EEE1024:   Fundamentals of Electrical and Electronics Engineering

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Course Outline

DC Circuits – Basics

AC Circuits - Basics

Digital Systems

Semiconductor Devices

μ processor & μ controller

Sensors

Comm. Systems

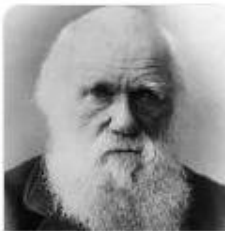# "Standing on the shoulder of Giants!"
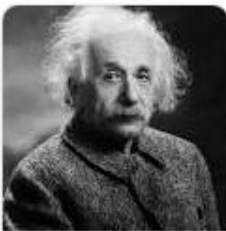
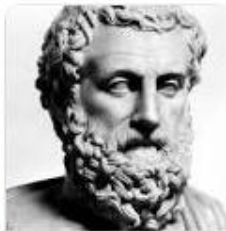| Albert Einstein 1879–1955 | Isaac Newton 1643–1727 | Galileo Galilei 1564–1642 | Marie Curie 1867–1934 | Charles Darwin 1809–1882 | Nikola Tesla 1856–1943 | Stephen Hawking 1942–2018 | Aristotle 385 BC–32... |

| Louis Pasteur 1822–1895 | Michael Faraday 1791–1867 | Nicolaus Copernicus 1473–1543 | Leonardo da Vinci 1452–1519 | Archimedes 288 BC–21... | Francis Crick 1916–2004 | Thomas Edison 1847–1931 | James Watson | Richard Feynman 1918–1988 |

| Richard Feynman 1918–1988 | Rosalind Franklin 1920–1958 | Niels Bohr 1885–1962 | James Clerk Maxwell 1831–1879 | Carl Sagan 1934–1996 | Gottfried Wilhelm Lei... 1646–1716 | Robert Hooke 1635–1703 | Alexander Fleming 1881–1955 | Carl Linnaeus 1707–1778 |

Basic concepts

Electric Circuit –   A closed interconnection of electrical elements like sources and loads through wires (or cables) and through which current flows

Simple Electric Circuit

switch

battery

+

−

light bulb

wire
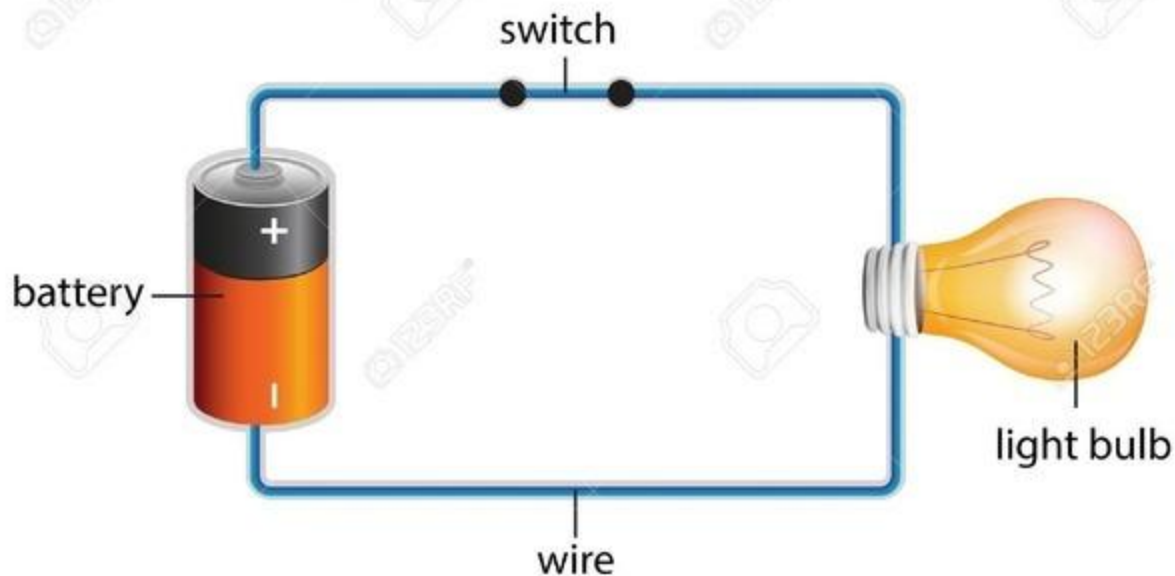
➢ **CHARGE**

➢ **CURRENT**

➢ **VOLTAGE**

➢ **POWER**

CHARGE - q

- Most fundamental concept in electric circuits.
- Unit – coulomb (C): Charles-Augustin de Coulomb
- From basic physics, charge of 2 types
- 1 electron has $-1.6 \times 10^{-19} C$
  1 proton has $1.6 \times 10^{-19} C$

CURRENT - I

o Time rate of change of charge. $i = \dfrac{dq}{dt}$
o Unit – ampere (A): A. M. Ampère
o Direct Current (DC) and Alternating Current (AC)

VOLTAGE - V

- Amount of energy needed to push charge through an element.
- Unit – volts (V): Alessandro Volta
- *Voltage can exist between a pair of terminals regardless of whether current flows through them or not!*

