Microwave Magnetics
Homework assignment 2

Problem 1:

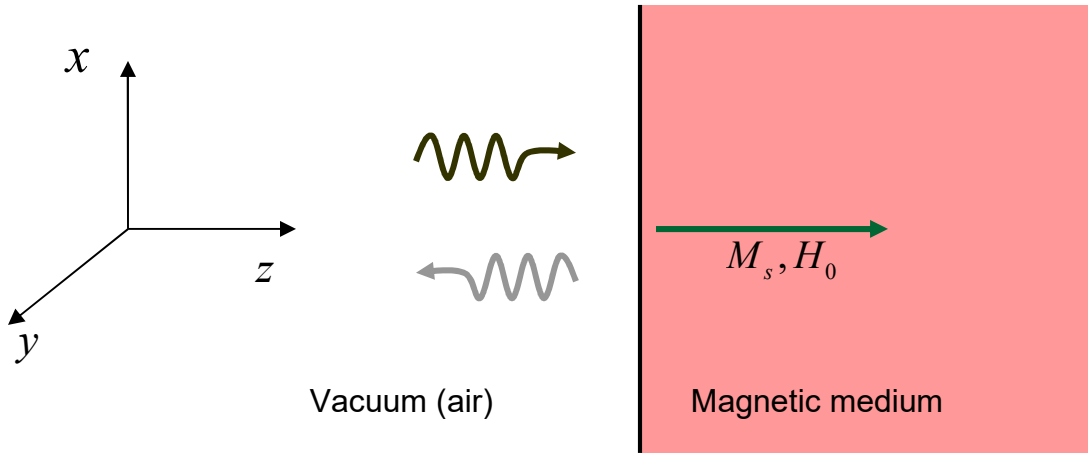
A circularly polarized plane wave, traveling in vacuum in the z-direction, is incident on a half-infinite ferromagnetic region as shown in the figure below. The ferromagnetic material is magnetized in the +z-direction with the saturation magnetization M_s. The dc magnetic field inside this material is constant everywhere, and given by H_0 (also in the +z-direction). The material is considered to be insulating and lossless for simplicity, and has a relative dielectric constant of 1.

(i) Show that the reflected wave, and the wave travelling inside the ferromagnetic material are both circularly polarized and have the same polarity (left- or right handed) as the original wave.

(ii) Calculate the reflection coefficient for the right- and left hand waves, and plot it as function of frequency.

(iii) Now consider a linearly polarized wave travelling in vacuum towards the interface with the ferromagnetic material. Take the polarization to be in the x-direction. By decomposing this wave into circularly polarized waves, calculate the reflected wave.

(iv) What can be said about the polarization of the reflected wave? How does it behave as function of frequency?



Problem 2:

A linearly polarized plane wave, traveling in vacuum in the *x*-direction, is incident on a half-infinite ferromagnetic region. The ferromagnetic material is magnetized in the +*z*-direction with the saturation

magnetization M_s. The dc magnetic field inside this material (internal dc field) is constant everywhere, and given by H_0 (also in the +*z*-direction). The material has a relative dielectric constant of ε, and is assumed to be insulating and lossless. Consider the two cases where the incident wave is polarized in the in the *y*- and z-directions (in the sense of the electric field):

(i) Is the reflected wave also linearly polarized in both cases? In which direction?

(ii) Calculate the reflection coefficient for these two cases. Plot the magnitude of the two reflection coefficients as function of frequency.

Next consider the general case of a linearly polarized wave with the electric field in an arbitrary direction (in the *y*-*z* plane).

(iii) What can be said of the polarization of the reflected wave? What about its dependence on frequency?