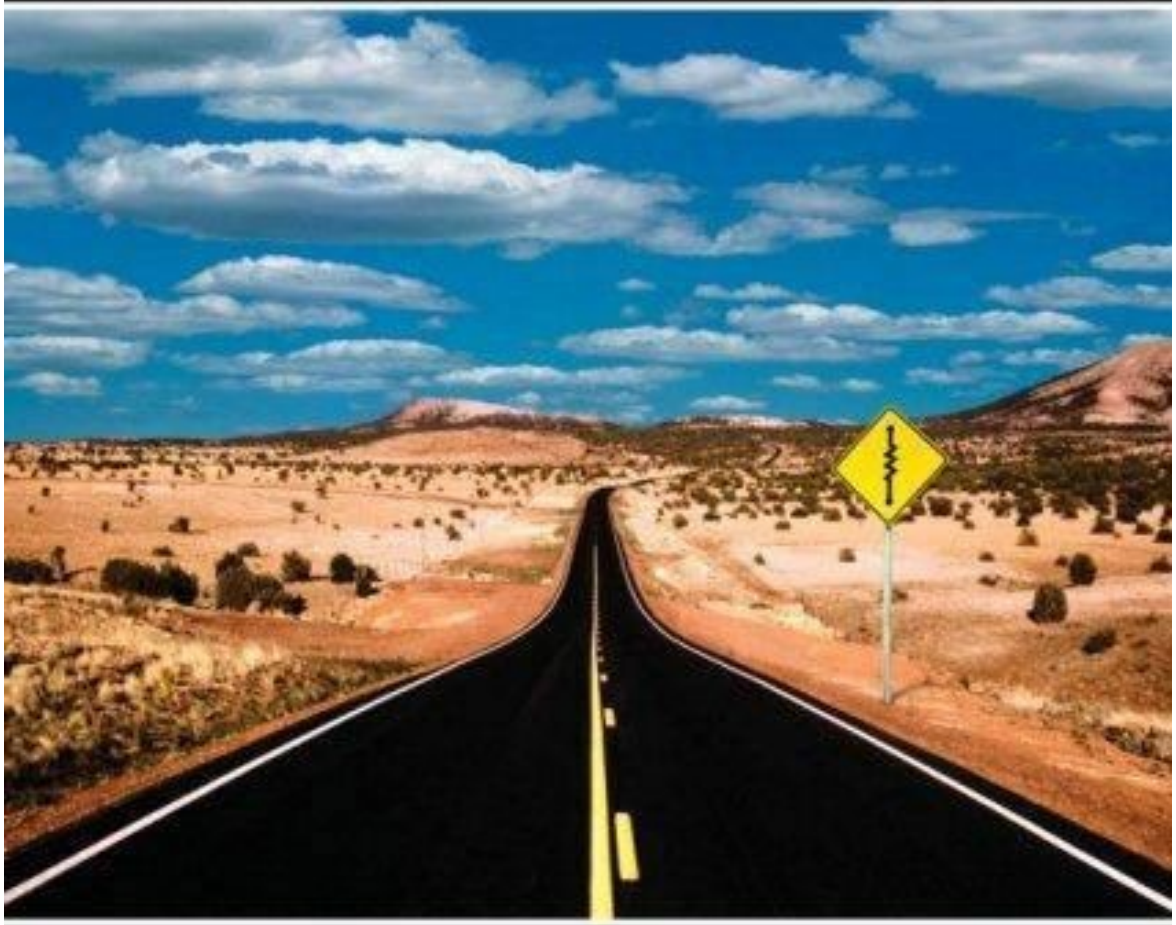
NILSSON | RIEDEL



ELECTRIC CIRCUITS

CHAPTER 1

Circuit Variables

- Electrical Engineering: An Overview
- The International System of Units
- Circuit Analysis: An Overview
- Voltage and Current
- The Ideal Basic Circuit Element
- Power and Energy

Electrical Engineering: An Overview

- Electrical engineering is the profession concerned with systems that produce, transmit, and measure electric signals.

