

ECE 1259: Electromagnetics - Capacitor Simulation Documentation

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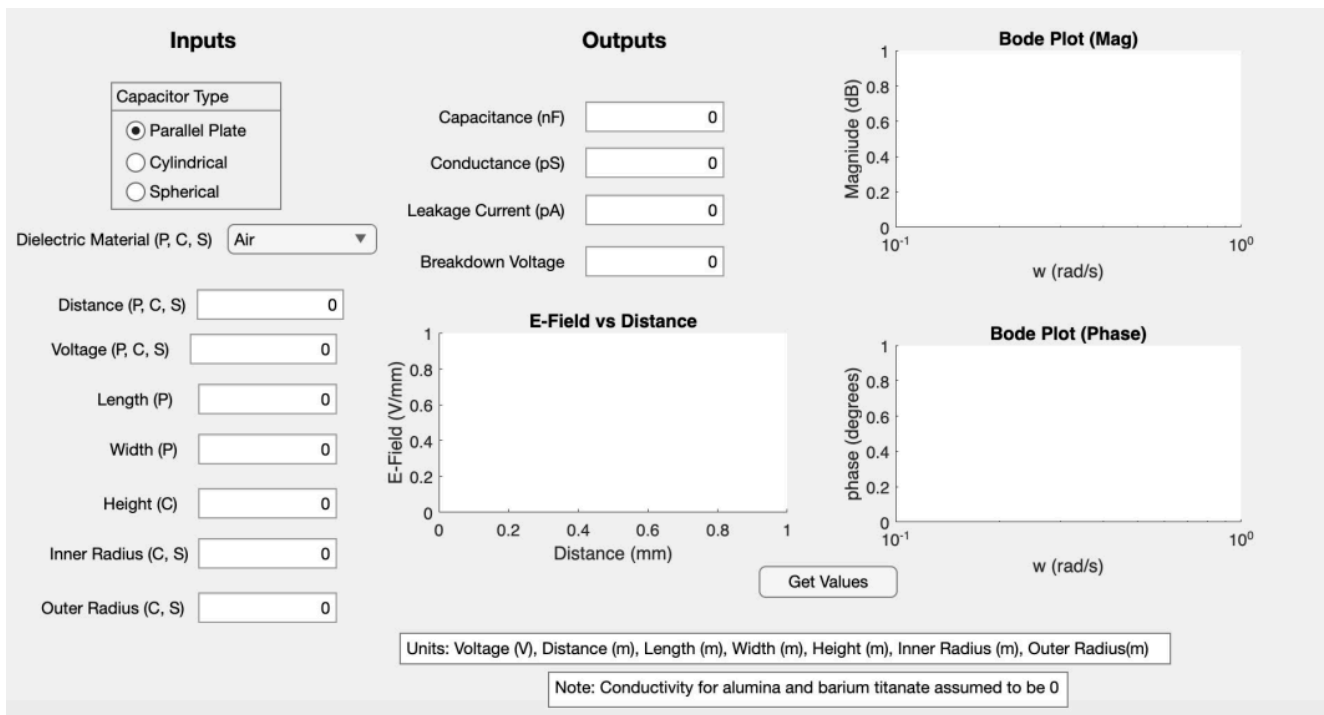
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Matlab Application Purpose:

This file outlines the code for the ECE 1259 Capacitor Simulation project in April 2023.

This project script is partnered with an Matlab application that contains all code described in this live editor.

The purpose of this live editor is to help the user gain a deeper understanding of this application. Program inputs, outputs, and requirements are described within.



System Inputs:

- Capacitor Selection
- Dielectric Material
- Distance (with units: meters) - Distance between capacitor plates
- Voltage (with units: volts)
- Length (with units: meters) - lenth of capacitor plate
- Width (with units: meters) - width of capacitor plate
- Height (with units: meters) - height of capacitor cylinder
- Inner Radius (with units: meters) - radius of capacitor
- Outer Radius (with units: meters) - radius of capacitor

Inputs

Capacitor Type

☒ Parallel Plate

☐ Cylindrical

☐ Spherical

Dielectric Material (P, C, S) Air ▼

Distance (P, C, S)

Voltage (P, C, S)

Length (P)

Width (P)

Height (C)

Inner Radius (C, S)

Outer Radius (C, S)

Capacitor Type Selection

- Parallel Plate Capacitor (P)
- Cylindrical Capacitor (C)
- Spherical Capacitor (S)

