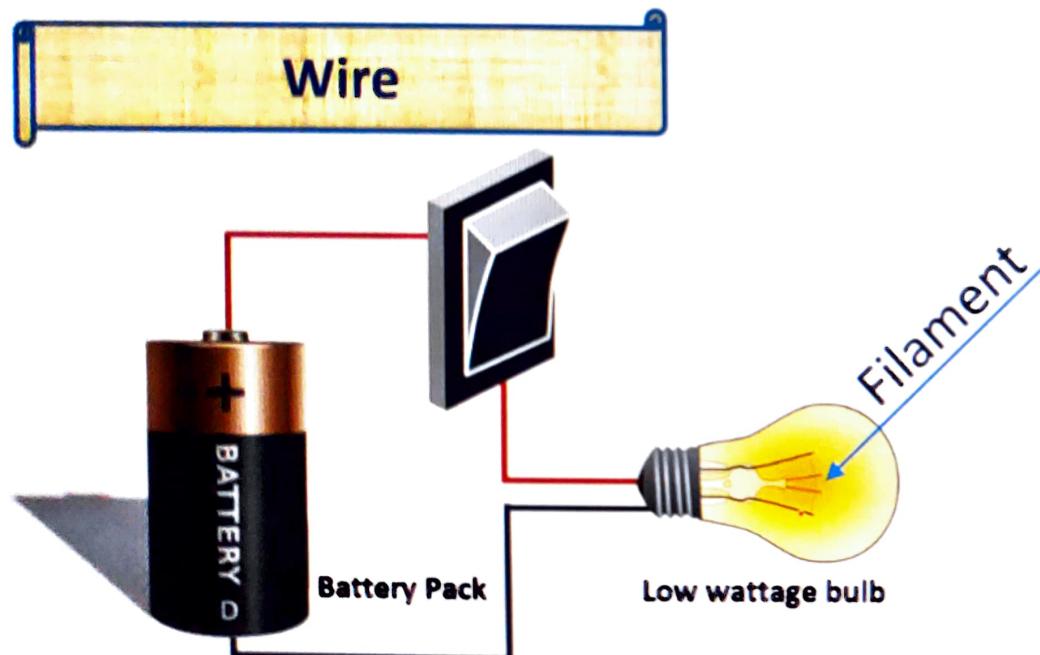


Transferring energy from one location to another



Electric circuit

Interconnection of electrical elements to form a closed path

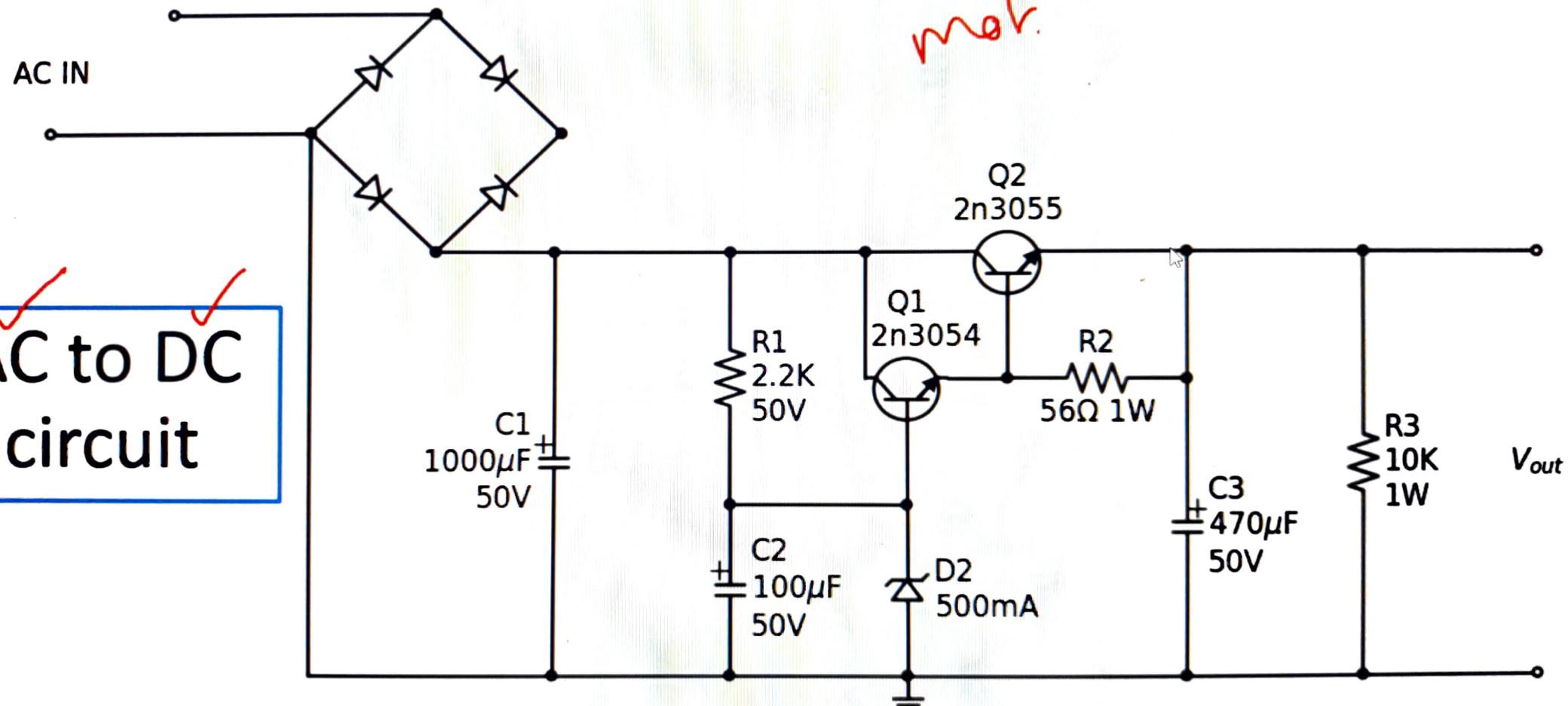


*God said,
Let there be light:
and there was light*

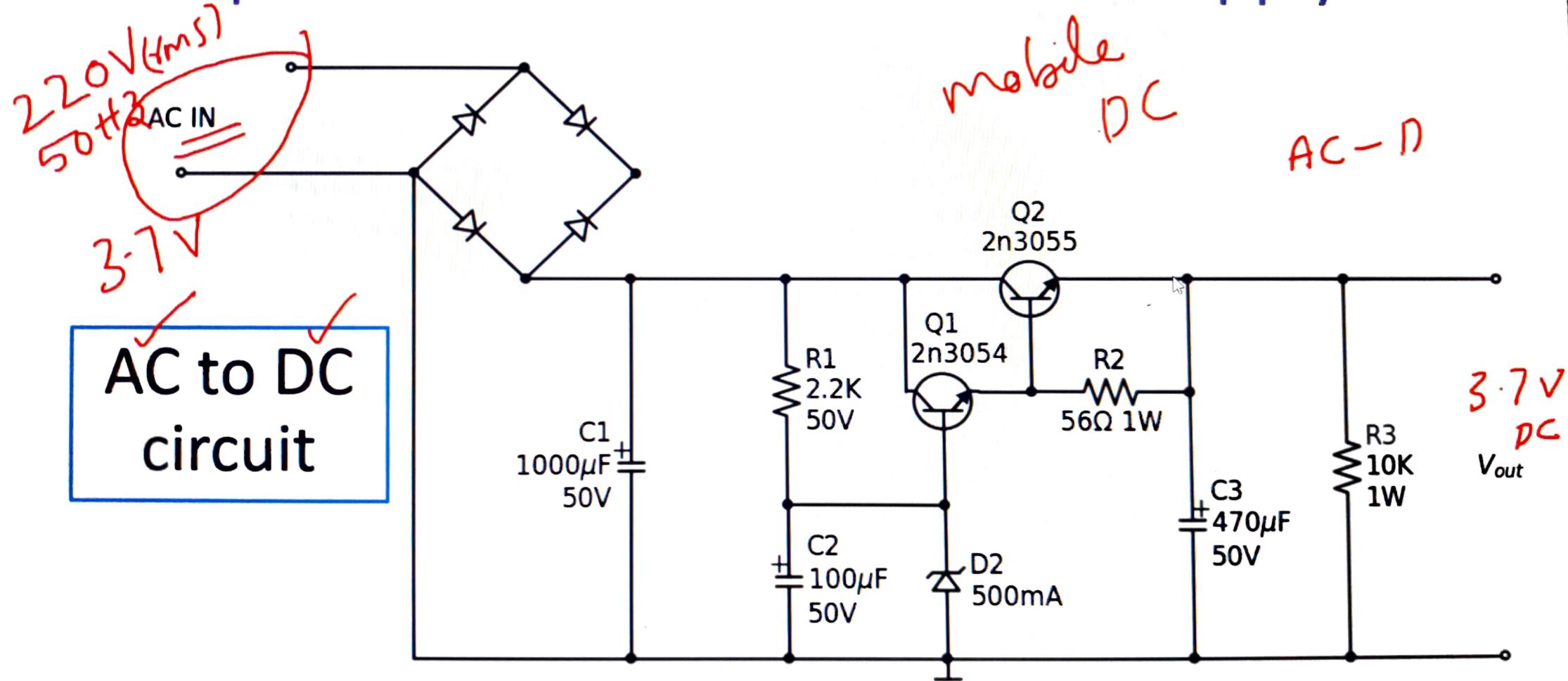