POWER - P

❑ Time rate of expending or absorbing energy
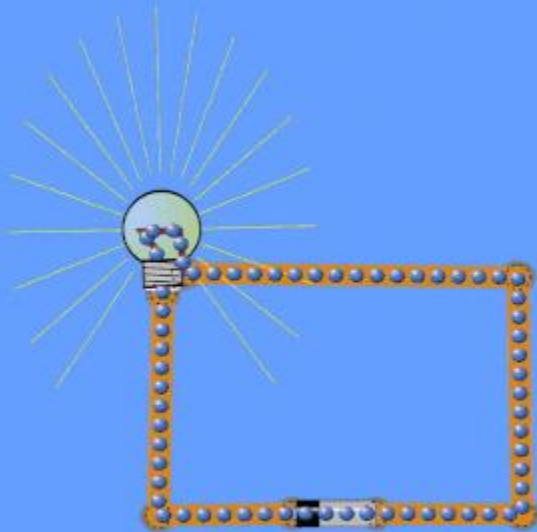❑ Unit – watts (W): James Watt

Direct Current Vs Alternating Current

Thomas Elva Edison

Current remains constant with time

Unidirectional

DC: Constant flow of electrons from an area of high electron density to an area of low electron density.

Nikola Tesla

Current varies sinusoidally with time

Bi-directional

AC: Current will flip the direction of charge flow (60 times a second in USA (60 Hz) and 50 times a second in Europe (50 Hz) and also in ?
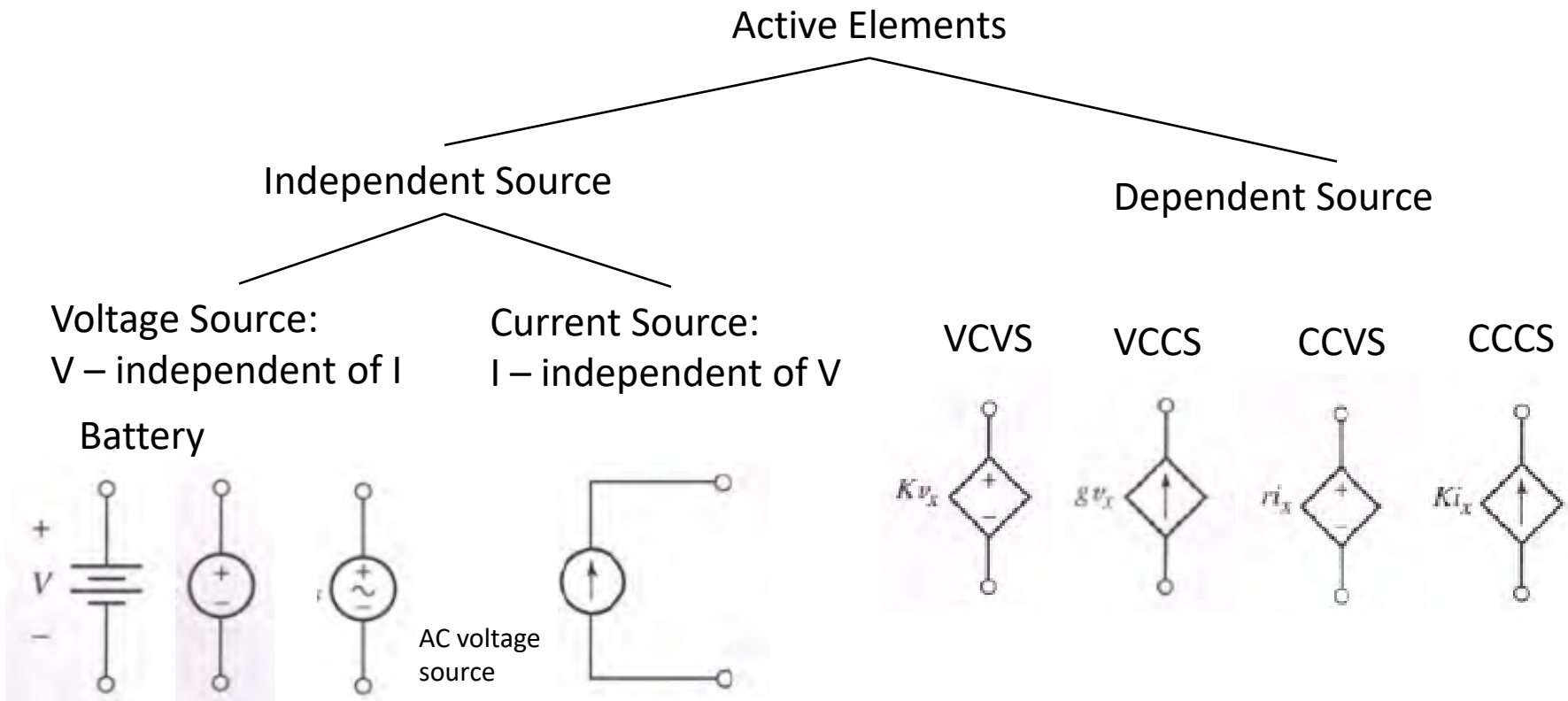
Elements and Sources - Types

Active element:
Capable of generating energy

Passive element:
Not Capable of generating energy

Generators, Batteries, Operational Amplifiers – Active elements

Resistors, Capacitors and Inductors *– Passive elements*

Active Elements

Independent Source

Dependent Source

Voltage Source:
V – independent of I

Current Source:
I – independent of V

VCVS   VCCS   CCVS   CCCS

Battery

AC voltage source

Kv_x gv_x ri_x Ki_x

Ideal Vs Practical Sources

Independent Voltage source – Voltage completely independent of the current flowing through it.

