

PROBLEM 1 (20 Points)

- (a) Write down Maxwell's equations in differential form.
 (b) Derive the charge conservation law from Maxwell's equations.

PROBLEM 2 (20 Points)

The dielectric strength of air (i.e., the electric field above which the air becomes conducting) is 3×10^6 V/m. What is the highest possible potential of an isolated spherical conductor of radius 8 cm?

PROBLEM 3 (20 Points)

An isolated straight conducting wire of length L has total charges Q on it. Find the absolute potential of this wire.

PROBLEM 4 (20 Points)

What is the minimum amount of the current needed to magnetize the ferrite film of a magnetic tape? The hysteresis loop of the ferrite material and the magnetic circuit of the recording head are shown in the figure. To take into account the spread of the magnetic field in the air gap of the recording head, assume that effective cross-sectional area of the air gap is 25 % larger than that of the magnetic core.

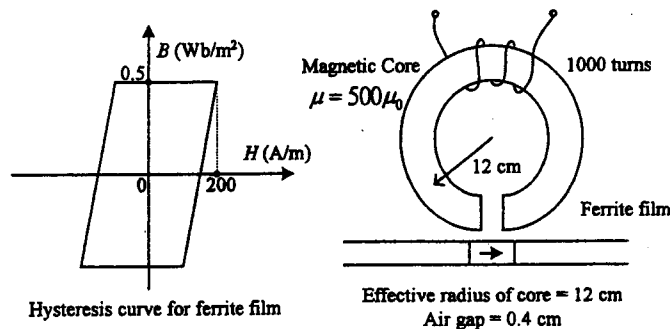


Figure for Problem 4

PROBLEM 5 (20 Points)

On a distortionless line, the voltage wave is given by

$$V(l) = 120e^{0.0025l} \cos(10^8 t + 2l) + 60e^{-0.0025l} \cos(10^8 t - 2l),$$

where l is the distance from the load. If the load $Z_L = 300 \Omega$, find: the attenuation constant α , wave number β , wave velocity v , characteristic impedance Z_0 , and the current $I(l)$ on the line.