AC Circuits (quoting from E. M. Purcell, Electricity and Magnetism, 2nd. Ed, Sect. 8.3)

1. An alternating current or voltage can be represented by a complex number.
2. Any one branch or element of the circuit can be characterized, at a given frequency, by the relation between the voltage and the current in that branch.

Adopt the following rule for the representation:
1. An alternating current $I_o \cos(\omega t + \phi)$ is to be *represented by* the complex number $I_o e^{i\phi}$, that is, the number whose real part is $I_o \cos\phi$ and whose imaginary part is $I_o \sin\phi$.
2. Going the other way, if the complex number $x + iy$ represents a current *I*, then the current as a function of time is given by the real part of the product $(x + iy)e^{i\omega t}$.

	I=VY	**V=IZ**
Circuit Element	**Admittance Y**	**Impedance Z**
Resistor	$\frac{1}{R}$	R
Inductor	$\frac{1}{i\omega L} = \frac{-i}{\omega L}$	$i\omega L$
Capacitor	$i\omega C$	$\frac{1}{i\omega C} = \frac{-i}{\omega C}$

Note that impedances add for elements in series, since voltages add for elements in series
Note that admittances add for elements in parallel, since currents add for elements in parallel.

<u>REVIEW OF COMPLEX NUMBERS</u>

$i = \sqrt{-1}$, $\frac{1}{i} = -i$, $e^{i\theta} = \cos\theta + i\sin\theta$

$z = x + iy,\ z^* = x - iy,\ |z| = \sqrt{zz^*} = \sqrt{x^2 + y^2}$

$z = |z|e^{i\theta}$, $\tan\theta = \frac{y}{x}$

$z = \frac{A + iB}{C + iD}$, $z^* = \frac{A - iB}{C - iD}$