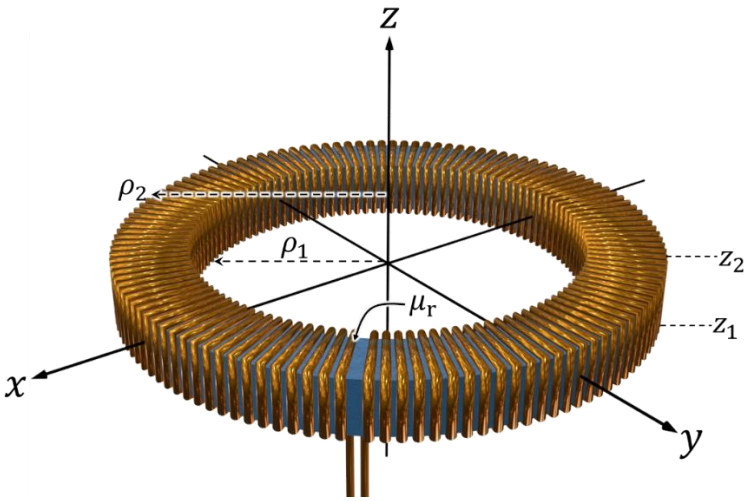
Reading

Chapter 8, pp. 348-368

Problem 1 – Toroidal Inductor

The toroidal inductor shown in the figure below has a core with permeability $\mu_r = 60$ and a square cross section in the ranges $1.5\text{ cm} < \rho < 2.0\text{ cm}$ and $-0.20\text{ cm} < z < 0.20\text{ cm}$. Calculate the inductance L of this device if it contains 4000 turns of wire.

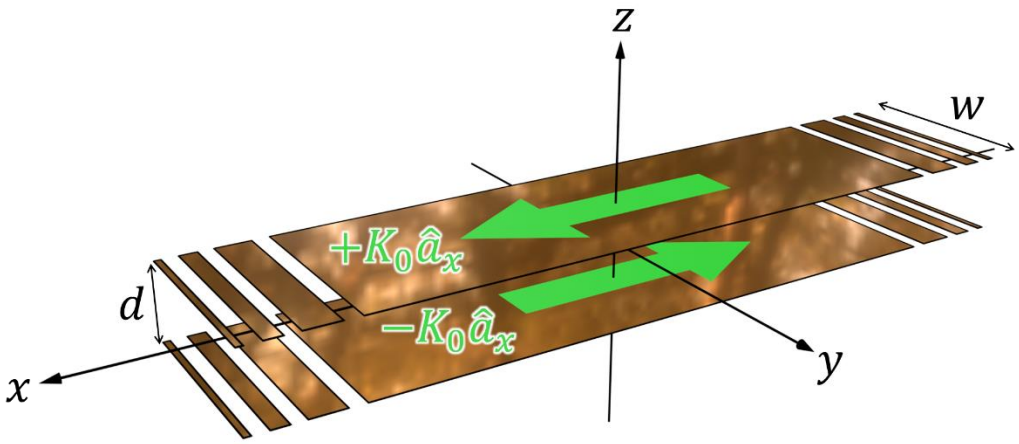


Problem 2 – Two Parallel Plates

A parallel plate transmission line is composed of two plates located at $z = -d/2$ and $z = +d/2$ and each has a width of w. When used as a transmission line, each plate carries a surface current that are in opposite directions as shown in the figure below.

(a) Derive an expression for the energy stored in the magnetic field per unit length (meters) between the lines.

(b) Derive an expression for the inductance per unit length (meters) using the stored magnetic energy derived in part (a).



Problem 3 – Inhomogeneous Permeability

The solenoid inductor shown below has 500 turns, an air core, a length of 3.0 cm, and a diameter of 1.0 cm. A stock of iron rod is available with a relative permeability of $\mu_r = 20$ and a diameter that will perfectly fit inside of the inductor. How long ℓ_{Fe} should the rod be cut so that the device has an overall inductance of 6.0 nH when the rod partially fills the inductor?