Parallel Plate Capacitor System Inputs:

- Dielectric Material
- Distance
- Voltage
- Length
- Width

Cylindrical Capacitor System Inputs:

- Dielectric Material
- Distance
- Voltage
- Height
- Inner Radius
- Outer Radius

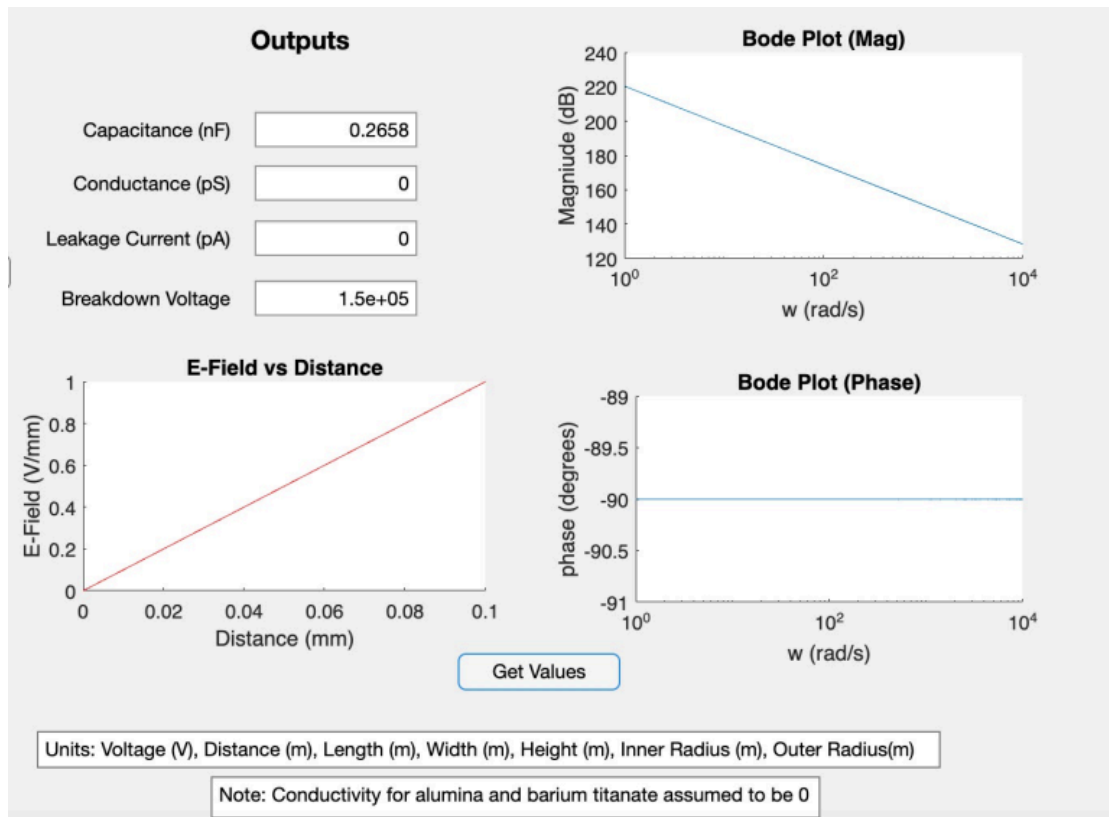
Spherical Capacitor System Inputs:

- Dielectric Material

- Distance
- Voltage
- Inner Radius
- Outer Radius

System Outputs:

- Capacitance (with units: nanoferads)
- Conductance (with units: picosiemans)
- Leakage Current (with units: picoamps)
- Breakdown Voltage (with units: volts)
- Plot of **Electric Field vs. Distance**
- **Bode Plot Magnitude**
- **Bode Plote Phase Angle**



Electric Field Vs. Distance Plot:

- **X Axis:** Distance in millimeters
- **Y Axis:** Voltage per millimeter

Magnitude Bode Plot:

- **X Axis:** ω (radians per second)

- **Y Axis:** Magnitude (dB)

Phase Angle Bode Plot

- **X Axis:** ω (radians per second)
- **Y Axis:** Degrees

Program Functionality:

Generating Output:

