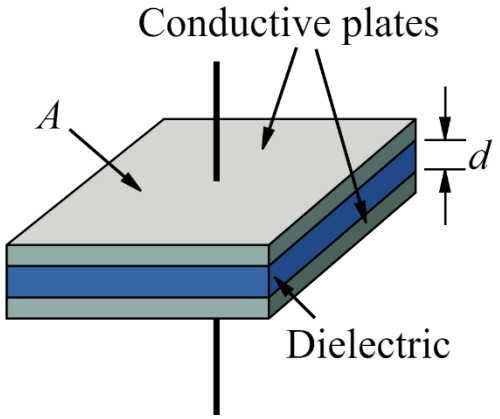
CG1111: Engineering Principles and Practice I

Capacitors

Main Concepts of Capacitors

$$C = \frac{Q}{V}$$

$$C = \frac{\varepsilon A}{d}$$



ε: Permittivity of the dielectric
A: Cross-sectional area of the plate
d: Distance between the plates

$$E = \frac{1}{2}CV^2$$

$$i(t) = C\frac{dv(t)}{dt}$$

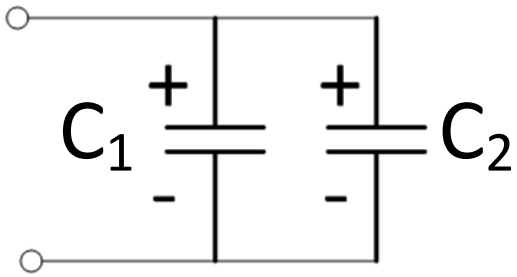
Main Concepts of Capacitors

$$i(t) = C\frac{dv(t)}{dt}$$

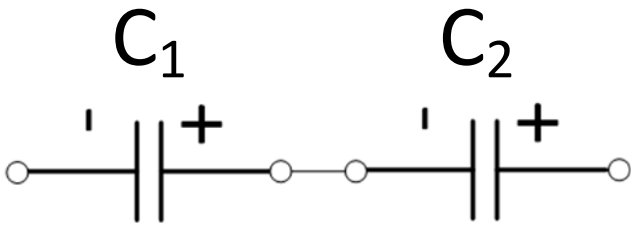
Capacitors in DC circuits behave as open−circuit at steady state

Capacitor voltage cannot change instantaneously, and must be continuous

Main Concepts of Capacitors



Parallel Connection of Capacitors



Series Connection of Capacitors

$$C_{eq} = C_1 + C_2$$

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

Main Concepts of Capacitors

- A capacitor's transient voltage in a series RC circuit can be expressed as

$$v_c(t) = v_c(0)e^{-\frac{t}{\tau}} + v_c(\infty)[1 - e^{-\frac{t}{\tau}}],\ \tau = RC$$

t	$e^{-\frac{t}{\tau}}$	$1 - e^{-\frac{t}{\tau}}$
τ	0.368	0.632
2τ	0.135	0.865
3τ	0.050	0.950
4τ	0.018	0.982
5τ	0.007	0.993