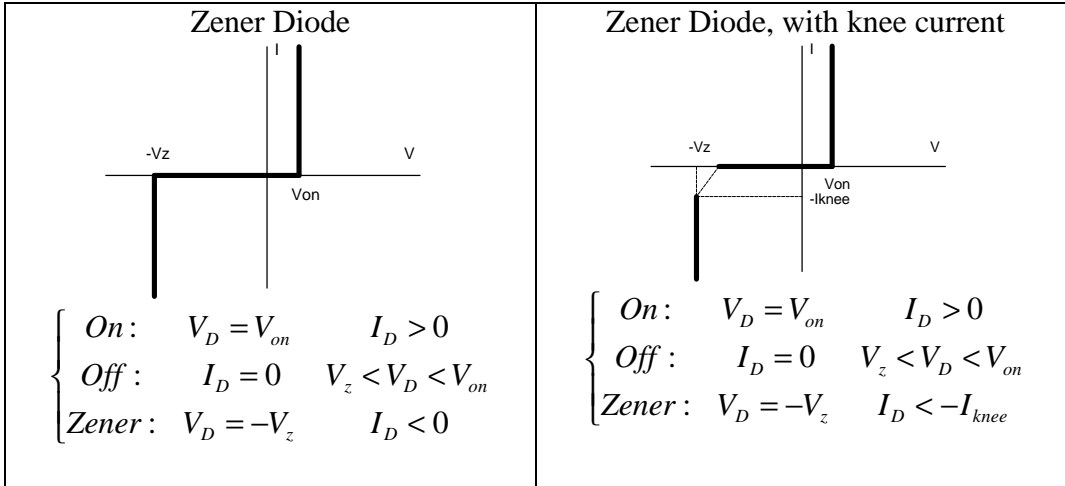
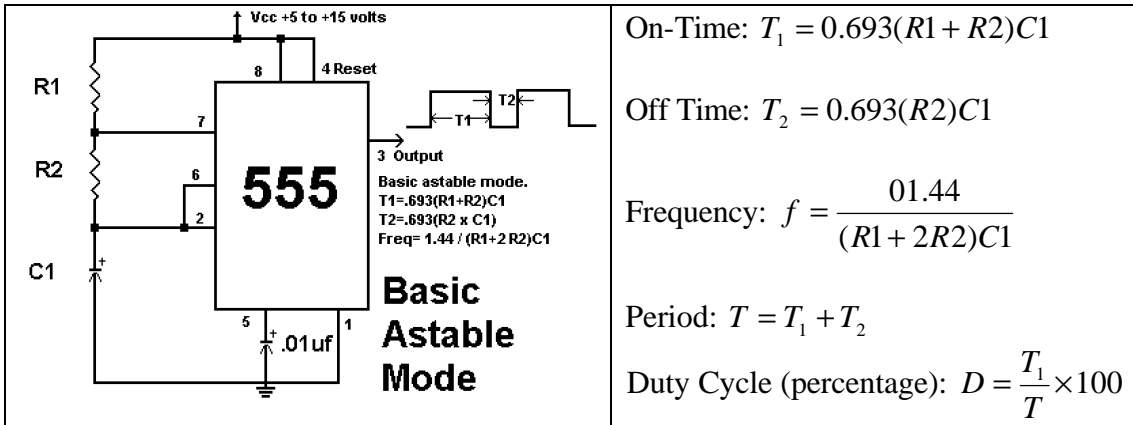


Zener Diodes:



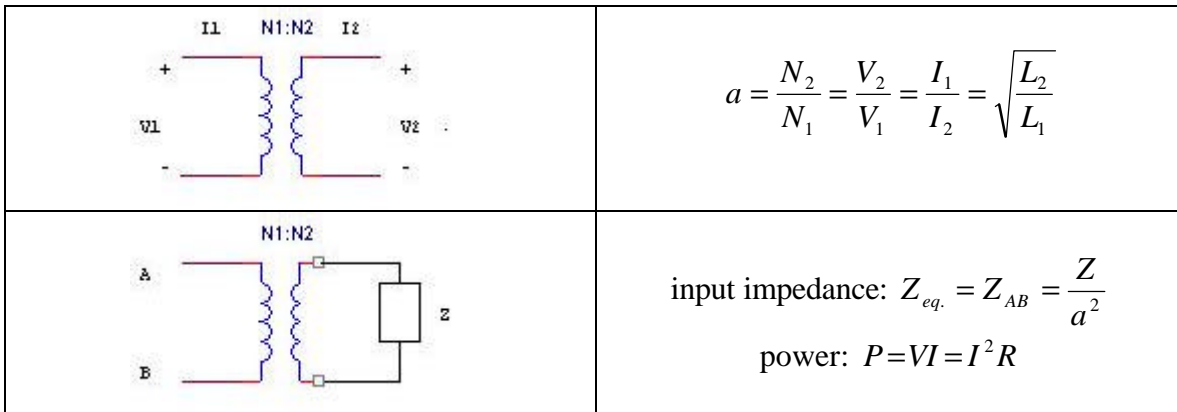
555 Timer:



