01.7 fun.ind Inductors

A **pure inductor** is defined as an element in which **flux linkage** λ—the integral of the voltage—across the inductor is a monotonic function $\mathcal{F}$ of the current i; i.e. the pure constitutive equation is

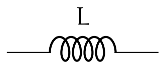

Figure ind.1: inductor circuit diagram symbol.

$$\lambda = \mathcal{F}(i). \tag{1}$$

An **ideal inductor** is such that this monotonic function is linear, with slope called the **inductance** L; i.e. the ideal constitutive equation is

The units of inductance are the SI derived unit **henry (*H*)**. Most inductors have inductance best represented in mH or μH.
The elemental equation for an inductor is found by taking the time-derivative of the constitutive equation.

Equation 2 inductor elemental equation

Inductors store energy in a *magnetic field*. It is important to notice how inductors are, in a sense, the *opposite* of capacitors. A capacitor's current is proportional to the time rate of change of its voltage. An inductor's voltage is proportional to the time rate of change of its current.
Inductors are usually made of wire coiled into a number of turns. The geometry of the coil determines its inductance L.

Often, a **core** material—such as iron and ferrite—is included by wrapping the wire around the core. This increases the inductance L. Inductors are used extensively in radio-frequency (rf) circuits, with which we won't discuss in this text. However, they play important roles in ac-dc conversion, filtering, and transformers—all of which we will consider extensively.

The circuit diagram for an inductor is shown in Fig. ind.1.