Dear student, If you pay enough attention, you will get enlightened

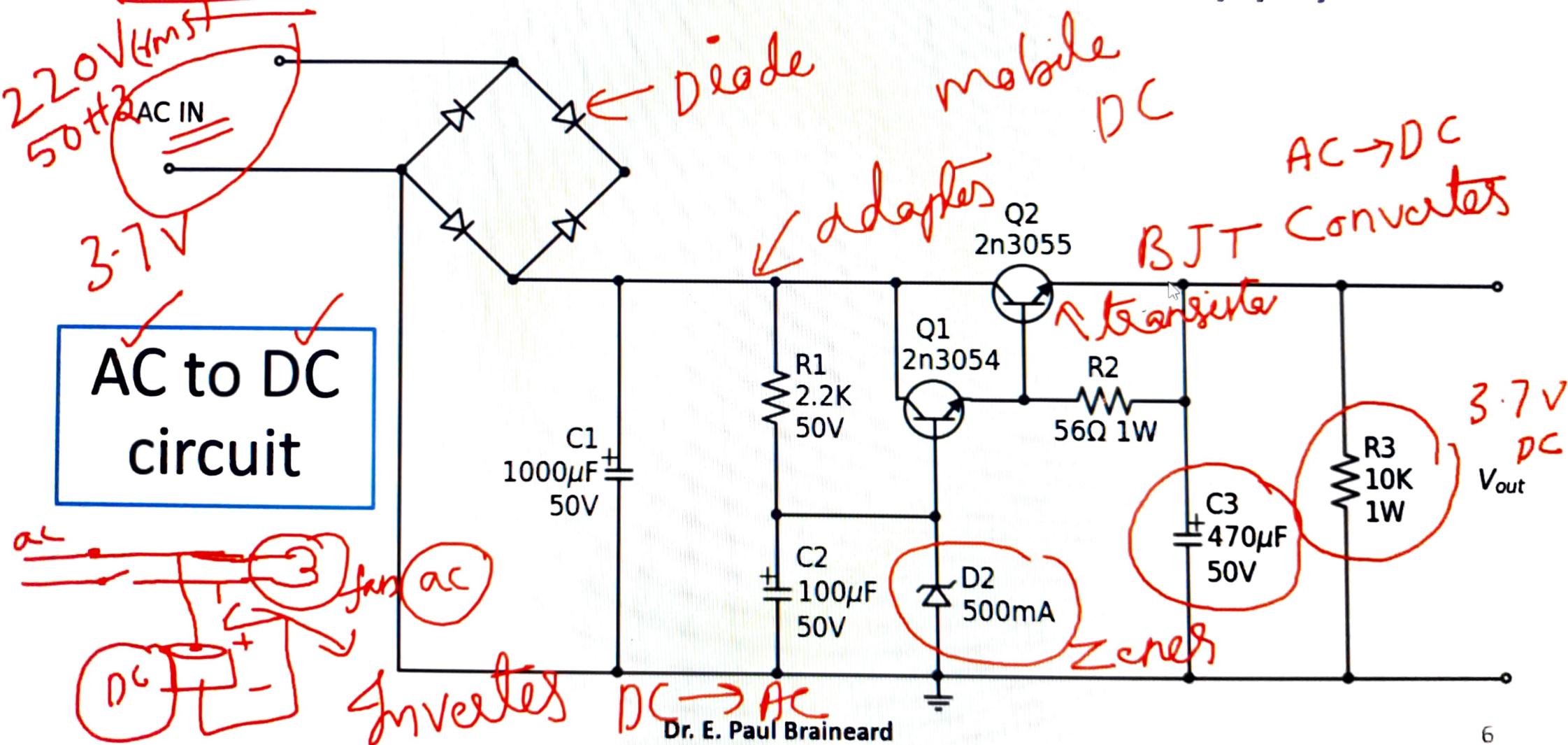
Complex electric circuit: DC Power Supply



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Complex electric circuit: DC Power Supply

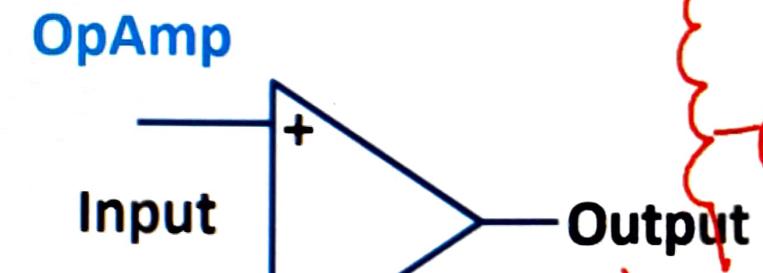
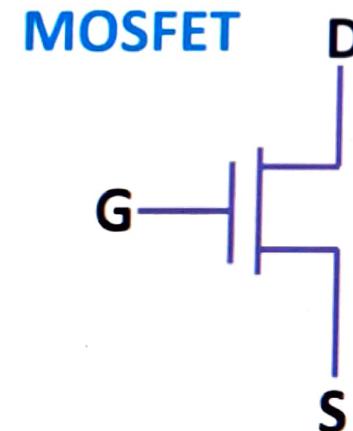