- Electrical engineering combines the physicist's models of natural phenomena with the mathematician's tools for manipulating those models to produce systems that meet practical needs.

A few examples from each of the **five** major classifications of electrical systems:

- communication systems
- computer systems
- control systems
- power systems
- signal-processing systems

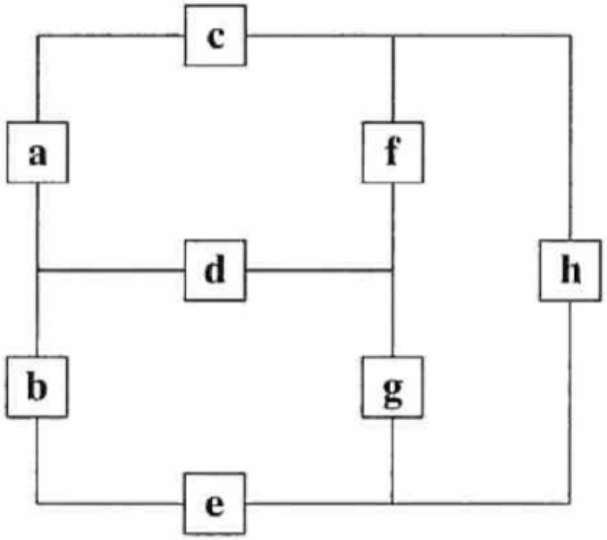
Problem Solving

By reading about and discussing how the problems were solved in the past, and by solving related homework and exam problems on your own, you will begin to develop the skills to successfully attack the unsolved problems you'll face as a practicing engineer.

- Identify what's given and what's to be found.
- Sketch a circuit diagram or other visual model.
- Think of several solution methods and decide on a way of choosing among them.
- Calculate a solution.
- Use your creativity.
- Test your solution.

Balancing Power

An **electric circuit** is a *mathematical model* that approximates the behavior of an actual electrical system.



- **a** and **b**: electrical source to the home;
- **c**, **d**, and **e**: the wires that carry the electrical current from the source to the devices in the home requiring electrical power;
- **f**, **g**, and **h**: lamps, televisions, hair dryers, refrigerators, and other devices that require power.

The International System of Units

Quantity	*Basic unit*	*Symbol*
Length	meter	m
Mass	kilogram	Kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

Derived Units in SI

Quantity	Unit Name (Symbol)	Formula
Frequency	hertz (Hz)	s^{-1}
Force	newton (N)	$kg \cdot m/s^2$
Energy or work	joule (J)	$N \cdot m$
Power	watt (W)	J/s
Electric charge	coulomb (C)	$A \cdot s$
Electric potential	volt (V)	J/C
Electric resistance	ohm (Ω)	V/A
Electric conductance	siemens (S)	A/V
Electric capacitance	farad (F)	C/V
Magnetic flux	weber (Wb)	$V \cdot s$
Inductance	henry (H)	Wb/A

Standardized Prefixes to Signify Powers of 10

Prefix	Symbol	Power
atto	a	10^{-18}
femto	f	10^{-15}
pico	p	10^{-12}
nano	n	10^{-9}
micro	μ	10^{-6}
milli	m	10^{-3}
centi	c	10^{-2}
deci	d	10^{-1}
deka	da	10
hecto	h	10^{2}
kilo	k	10^{3}
mega	M	10^{6}
giga	G	10^{9}
tera	T	10^{12}

Example #1

- If a signal can travel in a cable at 80% of the speed of light, what length of cable, in inches, represents 1 ns?

Solution：

$$\frac{2.4 \times 10^8 \text{ meters}}{1 \text{ second}} \cdot \frac{1 \text{ second}}{10^9 \text{ nanoseconds}} \cdot \frac{100 \text{ centimeters}}{1 \text{ meter}} \cdot \frac{1 \text{ inch}}{2.54 \text{ centimeters}}$$

$$= \frac{(2.4 \times 10^8)(100)}{(10^9)(2.54)} = 9.45 \text{ inches/nanosecond}$$