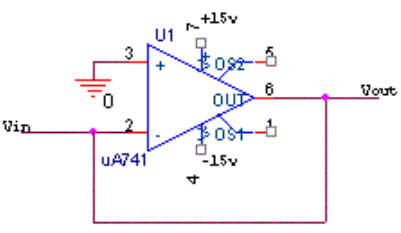
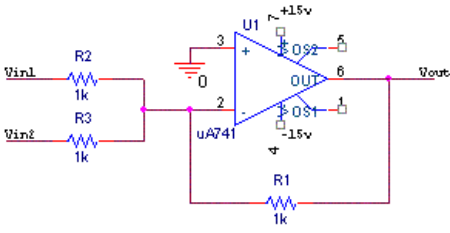
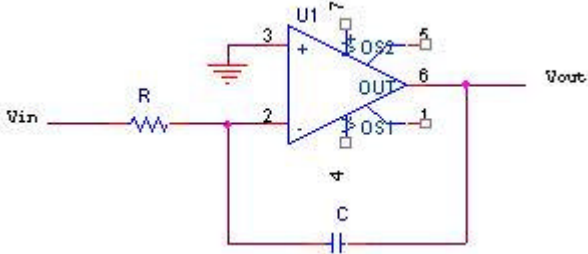
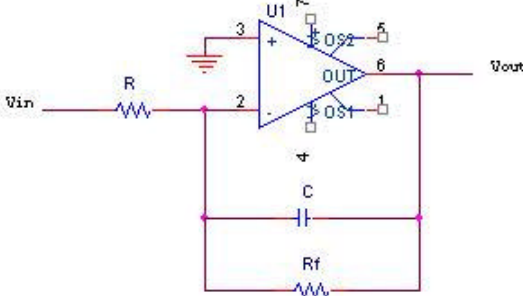
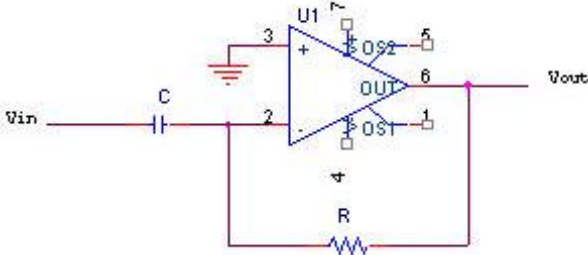
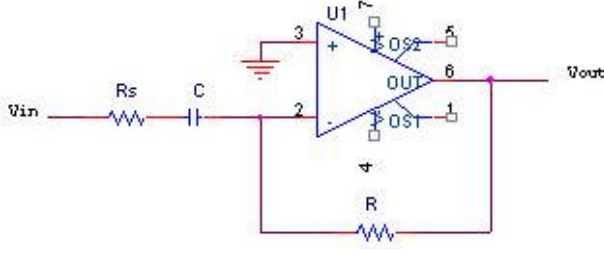
Inductance and Resistance:

| Long Coil | Ring shaped Coil | Wire Resistance |
|--------------------------------|--|--------------------|
| $L = \frac{mN^2 \mu r_c^2}{d}$ | $L = mN^2 r_c \left[\ln\left(\frac{8r_c}{r_w}\right) - 2 \right]$ | $R = \frac{l}{SA}$ |

Ideal Transformers:



Op-Amp Circuits:

| | |
|--|--|
| <p style="text-align: center;">Buffer</p>  $A_V = \frac{V_{out}}{V_{in}} = 1$ | <p style="text-align: center;">Adder</p>  $V_{out} = -\frac{R_1}{R_2} V_{in1} - \frac{R_1}{R_3} V_{in2}$ |
| <p style="text-align: center;">Ideal Active Integrator</p>  $H(j\omega) = \frac{V_{out}}{V_{in}} = -\frac{1}{j\omega RC}$ $v_{out}(t) = -\frac{1}{RC} \int v_{in}(t) dt$ | <p style="text-align: center;">Miller Integrator</p>  $H(j\omega) = \frac{V_{out}}{V_{in}} = -\frac{R_f}{R(1 + j\omega R_f C)}$ $\omega \gg \frac{1}{R_f C} \Rightarrow H(j\omega) \approx -\frac{1}{j\omega RC}$ $\omega \gg \frac{1}{R_f C} \Rightarrow v_{out}(t) \approx -\frac{1}{RC} \int v_{in}(t) dt$ |
| <p style="text-align: center;">Ideal Active Differentiator</p>  $H(j\omega) = \frac{V_{out}}{V_{in}} = -j\omega RC$ $v_{out}(t) = -RC \frac{dv_{in}(t)}{dt}$ | <p style="text-align: center;">Practical Active Differentiator</p>  $H(j\omega) = \frac{V_{out}}{V_{in}} = -\frac{j\omega RC}{1 + j\omega R_s C}$ $\omega \ll \frac{1}{R_s C} \Rightarrow H(j\omega) \approx -j\omega RC$ $\omega \ll \frac{1}{R_s C} \Rightarrow v_{out}(t) = -RC \frac{dv_{in}(t)}{dt}$ |