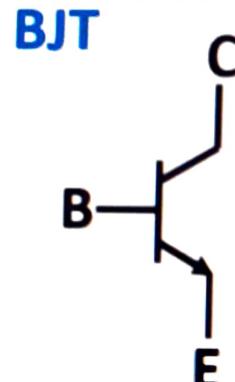


Electric circuit elements

Passive elements

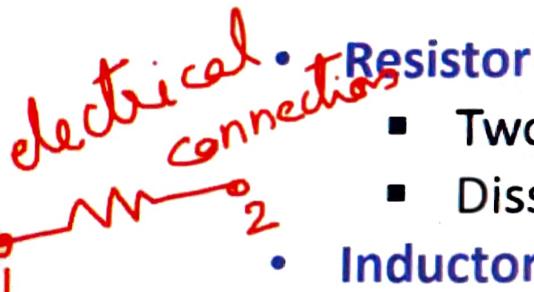
Element	Notation	Circuit symbol
Resistor	R	
Inductor	L	
Capacitor	C	

Active elements



Electric circuit elements

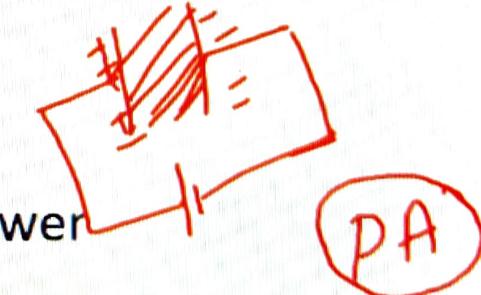
Passive elements Either dissipate power or store energy



