EELE 250: Circuits, Devices, and Motors

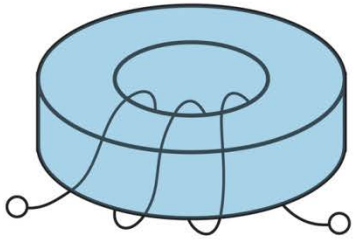
Lecture 9

Assignment Reminder

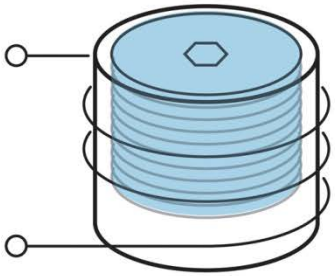
- Read 4.1 – 4.3 AND 5.1 - 5.4
- Practice problems:
  - **P3.60, 3.64, 3.72**
  - **P4.3, 4.8, 4.9, 4.23, 4.37, 4.38**
- D2L Quiz #4 by 11AM on Wednesday 25 Sept. Then Quiz #5 will be posted this week (due by 11AM on Monday 30 Sept.
- REMINDER: No lab meetings this week.

Inductors

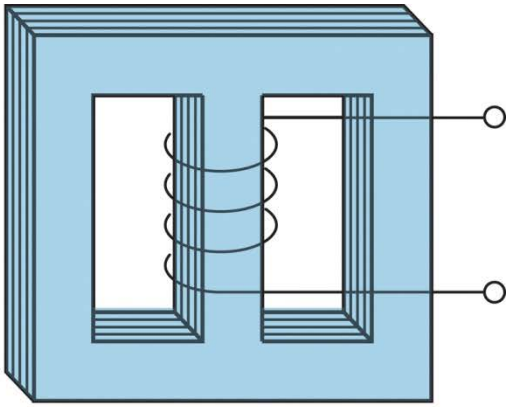
- An inductor stores energy in a magnetic field. Current through the coil acts like an electromagnet. A typical inductor has a coil of wire around an iron core.



(a) Toroidal inductor



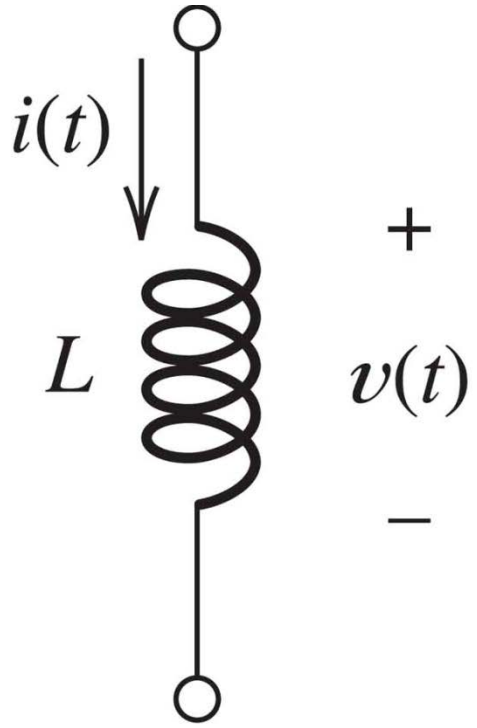
(b) Coil with an iron-oxide slug that can be screwed in or out to adjust the inductance



(c) Inductor with a laminated iron core

Inductors (cont.)

- Rather than storing charge like a capacitor, think of an inductor as having "current inertia"



