

# EELE 250: Circuits, Devices, and Motors

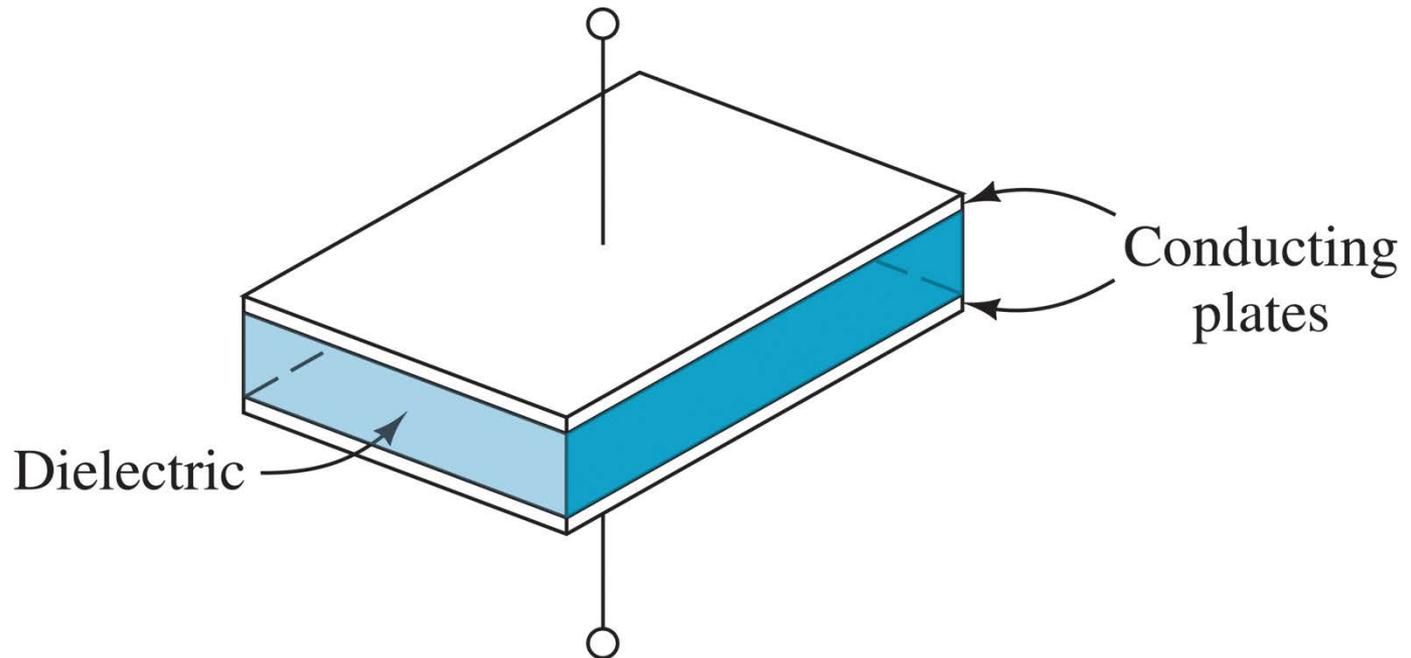
Lecture 8

# Assignment Reminder

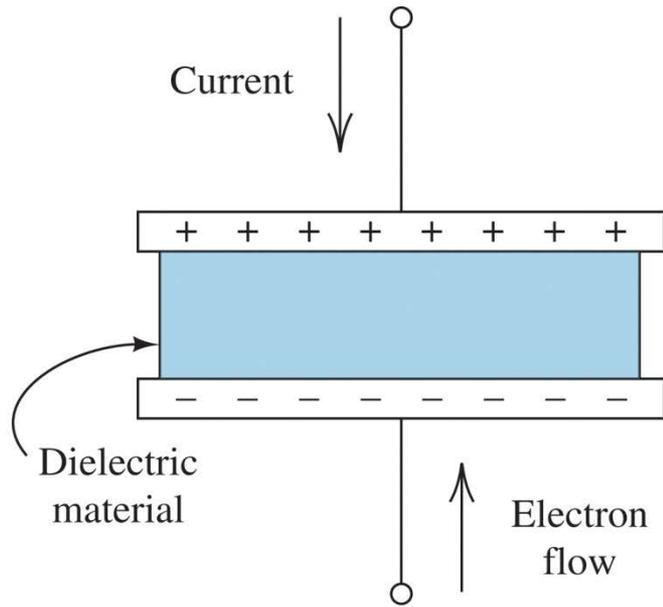
- Read 3.4 - 3.7, AND 4.1 - 4.3
- Practice problems:
  - P2.57, P2.59, P2.91 <--**note that these involve *controlled* sources**
  - P3.26, P3.28, P3.48, P3.49
- D2L Quiz #4 by 11AM on Monday 23 Sept. (The quiz will be posted soon).