- Two terminal passive component that opposes the flow of electrons
- Dissipates energy in the form of heat
- **Inductor (coil, choke, reactor)**
 - Stores energy in the magnetic field when current flows through it
- **Capacitor**
 - Device that stores energy in the electric field

Active elements Amplifies power

- **BJT, MOSFET, OpAmp** amplify power

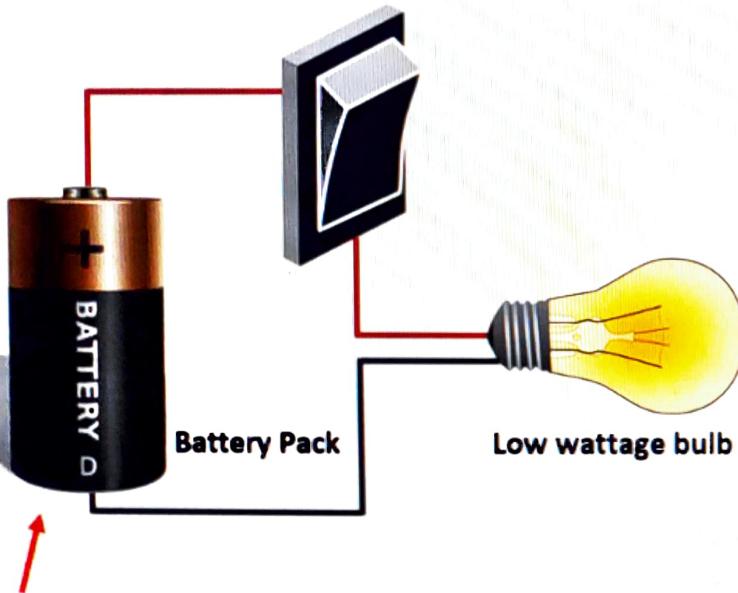


Voltage and current sources

- **Independent sources**
 - Whose magnitude doesn't depend on any other quantity in the circuit
 - Provide constant magnitude of voltage or current
 - Examples
 - *Independent voltage source*: Generator, Battery etc.
 - *Independent current source*: Common base, Common gate transistor circuits
- **Dependent sources**
 - Whose magnitude depend on any other quantity in the circuit
 - Dependent voltage source
 - Dependent current source
- **Ideal sources**
 - Which will provide constant terminal voltage or current irrespective of load
- **Practical sources**
 - Has source resistance drop, whose terminal voltage or current decreases with load

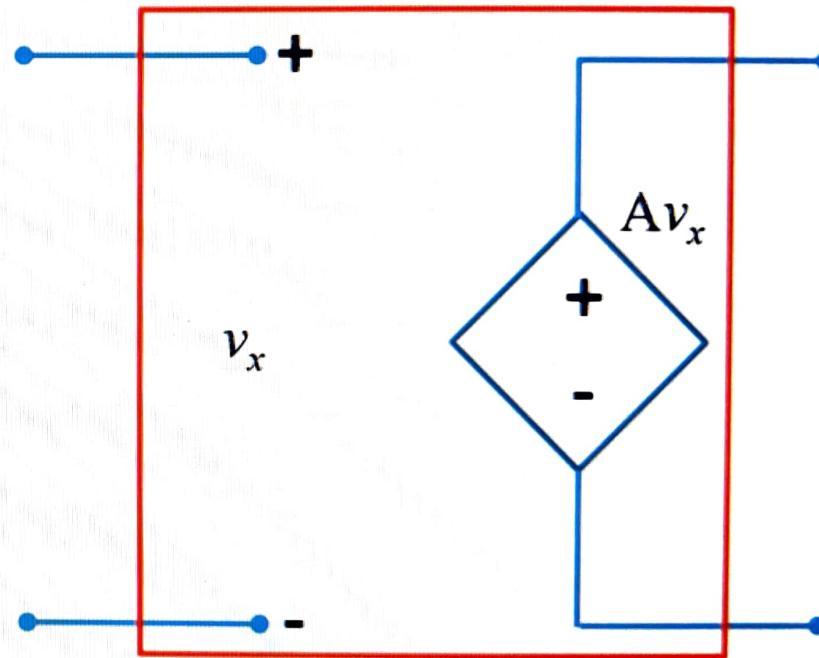
Examples of Independent and Dependent voltage sources

