BME 301

3-Electrical Elements

Homework

1. Describe each of the circuit elements.

The active elements are voltage sources and current sources.

The passive elements are resistors, capacitors and inductors

Homework

2. For the passive elements that store energy, describe how the energy is stored; that is, what are features of these elements that lend themselves to this type of energy storage.

Capacitors are devices which have two plates separated by a gap of insulation material. Charges can form on both plates at equal and opposite charge. The gap prevents the charges from moving from one plate to another.

Inductors are coils of wires sometimes wound around a metallic core. When a wire carries an electric current a magnetic field surrounds the wire (Ampere's Law). The number of turns in the coil enhances the field.

Homework

3. HONORS STUDENTS ADD THE FOLLOWING

What type of passive circuit elements would be required to filter out the noise from a bio-signal.

Assuming we are dealing with signals and noise that can be represented be sinusoidal functions, resistors are not frequency dependent then using only resistors would not be able to detect frequency. However, capacitors and inductors are. For capacitors, the current through flowing them are proportional to the derivative of the voltage across them and for inductors, the voltage across them are proportional to derivative of the current flowing through them.

Furthermore, taking the derivative of a sinusoidal function will yield the frequency of the sinusoid.

$$x(t) = A\sin(\omega t);\ \text{then}\ \frac{d}{dt}x(t) = A\frac{d}{dt}\sin(\omega t) = A\omega\cos(\omega t)$$