- REMINDER: [Lab #3](#) this week, then your lab notebooks will be graded by the TAs. Notebooks are due by 2:00PM on Friday 9/20/13
- Exam #1 in class on Wednesday 9/18/13

# Capacitors

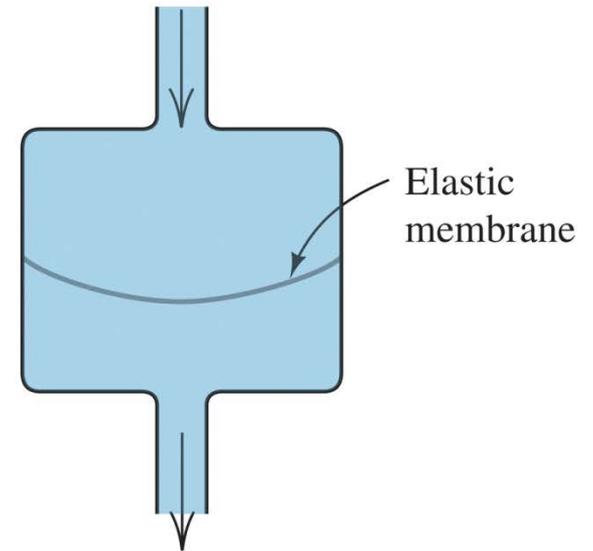
- A capacitor stores electric charge. The capacitor “charges up” as a current delivers charge to it.



# Capacitors (cont.)



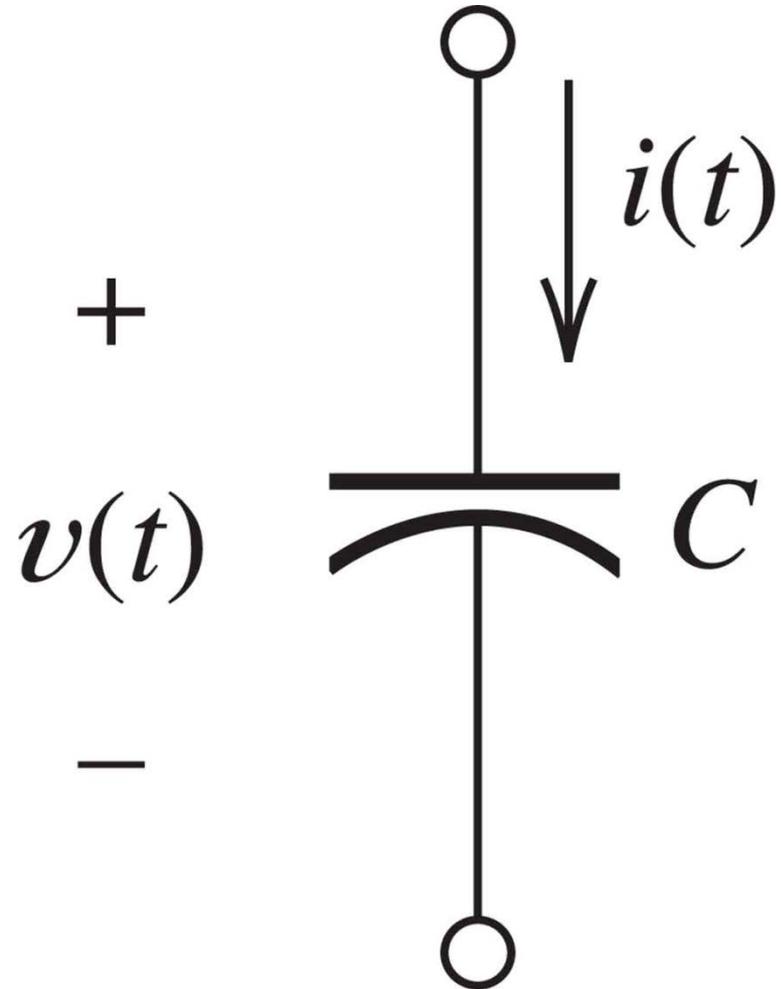
(a) As current flows through a capacitor, charges of opposite signs collect on the respective plates