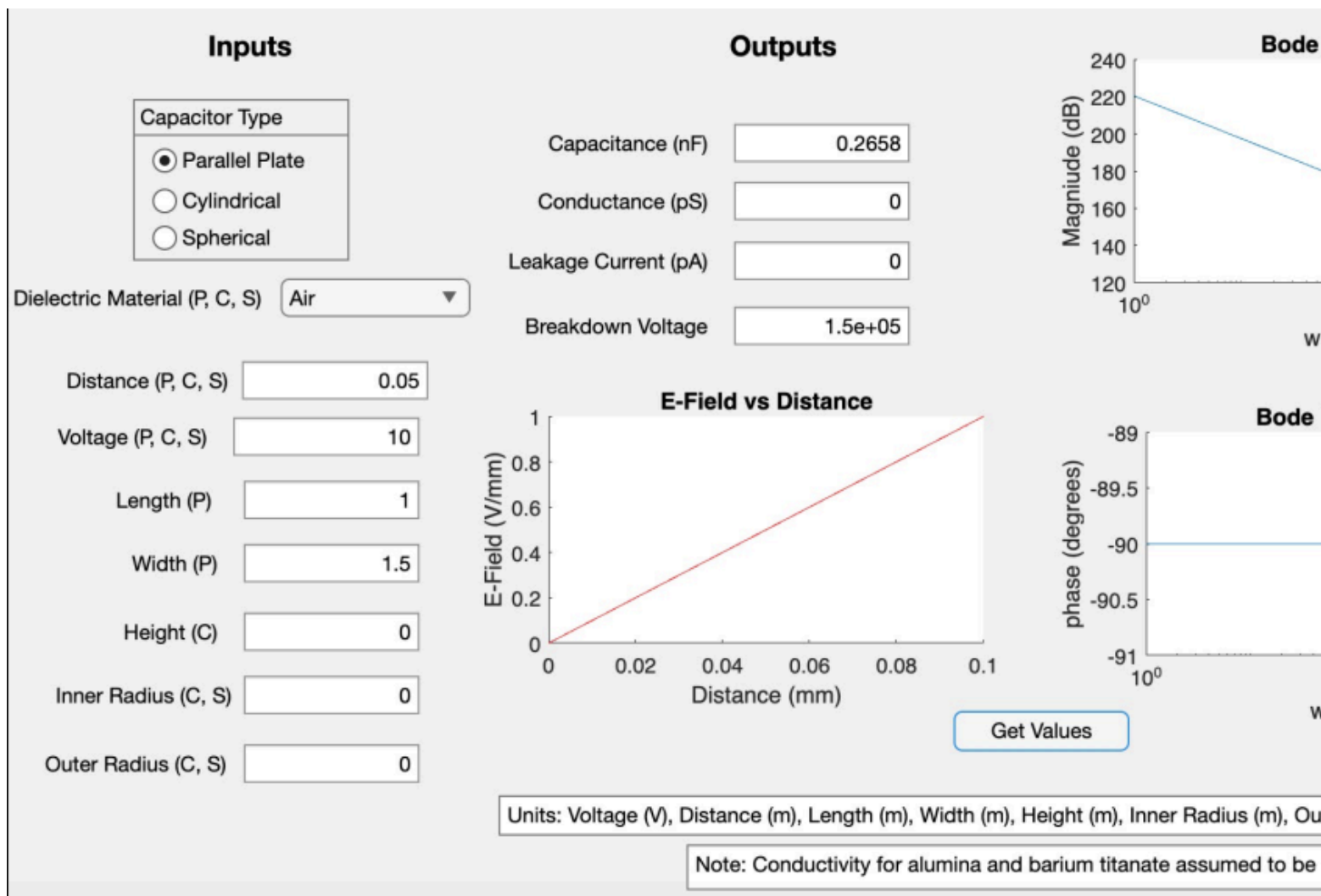
1. Select Capacitor Type
2. Select Dielectric Material from dropdown menu, and fill out remaining inputs (dielectric material options shown in dropdown menu below)

"Air"

```
ans =  
"Air"
```

3. Click "Get Values" button and output will generate

Full Program Output:



Edge Cases and Error Mitigation:

Case 1: User Inputs Negative value for distance, length, width, height, inner radius, or outer radius

- Error Mitigation Employed - Take the absolute value of the user input and display program outputs

Case 2: Required User Input for Capacitor Type is left blank or set to 0

- Error Mitigation Employed - Return an error and ask the user to enter a value for missing input

Case 3: User Inputs an Inner Radius value greater than the inputted Outer Radius value

- Error Mitigation Employed - Swap the inner and outer radius values

Case 4: User inputs Inner and Outer Radii values that are equal to one another

- Error Mitigation Employed - Return an error and ask the user to change one of the values