Circuits & Electronics

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An introduction to electric circuit elements and electronic devices, and a study of circuits containing such devices. Both analog and digital systems are considered.

Linearity

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- *Describe linearity, superposition, and homogeneity*

Previous Lesson

- Identified how Ohm's Law and Kirchhoff's Laws apply to resistors
- Learned how to combine parallel/series resistors
- Used laws to generate equations to analyze some simple circuits
- Multimeter and resistor labs

Module 2: Resistive Circuits

- Resistance
- Kirchhoff's Laws
- Resistors
- Superposition
- Systematic Solution Methods
- Maximum Power Transfer
- Wye-Delta and Wheatstone Bridge
- Application: Sensors

Lesson Objectives

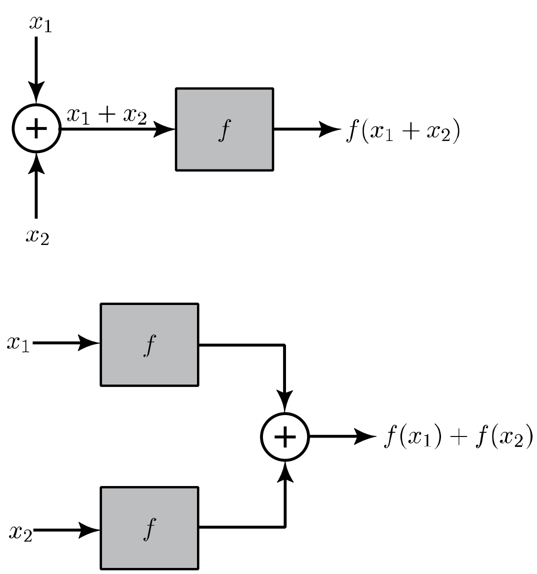
- Define linearity, superposition, and homogeneity
- Identify if a given function exhibits superposition or homogeneity

Linear Circuits

- Why is this course called *linear* circuits? What does the linear mean?

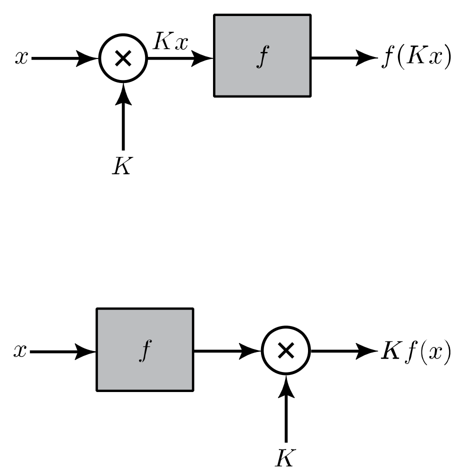
Linearity Defined

Superposition



$$f(x_1 + x_2) = f(x_1) + f(x_2)$$

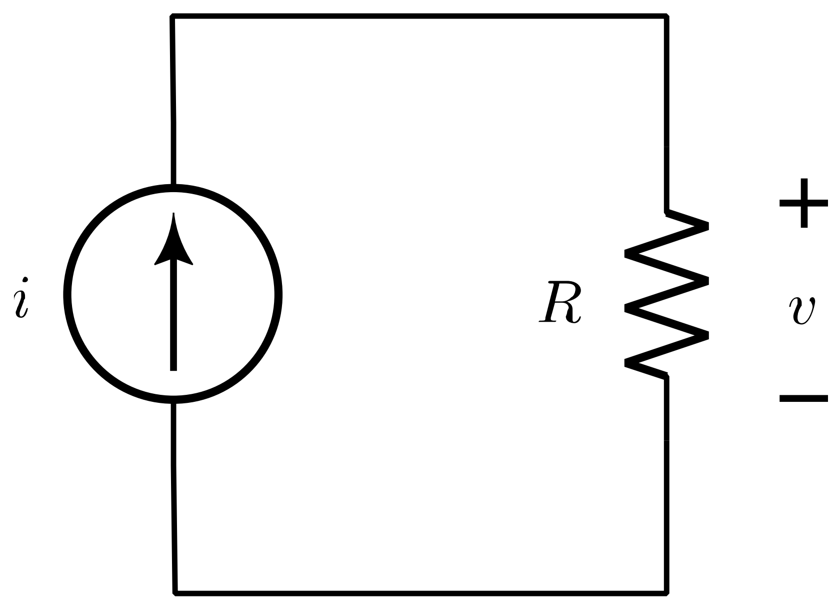
Homogeneity



$$f(Kx) = Kf(x)$$

If both properties hold, the system is **linear**.

Ohm's Law: Linear



$$v(i) = Ri$$

$$v(i_1 + i_2) = R(i_1 + i_2) = Ri_1 + Ri_2 = v(i_1) + v(i_2)$$

$$v(ai) = R(ai) = aRi = av(i)$$

Examples and Counterexamples

Linear	Non-Linear
$f(x) = 0$	$f(x) = x + c$
$f(x) = kx$	$f(x) = x^2$
$f(x(t)) = \frac{dx(t)}{dt}$	$f(x) = \sin(x)$
$f(x(t)) = \int_a^b x(t)dt$	$f(x(t)) = \int x(t)dt$

Summary

- Introduced linear operators (superposition and homogeneity)
- Identified if an operator is linear
- Used linear operators to generate new linear operators

Next Lesson

- Apply these principles to circuit analysis