Electromagnetic scattering I (53919, 5 cr)
Exercise 3: FDTD

1. Starting from Maxwell's equations, derive the update equations for a one-dimensional finite-difference time-domain algorithm. You can assume that the space is uniform in the x- and y-direction. Assume also that the material parameters, permittivity ϵ_r, permeability μ_r, and electric conductivity σ are isotropic.

2. Implement a one-dimensional FDTD-algorithm for the E_y/H_x-mode based on the update equations derived in the problem 1. The program should include

- Total-field / scattered field source (Gaussian pulse)
- Perfectly absorbing boundary conditions
- Computation of reflectance and transmittance
- Visualization of the electric and magnetic fields

You may use the following parameters:

- grid size $N_k = 1000$,
- $\Delta z = 10^{-8}$,
- Gaussian pulse width $\tau = 5 \times 10^{-16}$
- Gaussian pulse delay $t_0 = 6\tau$
- $\epsilon_r(1:299) = 1$, $\epsilon_r(300:500) = 5$, $\epsilon_r(501:700) = 3$, $\epsilon_r(701:1000) = 1$

Plot the reflection and transmission as a function of frequency ($430 - 850$ THz).