MT3607_2_2_1 Parallel-Plate Transmission-Line Parameters

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Title

```
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Description

A 1 GHz parallel-plate transmission line consists of 1.2 cm wide copper strips separated by a 0.15 cm thick layer of polystyrene. Assume that $\mu \approx \mu_0$ and $\sigma \approx 0$ for polystyrene.

Exercise

1. Calculate the line parameters of the transmission line.
2. Calculate the capacitance of the wire as a function of ϵ_r, the relative permittivity of the insulator, with ϵ_r being $\epsilon_r = 1 : 0.5 : 100$.
3. Plot the capacitance as a function of the relative permittivity of the insulator.

Questions

1. How does the relative permittivity of the insulator affect the capacitance of the wire?

Useful Information

Below are the parameters for the Parallel-Plate transmission-line.

```
w = width of each plate, m
h = thickness of insulation between plates, m
```

$$R' = \frac{2R_s}{w}$$

$$L' = \frac{\mu h}{w}$$

$$G' = \frac{\sigma w}{h}$$

$$C' = \frac{\epsilon w}{h}$$

$$R_s = \sqrt{\pi f \mu_c / \sigma_c}$$

*Note that μ, ϵ, and σ pertain to the insulating material between the conductors, and μ_c and σ_c pertain to the conductors.

To download the param file go here > and navigate to down until you see **param file**.

Provided Code

```
param
w = 1.2e-2;         % Width of each plate, m
h = 0.15e-2;        % Thickness of insulation between plates, m

% Insulator Parameters
epsilon_r = 2.6;  % Relative permittivity of insulator
epsilon =...      % Permittivity of insulator, F/m
  epsilon_r*P.Eo;
sigma = 0;        % Conductivity of insulator, S/m
mu = P.Uo;        % Permeability of insulator, H/m

% Conductor Parameters
sigma_c = 5.8e7;  % Conductivity of conductor, S/m
mu_r_c = 1;       % Relative permeability of conductor
mu_c = P.Uo;      % Permeability of conductor, H/m

% Signal Frequency
f = 1e9;          % Frequency of signal, Hz

1)
Rs = sqrt(pi*f*mu_c/sigma_c);
R_prime = % INSERT CODE HERE      % Resistance, Ohms/m
L_prime = % INSERT CODE HERE      % Inductance, H/m
G_prime = % INSERT CODE HERE      % Conductance, S/m
C_prime = % INSERT CODE HERE      % Capacitance, F/m

2)
epsilon_r = 1:0.5:100; % Relative permittivity of insulator
epsilon =...           % Permittivity of insulator, F/m
  epsilon_r*P.Eo;
```

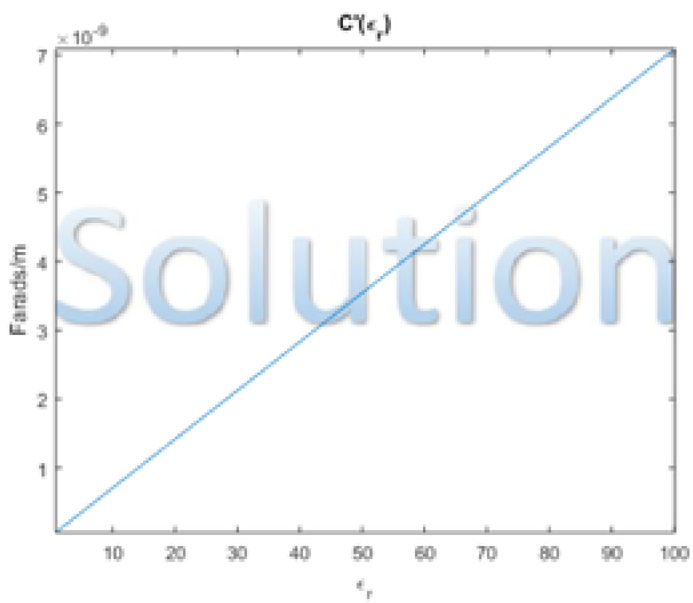
```
C_prime = % INSERT CODE HERE % Capacitance, F/m
```

```
3)
figure(1),clf;
plot(epsilon_r,C_prime);
xlabel(' \epsilon_r ');
ylabel('\Omega/m');
title('C_{prime}(\epsilon_r)');
```

Solution

```
Line Parameters
R' = 1.3750e+00 Ohms/m
L' = 1.5708e-07 H/m
G' = 0 S/m
C' = 1.8408e-10 F/m
```

```
C' as a function of epsilon_r
Make sure you answer the question(s)
```



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