

PHY 322: Electromagnetic Fields - Spring 2004

Final Exam

May 12, 2004, 7:45-9:45am

Please print your name here:

For the grader:

Problem 1	
Problem 2	
Problem 3	
Total	

Problem 1 (*8 points*):

A steady current I flows down a long cylindrical wire of radius a . Find the magnetic field, both inside and outside the wire, if

- (a) The current is uniformly distributed over the outer surface of the wire.
- (b) The current is distributed in such a way that J is proportional to s , the distance from the axis.

Problem 2 (7 points) :

An infinitely long cylinder, of radius R , carries a "frozen-in" magnetization, parallel to the axis,

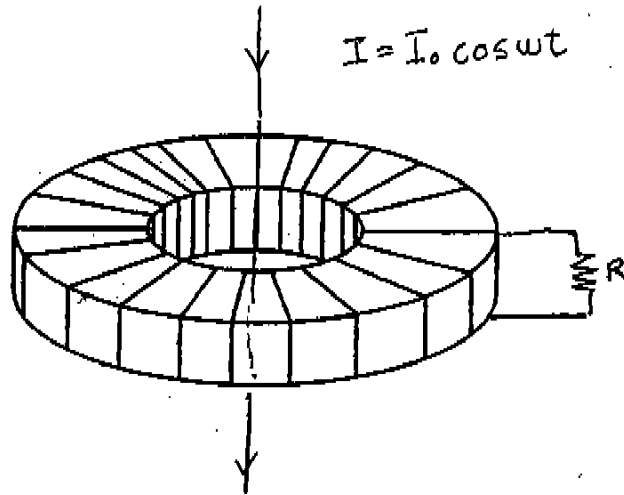
$$\vec{M} = ks\hat{z}$$

where k is a constant and s is the distance from the axis; there is no free current anywhere. Find the magnetic field inside and outside the cylinder by two different methods:

- (a) Locate all the bound currents and calculate the field they produce.
- (b) Using Ampere's law in magnetized materials to find \vec{H} , and then get \vec{B} .

Problem 3 (10 points) :

An alternating current $I_0 \cos(\omega t)$ flows down a straight wire, which runs along the axis of a toroidal coil with rectangular cross section (inner radius a , outer radius b , height h , N turns). The coil is connected to a resistor R .



- What is the induced emf in the toroid?
- Find the current $I_r(t)$ through the resistor.
- Find the self-inductance of the toroidal coil.
- Calculate the back emf in the coil, due to the current $I_r(t)$.