Introduction to Electricity and Magnetism B38EM

Tutorial #5 - Problems

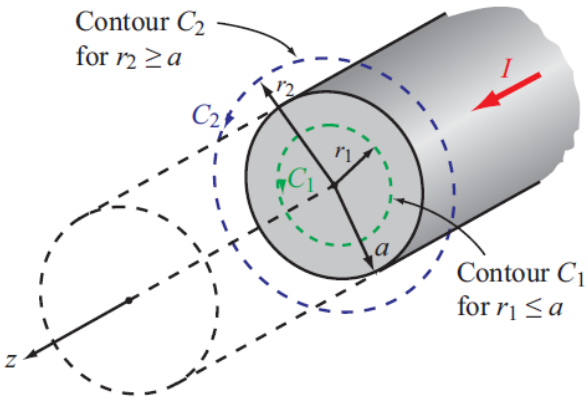
$\varepsilon_0 = 8.85\text{x}10^{-12}\ \text{Fm}^{-1}$, $e = 1.6\text{x}10^{-19}\ \text{C}$, $1\ \text{nC} = 10^{-9}\ \text{C}$

1) A semi-infinite linear conductor extends between z=0 and z=∞ along the z-axis. If the current I in the conductor flows along the positive z-direction, find **H** at a point in the x-y plane at a radial distance r from the conductor. (Ex. 5.6 Ulaby)

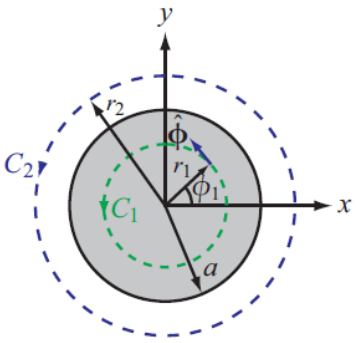
2) A wire is formed into a square loop and placed in the x-y plane with its centre at the origin and each of its sides parallel to either the x- or the y- axes. Each side is 40cm in length, and the wire carries a current of 5 A whose direction is clockwise when the loop is viewed from above. Calculate the magnetic field at the centre of the loop. (Ex. 5.8 Ulaby)

3) The metal niobium becomes a superconductor with zero electrical resistance when it is cooled to below 9 K, but its superconductive behavior ceases when the magnetic flux density at its surface exceeds 0.12 T. Determine the maximum current that a 0.1-mm-diameter niobium wire can carry and remain superconductive. (Ex. 5.10 Ulaby)

4) Find the internal and external magnetic field of long conductor



(a) Cylindrical wire



(b) Wire cross section

5) Find the magnetic field of a toroid.

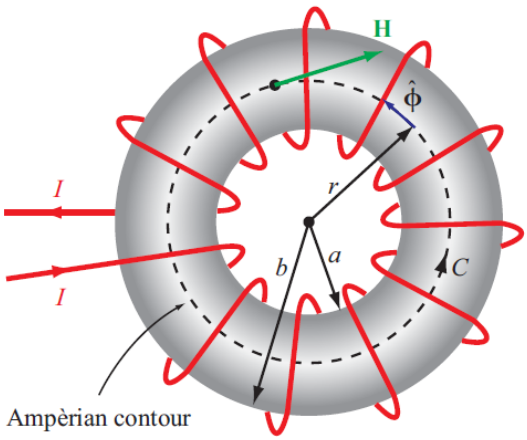


Figure 5-18: Toroidal coil with inner radius *a* and outer radius *b*. The wire loops usually are much more closely spaced than shown in the figure (Example 5-5).