$$v(t) = L\frac{di}{dt}$$

Inductance

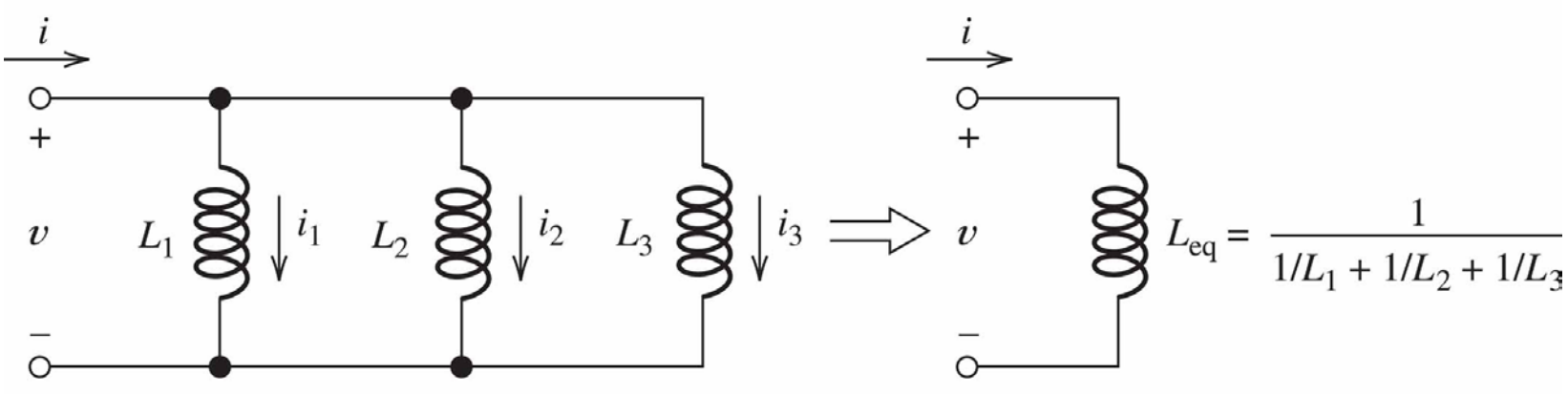
- Inductance is measured in *Henrys* [volt seconds per amp]

$$v(t) = L\frac{di}{dt}$$

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

Parallel and Series

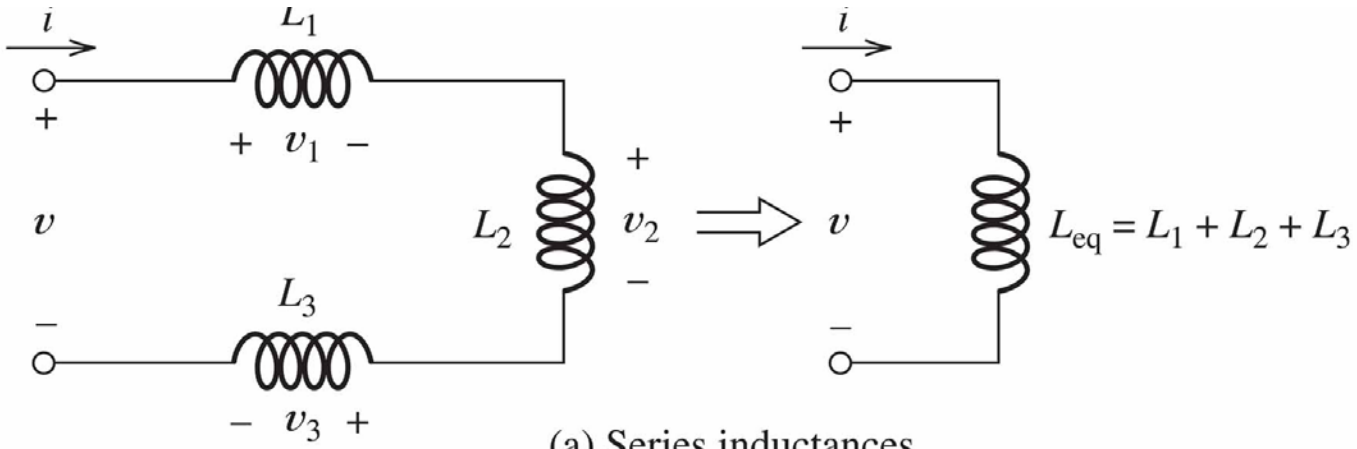
- Inductors in parallel have the same voltage but different currents, so they add reciprocally (like resistors).



(b) Parallel inductances

Parallel and Series (cont.)

- Inductors connected in series share the same current, but have different voltages, so they add directly (like resistors).



(a) Series inductances

Important Rules of Thumb

- It takes time to change the voltage on a capacitor, because we have to wait while enough charge is delivered or removed by the current
- It takes time to change the current through an inductor, because the magnetic field must be increased or decreased
- Forcing a capacitor to change voltage quickly would require a BIG CURRENT: $dv/dt = i \cdot (1/C)$
- Forcing an inductor to change current quickly would require a BIG VOLTAGE: $di/dt = v \cdot (1/L)$

Summary and Review

- Inductors store energy in a magnetic field
- $v = L \, di/dt$
- $i = (1/L) \int v \, dt$
- Inductors in parallel add together reciprocally, like resistors in parallel.
- Inductors in series add *directly*, again like resistors in series.