## EE 42/100 Review

### Components, Devices, Systems

<table>
<thead>
<tr>
<th>Components</th>
<th>Devices (multiple parts but still relatively simple)</th>
<th>Systems (complex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(basic, simple)</td>
<td>Diodes (all kinds)</td>
<td>Internet</td>
</tr>
<tr>
<td>Resistor R (dissipates energy)</td>
<td>Transistors</td>
<td>Satellite communication system</td>
</tr>
<tr>
<td>Capacitor C (stores energy)</td>
<td>Op-amps (voltage follower, inverting amplifier, ...)</td>
<td>Computer</td>
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<tr>
<td>Inductor L (stores energy)</td>
<td>Filter</td>
<td>Memory unit</td>
</tr>
<tr>
<td>Transformer (changes I and V)</td>
<td>Logic gates (inverter, NAND, ...)</td>
<td>Smart Dust</td>
</tr>
<tr>
<td>Wires (assumed lossless)</td>
<td>Flip-flop, register, ...</td>
<td>Music system (final project)</td>
</tr>
<tr>
<td></td>
<td>Future? Nanotube FET, quantum dot computer, ...</td>
<td>Future? Magnetic RAM, IBM's Millipede memory unit</td>
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</tbody>
</table>

**Circuit Excitation:**  Steady (DC); Transient; Sinusoidal single-frequency (AC)

**Circuit Analysis:**  Using KCL, KVL, Ohm’s Law; Nodal analysis; Mesh analysis; Superposition; Numerical

### Categorizing Components and Devices Several Ways

#### Active

- Transistor (in amplifier with power source, power of signal out can exceed power of signal in)
- Solar cell (electrical output from energy of photons in)
- Battery (electrical output due to chemical reaction inside)

#### Passive

- R; L; C; transformer (it just varies levels of i and v output from those input)
- Diode (without energy source)

#### Linear I-V relationship

2. Characteristic behavior in circuit of linear components: all i and v are at frequency of input i and v only

#### Nonlinear I-V relationship

1. Analysis: can’t use superposition; more difficult than for linear case -- graphical (load line) or numerical?
2. Characteristic behavior in circuit with nonlinear component(s): frequencies in addition to input frequency may arise (often useful)

- Ideal R
- Ideal L
- Ideal C
- Ideal transformer
- Wire
- Diodes in small-signal regime
- Transistors in small-signal regime

- Diodes (all kinds) in large-signal regime
- Transistors in large-signal regime

(Note: almost everything in electronics is nonlinear if the current or voltage is large enough)

8.12.05 RMW