Battery bulb circuit



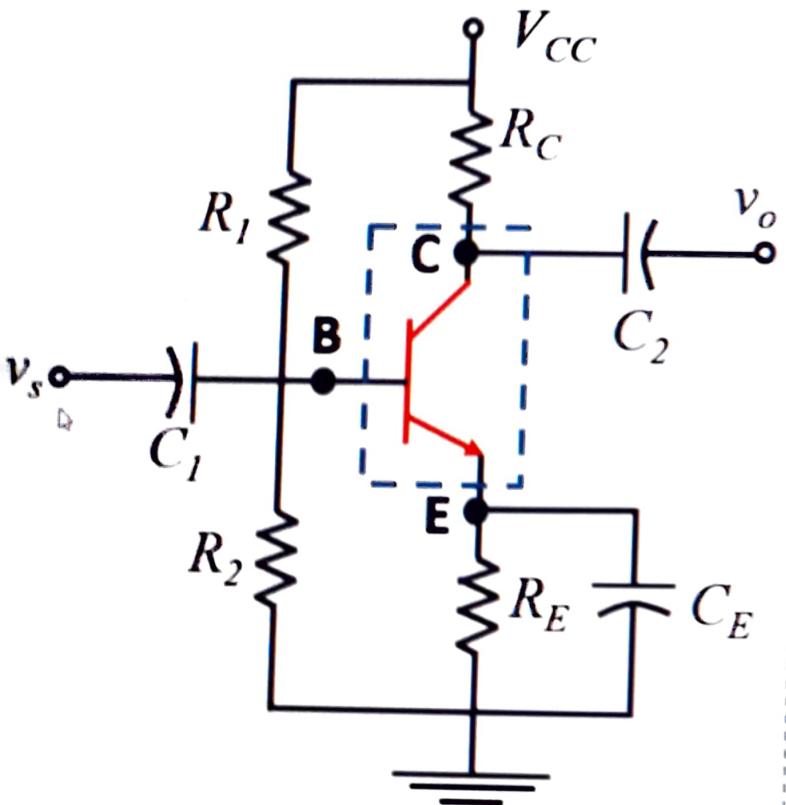
Independent voltage source

Transistor equivalent circuit model

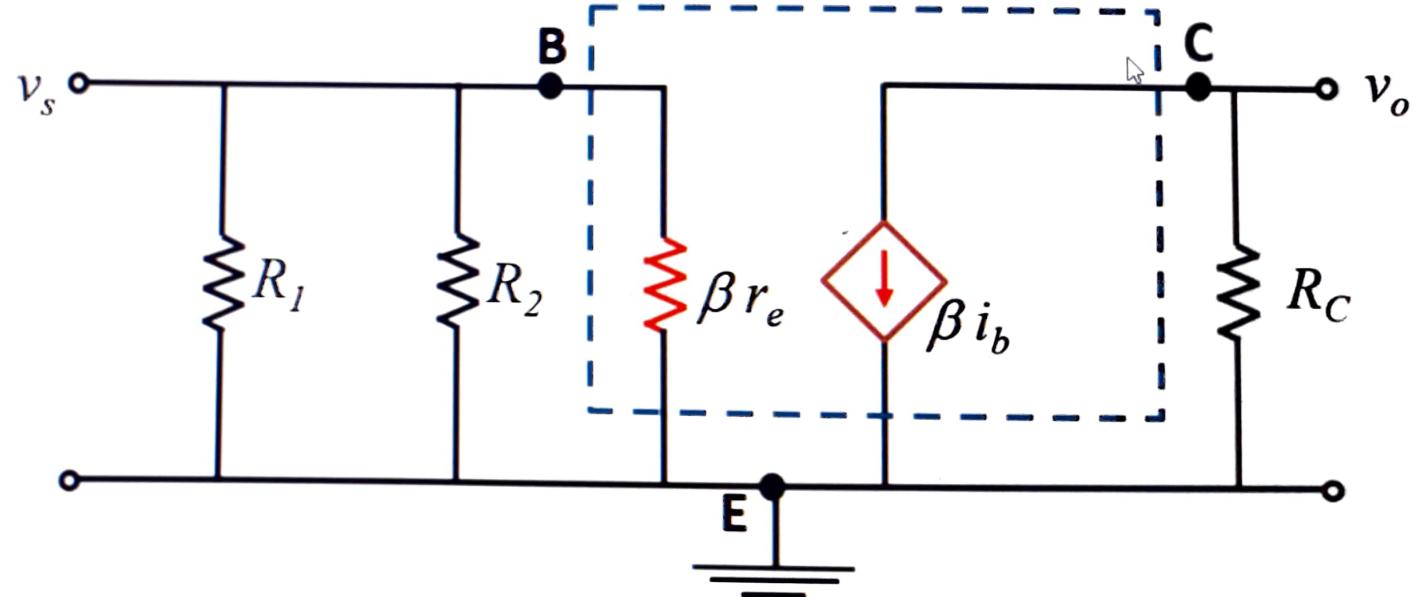


Magnitude of the voltage is dependent
on the open circuit voltage source

BJT Amplifier circuit



