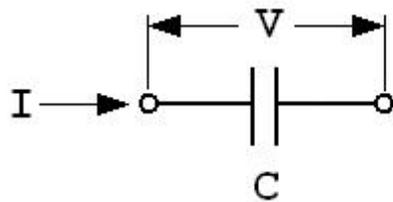


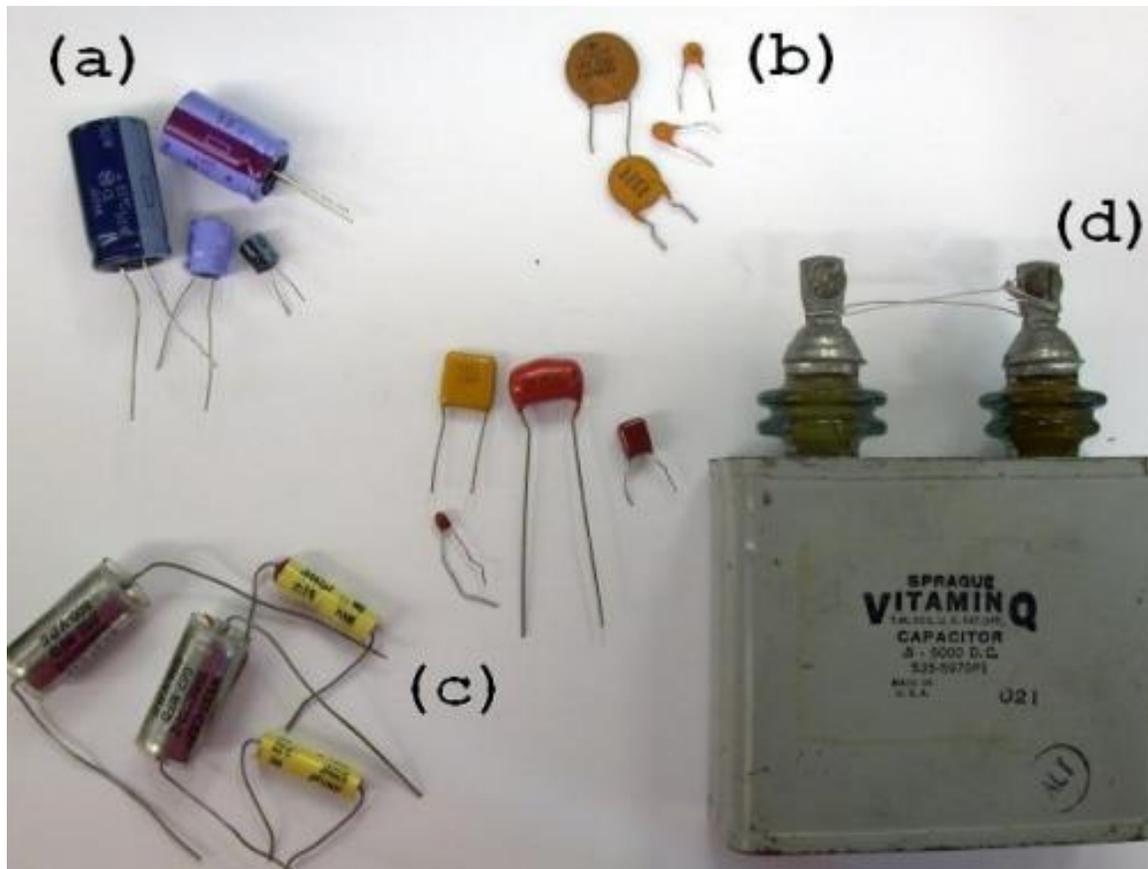
## Capacitors



$$Q = CV$$

$$I = C \frac{dV}{dt}$$

Capacitors are energy-storage devices. A capacitor of  $C$  farads with  $V$  volts across its terminals has a charge  $Q$  stored on one plate and  $-Q$  stored on the other plate. Energy is stored in the electric field between the plates. Capacitors are used for waveform generation and in integrators and differentiators (in integral and differential control, for example, which you may remember from your classes). They are essential in filtering applications. Electrolytic capacitors are used as power supply filters. When combined with a resistor, capacitors form low-pass and high-pass filters.



## Capacitor Varieties

Capacitors come in many varieties. The above picture shows some of the capacitors that can be found around the electronics lab.

- (a) **Electrolytic capacitors:** These capacitors are available in W294 in ranges from 1-1000 mF. These capacitors are commonly used in power-supply filters to smooth out fluctuations. *The most important thing to note about electrolytic capacitors is that they are polarized*, i.e. the pin marked negative must be connected to a lower potential than the pin marked positive (see special note below).
- (b) **Ceramic disc capacitors:** These capacitors are available in values from 10 pF-220 nF in W294. Larger values are available in W298. Ceramic capacitors are common and inexpensive. They are not polarized.
- (c) **Various other capacitors:** Other capacitors available in W298 include polystyrene, tantalum and metal foil. See a staff member if you need a capacitor not available in W294.
- (d) **High voltage capacitor:** Very large capacitors are used in high-voltage and high-current applications to store and discharge large amounts of voltage. The wire wrapped around the leads insures that the capacitor will not collect charge from its surroundings while in storage. It is good to know that they exist, but you would not use high voltage capacitors except under supervision.

**A special note on electrolytic capacitors:** As mentioned above, electrolytic capacitors are polarized. They will always be marked with a stripe on one side (see the photo below). The stripe indicates the pin which must be kept at a negative potential relative to the other one. For example, call the pin near the stripe (a). The other pin is (b). If (b) is connected to a positive voltage, (a) should be connected to ground. However, if your power supply is giving a voltage that is negative with respect to ground, then (a) should be connected to the negative voltage and (b) to ground. That way, (a) is maintained negative to (b).

