Notes for ECE 20001 - Electric Engineering Fundementals I

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> These are lecture notes for fall 2023 ECE 20001 at Purdue. Modify, use, and distribute as you please.

Contents

Course Introduction

This course covers fundamental concepts and applications for electrical and computer engineers as well as for engineers who need to gain a broad understanding of these disciplines. The course starts by the basic concepts of charge, current, and voltage as well as their expressions with regards to resistors and resistive circuits. Essential concepts, devices, theorems, and applications of direct-current (DC), 1st order, and alternating-current (AC) circuits are subsequently discussed. Besides electrical devices and circuits, basic electronic components including diodes and transistors as well as their primary applications are also discussed. For more information, see the syllabus.

Equations

1. $P = \frac{dW}{dt}$

2. $I = \frac{dq}{dt}$

3. $R = \frac{\rho L}{A}$

4. Coulomb's Law: $\vec{F} = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2} \hat{r}$

5. Kirchhoff's Voltage Law:

6. Ohm's Law: $V = IR$

Charge, current, voltage, and power

Charge: A fundemental property of matter.
**Current**: The rate of flow of charge.
Voltage: Related to the potential energy of charges.
**Power**: The rate of doing work, or changing energy

Passive sign convention is a sign convention or arbitrary standard rule adopted universally by the electrical engineering community for defining the sign of electric power in an electric circuit. The convention defines electric power flowing out of the circuit into an electrical component as positive, and power flowing into the circuit out of a component as negative. So a passive component which consumes power, such as an appliance or light bulb, will have positive power dissipation, while an active component, a source of power such as an electric generator or battery, will have negative power dissipation.

(In)dependent sources, connections, resistance and Ohm's Law

Series Combination: In a series combination, the elements are connected with end to end in contact, such that current flow is equal in all the elements in the combination
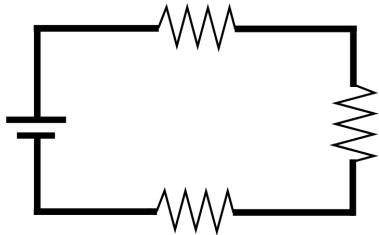
Parallel Combination: When two or more resistances are connected between the same two points, they are said to be connected in parallel combination. In this case voltage is equal across all elements
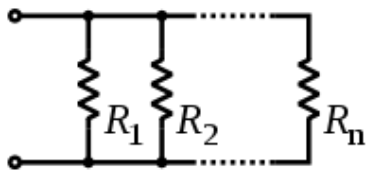
Turning off a voltage source is equivalent to replacing it with a short circuit (line). Turning off a current source is equivalent to replacing it with an open circuit (broken line).

$Resistance = \rho * Length\,of\,resistor / cross\,section\,area$

Conductance = 1/R