(b) Fluid-flow analogy for capacitance

# Capacitors (cont.)

- Circuit symbol and polarity convention



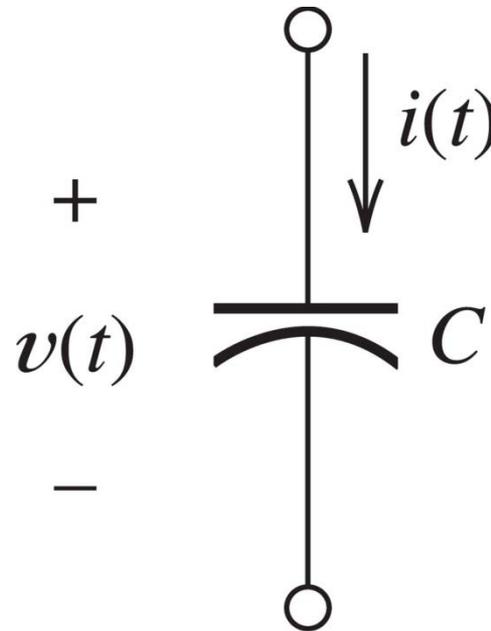
# Capacitance

- Capacitance is measured in *Farads*

$$C = \frac{q}{v}$$

$$i = \frac{dq}{dt} = \frac{d}{dt}(Cv)$$

$$i = C \frac{dv}{dt}$$



# Capacitance (cont.)

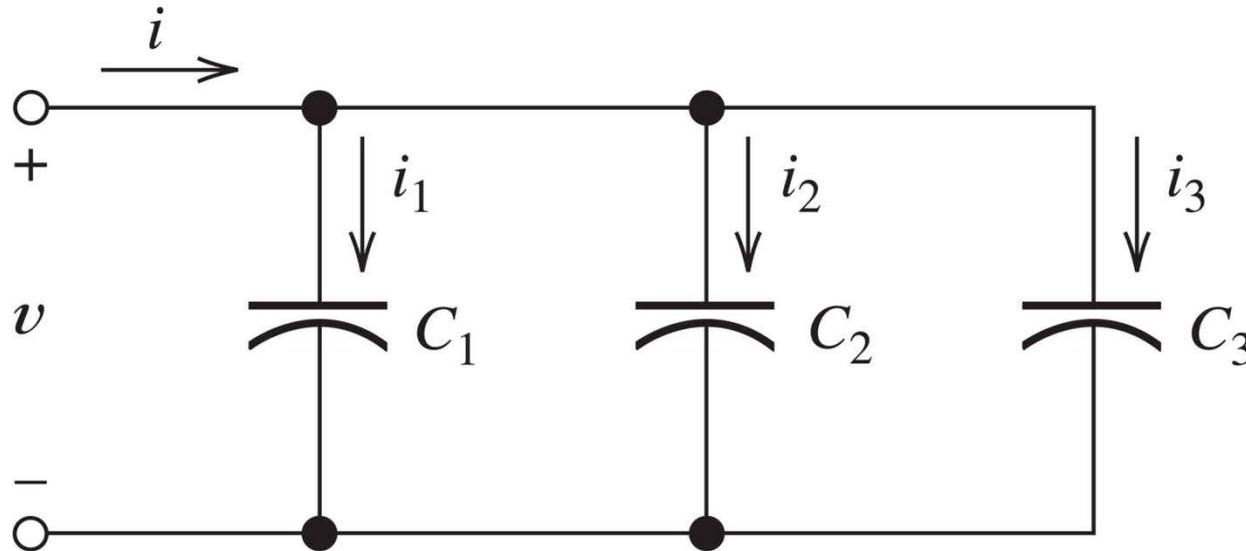
- In terms of voltage:

$$v(t) = \frac{1}{C} \int_{t_0}^t i(t) dt + v(t_0)$$

$$q(t) = \int_{t_0}^t i(t) dt + q(t_0)$$

# Parallel and Series

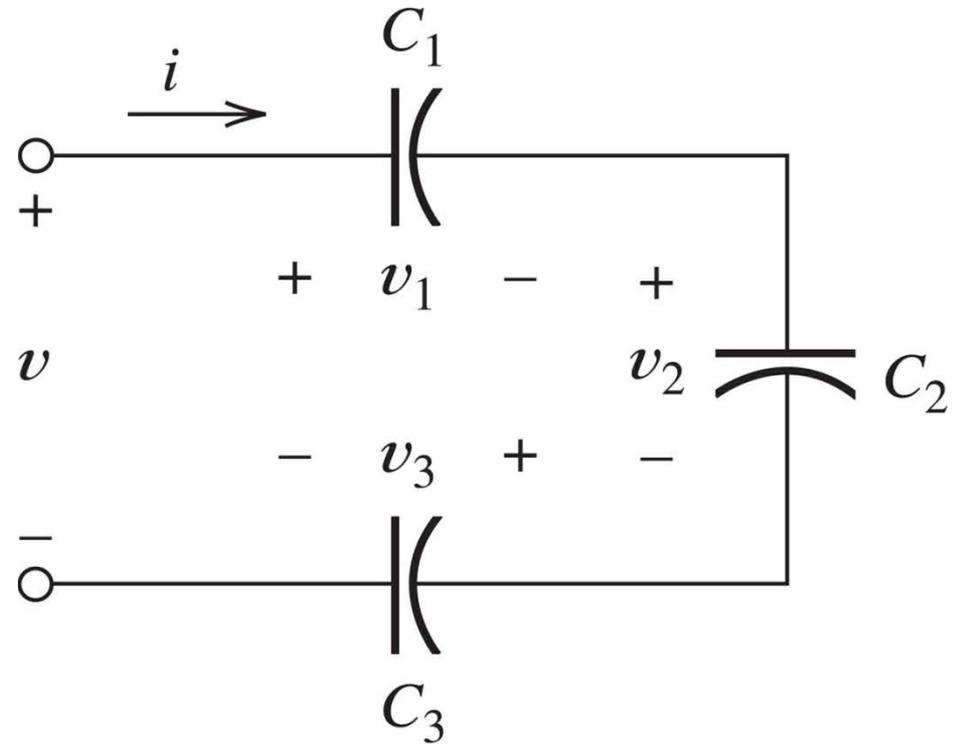
- Capacitors in parallel have the same voltage but different currents, so they act like the sum of the individual capacitances



$$C_{\text{eq}} = C_1 + C_2 + C_3$$

# Parallel and Series (cont.)

- Capacitors connected in series share the same current, but have different voltages, so they combine as reciprocals



$$C_{\text{eq}} = \frac{1}{1/C_1 + 1/C_2 + 1/C_3}$$

# Summary and Review

- Capacitors store charge: they *integrate* the current as the voltage charges up
- $C = q/v$
- $i = C \, dv/dt$
- $V = (1/C) \int i \, dt$
- Capacitors in parallel add together, like resistors in series.
- Capacitors in series add *reciprocally*, like resistors in parallel.