BJT Amplifier

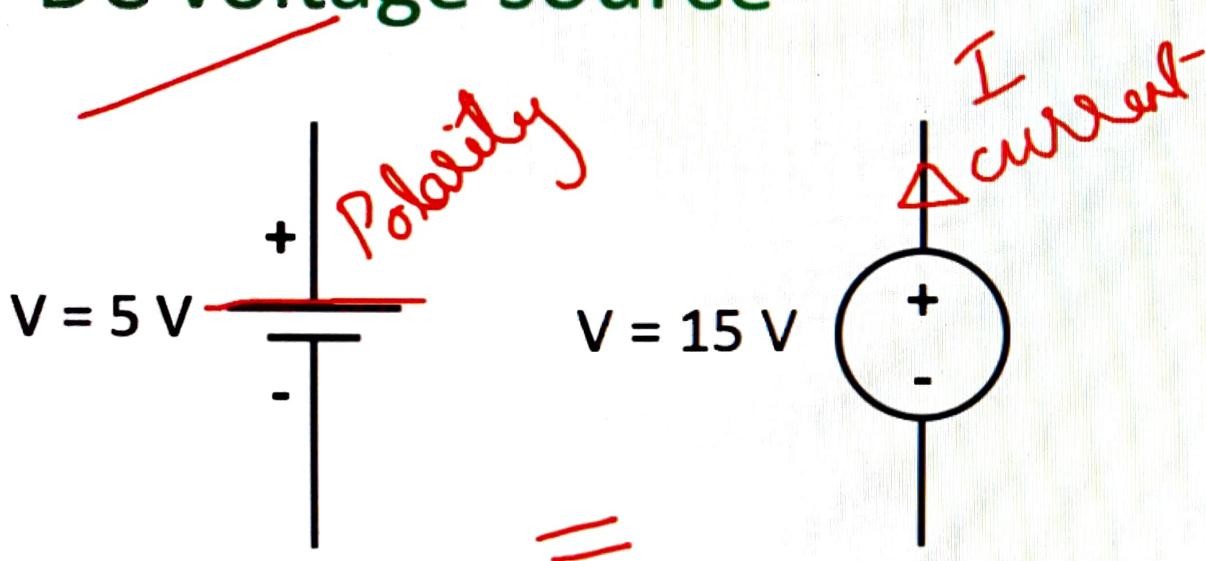


BJT Amplifier equivalent signal model

Circuit symbols

Independent **voltage** source

DC voltage source



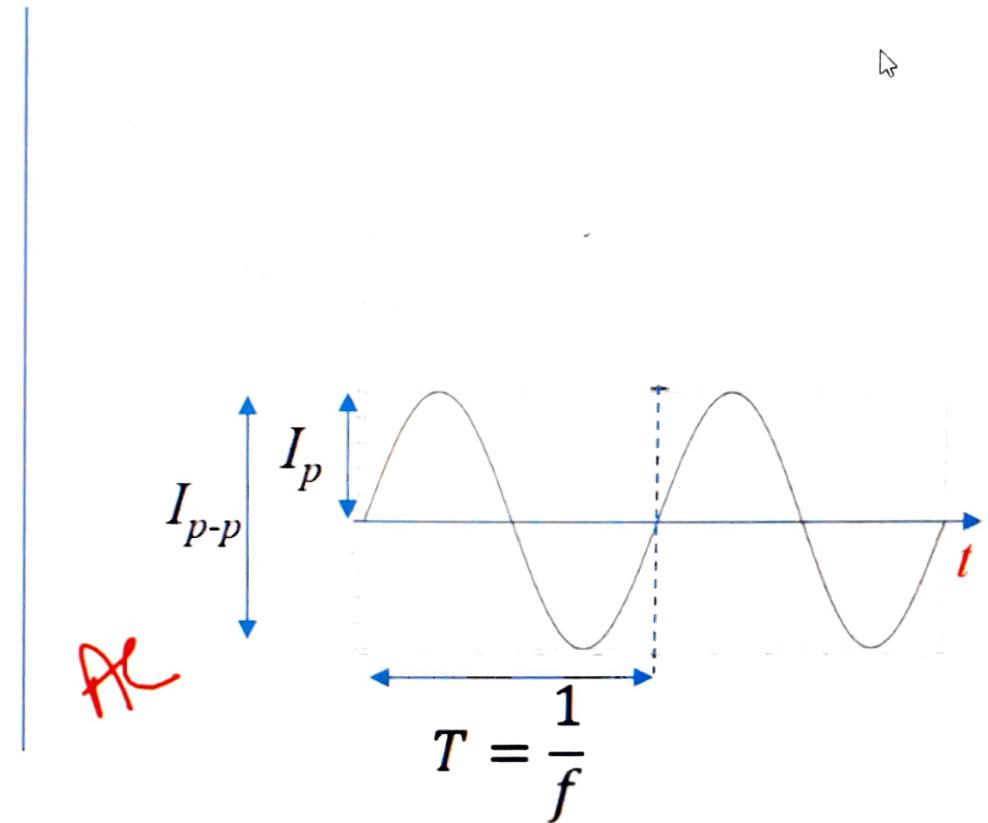
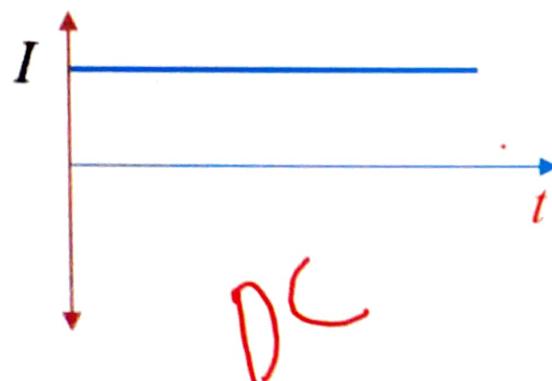
AC voltage source

