EM Scattering

Homework assignment 2

Problem 1:

Scattering from perfectly conducting cylinders was treated by using the $\boldsymbol{M}$ and $\boldsymbol{N}$ functions. The same method may be used to analyze the scattering of a plane wave by a dielectric or magnetic cylinder. Consider an infinitely long magnetic cylinder with the radius a and relative permeability μ_r. The permittivity of the cylinder is that of the vacuum (surrounding environment). The axis of the cylinder coincides with the z-axis. The incident wave travels along $+\hat{\boldsymbol{x}}$ and has a magnetic field polarized along z (electric field along y).

- In the region inside the cylinder, write the field vectors as a series in appropriate $\boldsymbol{M}$ and $\boldsymbol{N}$ functions.
- Outside the cylinder write the field as the incident plus the scattered field and expand each in series.
- Match the solutions at the surface of the cylinder and find the scattered field.
- Take the frequency of the incident wave to be 30GHz, $\mu_r = 4$, and $a = 2cm$. Calculate the electric and magnetic fields in the far zone and plot their amplitudes as function of angle

Problem 2:

An incident plane wave is traveling in free space with a wave vector $\boldsymbol{k}_i$ which lies on the y-z plane and makes an angle θ_i with the z-axis. The incident electric field is polarized along the x-axis and has an amplitude of E_0. The wave is scattered by a semi-infinite, circular, perfectly conducting cylinder which is mounted on top of an infinite, perfectly conducting ground plane. Calculate the scattered electric field.