MASSACHVSETTS INSTITVTE OF TECHNOLOGY

Department of Electrical Engineering and Computer Science

6.01 Introduction to EECS I

Spring Term, 2008

Week 7 Lecture

March 18, 2008

Introduction to Electric Circuits

Primitives:

- Voltage
- Current
- Circuit Elements

Means of Combination:

- Circuit Constraints (KCL, KVL), describing wiring

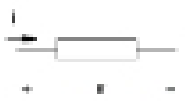
Means of Abstraction:

- Thevenin
- Norton

Common Patterns:

- Series
- Parallel
- Voltage Divider
- Current Divider

Two primitive notions with respect to a circuit element:



- Current is the flow of charge (electrons) through the element. Current is measured in Amperes. We will usually refer to milliamperes. (mA)

- Voltage is the electromotive force pushing the electrons through the element. The voltage appears 'across' the element. Voltage is also called 'potential' because it represents potential energy change of the charges from one end of the element to the other. The unit of potential is the Volt.

Conservation laws govern current and voltage

Conservation of current: is also called KCL,

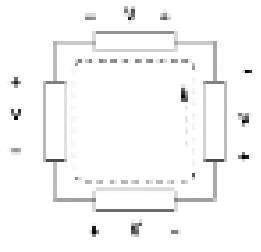
Or Kirchhoff's Current Law

$$\sum_k i_k = 0$$

1824-1887

Sum of all currents entering a node is zero, meaning whatever current enters a node must also leave the node. Current does not build up, but must go in circles.

KVL is Kirchhoff's Voltage Law, and it says that voltage really is a potential that is single valued. The sum of voltages around a loop must add to zero. So if you take one node as 'datum' or 'ground', every other node has a uniquely defined potential (voltage)

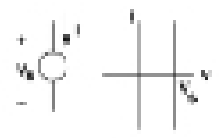


$$\sum_k v_k = 0$$

Primitive Circuit Elements

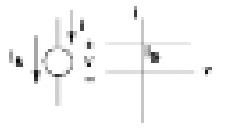
Voltage Source: Floss its terminal voltage, independent of current

(Sort of like a battery, but more about that later)



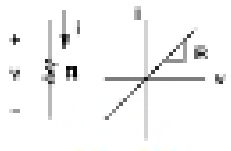
Current source: Floss its terminal current, independent of voltage

(sort of like lightning, but you don't want to fiddle with that...)



Resistance: Has a fixed ratio of voltage to current:

The unit if resistance is the Ohm, a volt/ampere.



$$V = RI$$

Here is a simple problem: what current will flow in the resistor?

What current will flow in the source?

Around the KVL loop: $-V_s + V_r = 0$

So current is: $i = \frac{V_s}{R} = \frac{12v}{1k\Omega} = 12mA$

One more thing about this:

Power is: $P = V \times I = I^2 R = \frac{V^2}{R}$

For 12 v and 1k, that is 144 mW

But if R = 100 Ohms, it is 1.44 W.

How would a 1/4 watt resistor handle this?