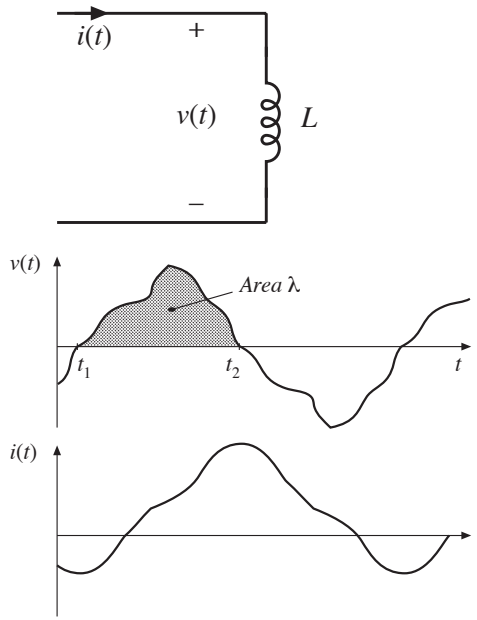
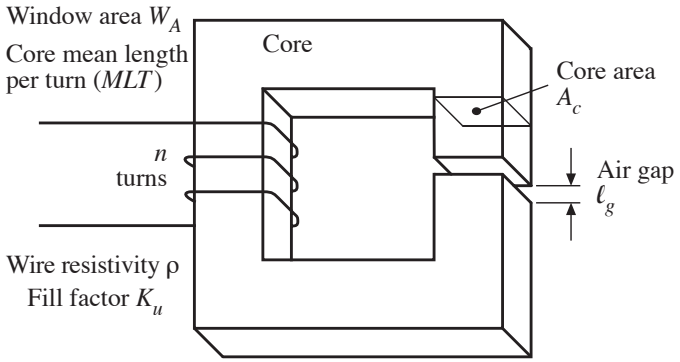
12.4 AC Inductor Design





Design a single-winding inductor, having an air gap, accounting for core loss

(note that the previous design procedure of this chapter did not employ an air gap, and inductance was not a specification)

Outline of key equations

Obtain specified inductance:

$$L = \frac{\mu_0 A_c n^2}{\ell_g}$$

Relationship between applied volt-seconds and peak ac flux density:

$$\Delta B = \frac{\lambda}{2 n A_c}$$

Copper loss (using dc resistance):

$$P_{cu} = \frac{\rho n^2 (MLT)}{K_u W_A} I^2$$

Total loss is minimized when

$$\Delta B = \left[\frac{\rho \lambda^2 I^2}{2 K_u} \; \frac{(MLT)}{W_A A_c^3 \ell_m} \; \frac{1}{\beta K_{fe}} \right]^{\left(\frac{1}{\beta + 2}\right)}$$

Must select core that satisfies

$$K_{gfe} \geq \frac{\rho \lambda^2 I^2 K_{fe}^{(2/\beta)}}{2 K_u \left(P_{tot}\right)^{\left((\beta + 2)/\beta\right)}}$$

See Section 12.4.2 for step-by-step design equations