Independent Current source – Current completely independent of the voltage flowing through it.
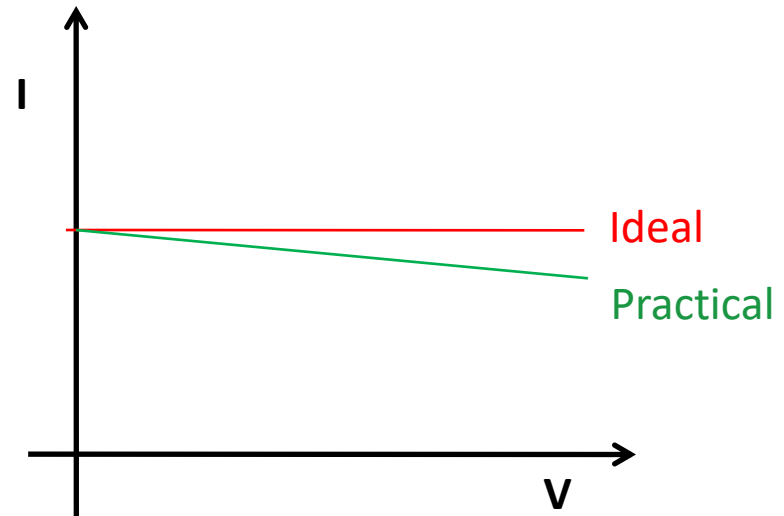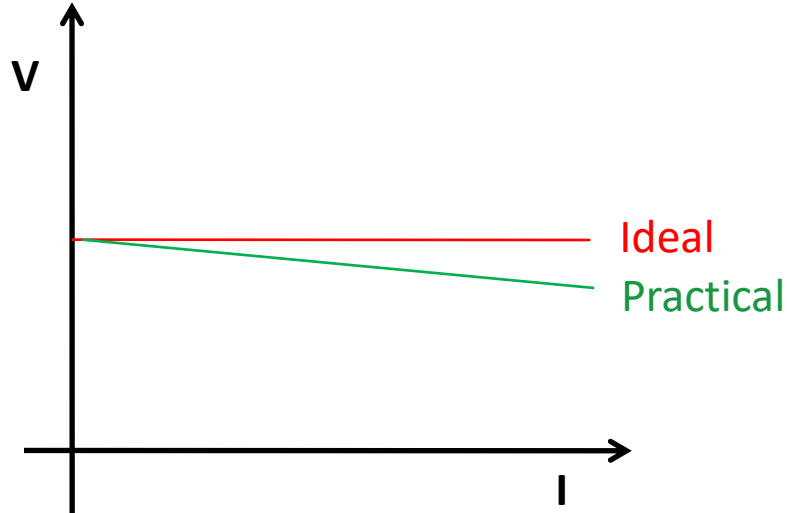
Passive Elements

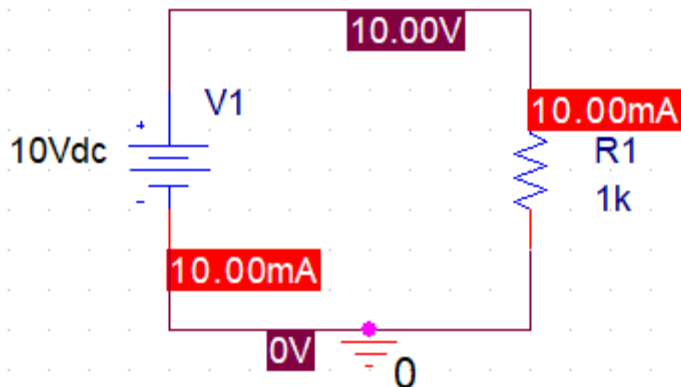Linear Resistor: 1827 – G. S. Ohm and later Henry Cavendish

"Voltage across conducting materials is proportional to the current flowing through it"

$$V \propto I \qquad V = IR \text{ or } R = \frac{V}{I} \qquad \text{where R is constant of proportionality - resistance}$$

Unit of resistance – ohm "Ω" $\qquad 1\Omega = \dfrac{1V}{1A}$ $\qquad \dfrac{1A}{1V} = 1S$ $\qquad$ where S is unit of Conductance 'G' $\qquad G = \dfrac{I}{V} = \dfrac{1}{R}$

$$V = IR$$
$$I = \frac{V}{R}$$
$$I = \frac{10}{1 \times 10^3}$$
$$I = 10^{-2} \text{ A}$$
$$I = 10mA$$

2 ΩResistor