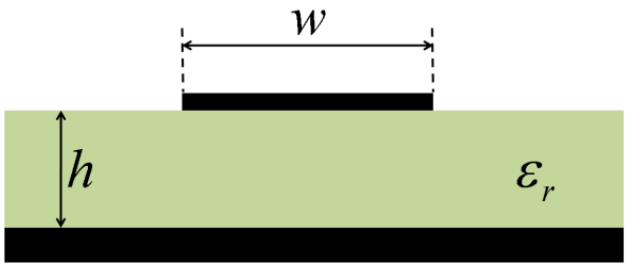
MICROWAVE ENGINEERING

Problem #1: Microstrip Transmission Line

The microstrip transmission line shown below operates at 2.4 GHz and has been designed according to h=2 mm, w=3 mm, and ε_r=6.0.

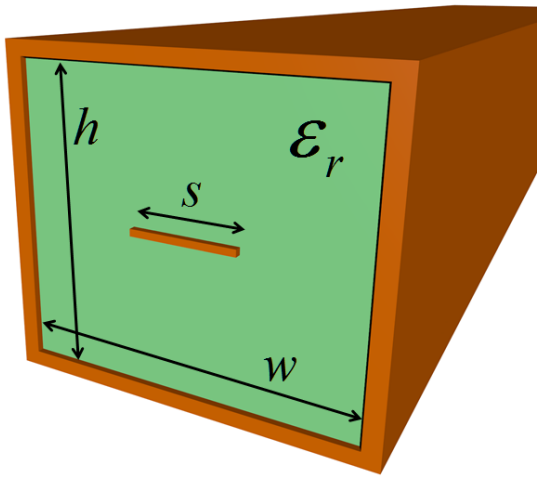


a. Calculate the characteristic impedance of this transmission line using Eq. (3.196) in the textbook. Show all your work and report the answer with proper units.
b. Find a transmission line calculator online and use that to determine the characteristic impedance. Show a screen capture of your input data and the answer.
c. Calculate L, C, Z_0, and β using MATLAB and the function `tlcalc.p` available on the course website.
d. Provide professional plots of your dielectric array `ER`, conductor 1 array `C1`, conductor 2 array `C2`, scalar potential `V`, and electric field components `Ex` and `Ey`.

Problem #2: Square Coaxial Transmission Line

Modify your MATLAB program in Problem #1 to calculate L, C, Z_0, and β for the square coaxial transmission line shown below. Provide professional plots of your dielectric array `ER`, conductor 1 array `C1`, conductor 2 array `C2`, scalar potential `V`, and electric field components `Ex` and `Ey`.

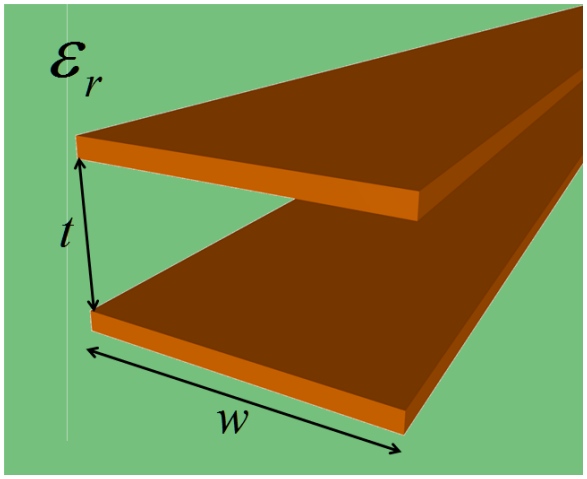
$$w = 1.6 \text{ mm}$$
$$h = 1.4 \text{ mm}$$
$$s = 500\ \mu\text{m}$$
$$\varepsilon_r = 2.5$$



Problem #3: Parallel Plate Transmission Line

Modify your MATLAB program again to calculate L, C, Z_0, and β for the parallel plate transmission line shown below. This transmission line is completely embedded in the dielectric. Provide professional plots of your dielectric array `ER`, conductor 1 array `C1`, conductor 2 array `C2`, scalar potential `V`, and electric field components `Ex` and `Ey`.

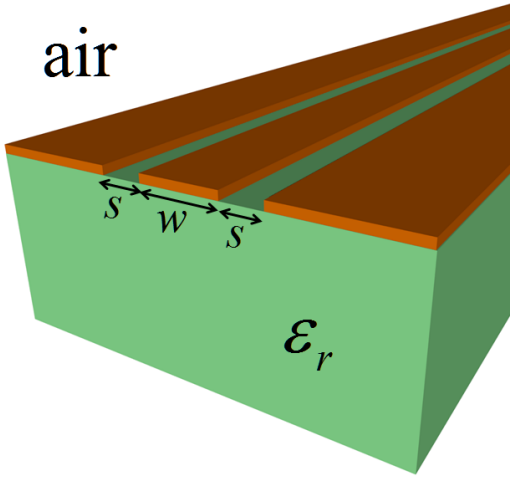
$$w = 3.0 \text{ mm}$$
$$t = 0.5 \text{ mm}$$
$$\varepsilon_r = 2.5$$



Problem #4: Coplanar Transmission Line

Modify your MATLAB program again to calculate L, C, Z_0, and β for the parallel plate transmission line shown below. Provide professional plots of your dielectric array `ER`, conductor 1 array `C1`, conductor 2 array `C2`, scalar potential `V`, and electric field components `Ex` and `Ey`.

$$w = 1.0 \text{ mm}$$
$$s = 0.5 \text{ mm}$$
$$\varepsilon_r = 2.5$$



Problem #5: Transmission Line Design

a. What value of h in Problem #2 makes the impedance 50 Ω?
b. What value of w in Problem #3 makes the impedance 50 Ω?
c. What value of s in Problem #4 makes the impedance 75 Ω?