$$v = 5 \sin(\omega t)$$



Circuit symbols

Independent **current** source



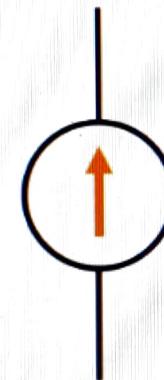
Circuit symbols

Independent **current** sources

DC current source



$$I = 5 \text{ A}$$



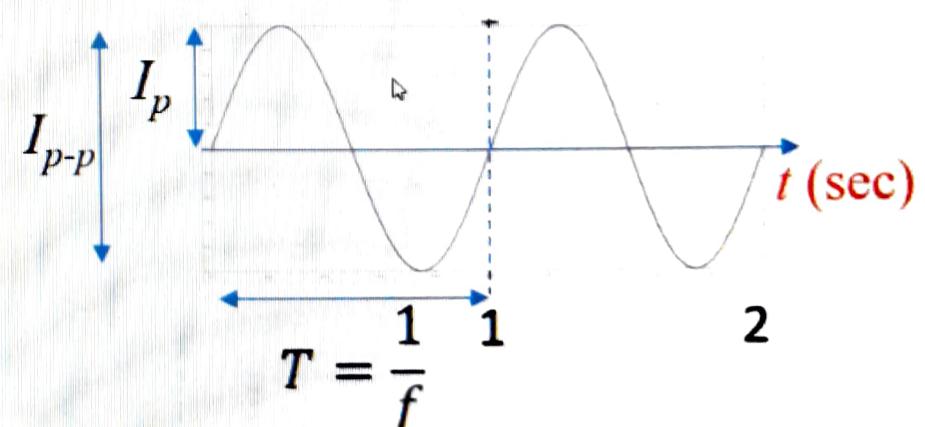
AC current source

where $\omega = 2\pi f$

Example:

$$i = 5\sin(2\pi 50t)$$

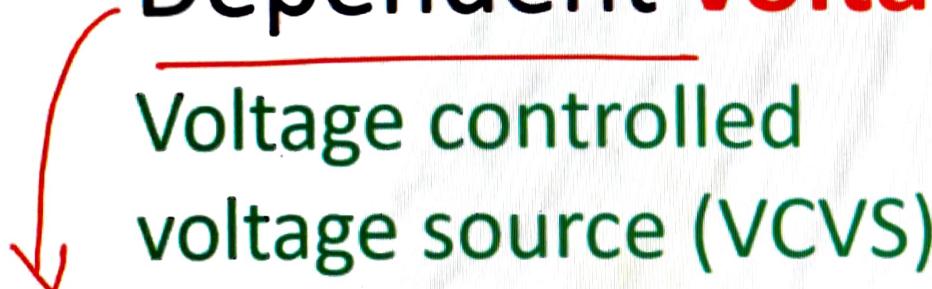
$$i = 5\sin(\omega t)$$



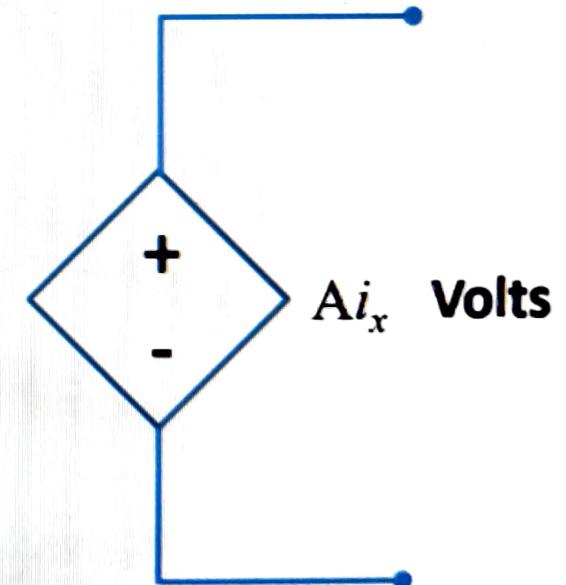
Circuit symbols

Dependent **voltage** sources

Voltage controlled
voltage source (VCVS)



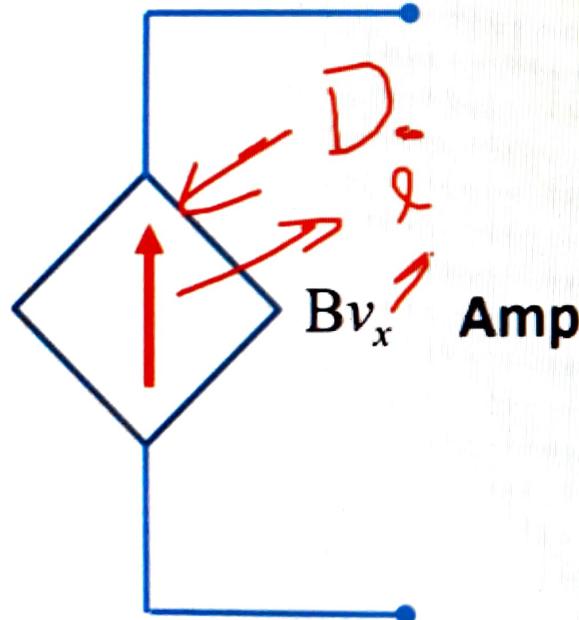
Current controlled
voltage source (CCVS)



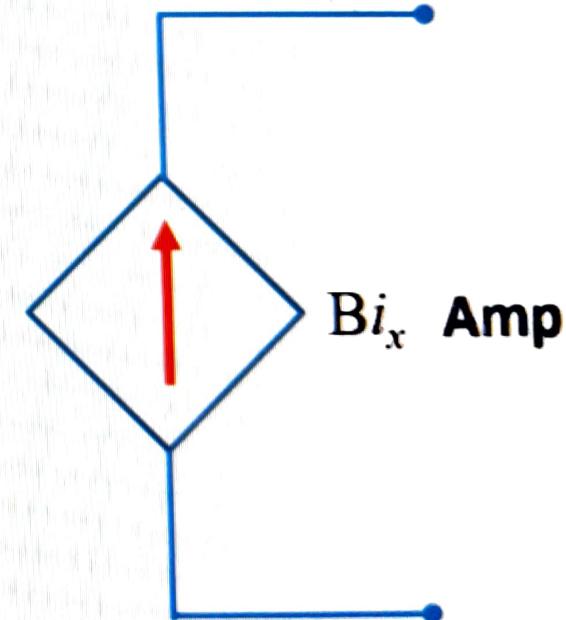
Circuit symbols

Dependent **current** sources

Voltage controlled
current source (VCCS)

