Computational light scattering, fall 2020 (PAP315, 5 cr)
Exercise 3 (geometric optics and FDTD)

1.(9 points) 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.(12 points) 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 (ideally) absorbing boundary conditions,
- computation of the reflectance and transmittance,
- visualization of the eletric 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).