Resonance is a characteristic of LC or RLC circuits where such a circuit will either sustain or block a specific AC frequency.

Sinusoidal Alternating Current Flow in a Closed Resonant Circuit

An example of resonance occurs in a closed LC circuit, where the inductor and capacitor are connected to each other, making a complete circuit, and where the capacitor has been previously charged. Here's the basic steps for a complete cycle of alternating current flow in this circuit.

1. When the circuit is first connected, the voltage across the capacitor is at its maximum, and current flow is zero.
2. As the capacitor discharges, current flows through the inductor and the voltage across the capacitor decreases. This builds up a magnetic field around the inductor.
3. Once the capacitor discharges, current flow is zero, the inductor's magnetic field begins to collapse, and generates current flow in the opposite direction.
4. The capacitor charges, but to a voltage whose polarity opposite to its original polarity.
5. When the inductor's magnetic field is completely collapsed, the capacitor again discharges, again building up a magnetic field around the inductor (with the opposite magnetic pole orientation).
6. When the capacitor is again discharged, the inductor's magnetic field again collapses, charging the capacitor to a voltage whose polarity is the same as its original polarity.

Resistance dampens the sinusoidal wave generated by the closed resonant circuit so that the amplitude of the sine wave gradually decreases (is it an exponential decay?).

Resonant Frequency

A given LC circuit will have a single frequency at which it exhibits resonance. This frequency is the one where the reactance of the inductor equals the reactance of the capacitor, so that the two types of reactance cancel out and the impedance at that frequency is purely resistive. The frequency can be calculated using the following formula: $f = 1 / (2 * pi * (LC)^{1/2})$.

Series Resonance

A series resonant circuit is where one end of an inductor is connected to one end of a capacitor (where the inductor and capacitor appear in series). Series resonant circuits exhibit minimum impedance at the resonant frequency.

Parallel Resonance

A parallel resonant circuit is where the inductor and capacitor are connected in parallel. Parallel resonant circuits exhibit maximum impedance at the resonant frequency.

Bandwidth

Bandwidth is defined as the range of frequencies for which current flow is within 3 dB of the maximum current flow. Bandwidth can be increased by adding resistance to the circuit.

Q

Also called quality factor, q quantifies the effects of power losses (resistance) in a resonant circuit.

Antiresonance

Antiresonance changes the frequency at which resonance occurs through the addition of resistance to the resonant circuit.

Resonant Rise of Voltage and Tesla Coils and Spark Gaps

This dangerous phenomenon is used to advantage in Tesla coils and spark gap transmitters based on Tesla coils.

Useful Web Sites

http://en.wikipedia.org/wiki/RLC_circuit

http://www.phys.unsw.edu.au/~jw/LCresonance.html

http://www.allaboutcircuits.com/vol_2/chpt_6/1.html

http://www.tb3.com/tesla/theory.html

http://www.richieburnett.co.uk/resonant.html