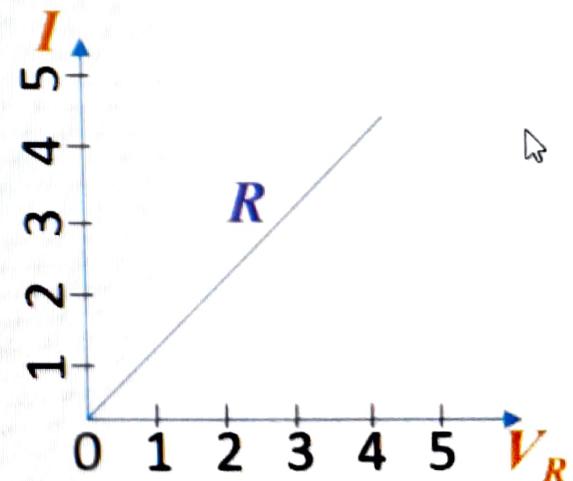
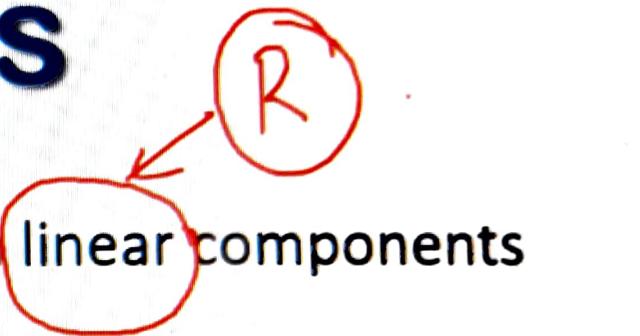
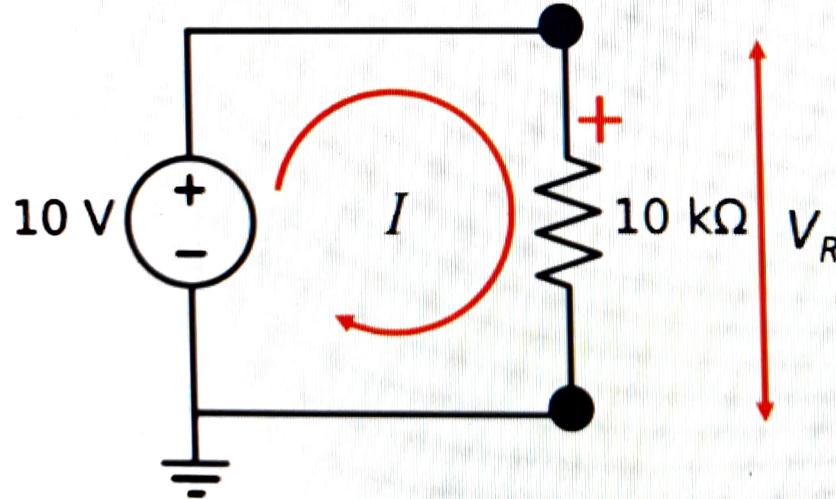


Current controlled
current source (CCCS)



Circuit Laws

- **Ohm's law**
 - Gives relation between voltage and current in linear components
 - Definition
 - Electric current through a conductor between two nodes is **directly proportional** to the potential/voltage difference between the two nodes
 - Current flowing through a resistor is directly proportional to the **voltage across it**
- $V_R = I \times R$



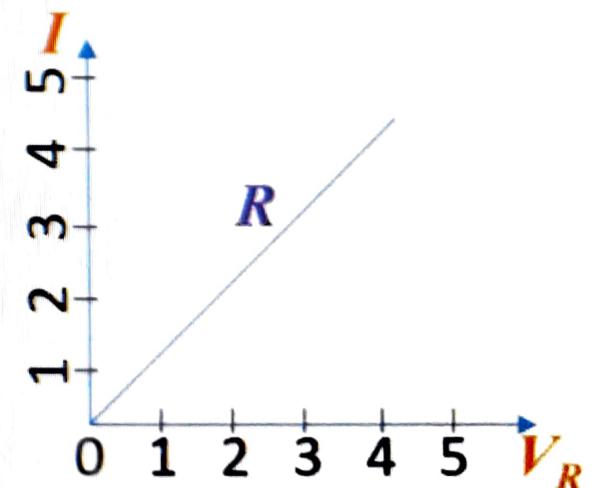
Circuit Laws

- **Ohm's law**

- Current flows from higher potential to lower potential in linear elements

- $i = \frac{v_{high} - v_{low}}{R}$

- *Conductance (G) = $\frac{1}{R}$ Mho (Ω)*



Definitions

- Node/Junction
 - A point in the network where two or more elements are connected
- Loop
 - Any closed path in the circuit is called a loop

