Assignment #3 with Fixes to #1 and #2

ELEC 4700

Modelling of Integrated Devices

By:

**Konrad Socha 101037642**

Departments of Electronics

Carleton University

[konradsocha@cmail.carleton.ca](mailto:konradsocha@cmail.carleton.ca)

**ASSIGNMENT #1**

**P1.Q1.**

Vth = 1.87e+5 V

Text, letter

Description automatically generated

Figure 1. Constants and Code for Vth

**P1.Q2.**

Mean free path using mean time between collision as 0.2ps is 3.7404e-08s

Text

Description automatically generated with medium confidence

Figure 2. Code for MFP

**P1.Q3.**

Attached File “Assignment1Fixed.m”. Set all flags to zero as seen below.

Text

Description automatically generated

Figure 3. Flag Setting for P1.Q3.

Chart

Description automatically generated

Figure 4. 2-D Plot tracking Particles.

Chart

Description automatically generated

Figure 5. 2-D Plot tracking Temperature.

Text, letter

Description automatically generated

Figure 6. Code Showing how Temp is found

**P2.Q1.**

Chart, histogram

Description automatically generated

Figure 7. Histogram of V

**P2.Q2.**

Chart

Description automatically generated

Figure 8. 2-D plot tracking Particles

**P2.Q3.**

Chart

Description automatically generated

Figure 9. 2-D plot tracking Temperature

**P2.Q4.**

Chart

Description automatically generated

Figure 10. 2-D plot tracking MFP

Chart

Description automatically generated

Figure 11. Code for Tmn

Text

Description automatically generated

Figure 12. Code for Scatter Checking

Text, letter

Description automatically generated

Figure 12. Code for Calculating Values for MFP Tmn, and Temp

**P3.Q1. INJECTION**

**Set all Flags to 1**

Chart

Description automatically generated

Figure 12. Plots for Part 3

**ASSIGNMENT #2**

**P1.Q1.**

Chart, line chart

Description automatically generated

Figure 13. 2-D Plot of V

Chart, surface chart

Description automatically generated

Figure 14. 3-D Plot of V

**P1.Q2.**

Chart, surface chart

Description automatically generated

Figure 15. 3-D Plot of V with meshing

Chart, surface chart

Description automatically generated

Figure 16. 3-D Plot of V using analytical

Chart, histogram

Description automatically generated

Figure 16. 3-D Plot of V with both solution methods

Meshing and analytical Solution yield similar results. A key difference is that the analytical solution does not have points on its boundary conditions and the values at the corners go above the boundary condition. Another difference is the middle of the 2 solutions. In analytical the values are significantly higher than the meshing solution.

**P2.Q1.**

Chart, surface chart

Description automatically generated

Figure 16. 3-D Plot of Voltage

A picture containing chart

Description automatically generated

Figure 17. 3-D Plot of Conductivity

A picture containing chart

Description automatically generated

Figure 18. 2-D Plot of E field

A picture containing background pattern

Description automatically generated

Figure 19. 2-D Plot of Current

**P2.Q2.**

Timeline

Description automatically generated

Figure 20. 2-D Plot of Current with smaller box

Table

Description automatically generated

Figure 21. 2-D Plot of Current with bigger box

Changing the box size changes how strong the current is in the center. Larger boxes condense the area in which the current must travel.

Background pattern

Description automatically generated with medium confidence

Figure 21. 2-D Plot of Current with larger conductivity

Table

Description automatically generated with low confidence

Figure 21. 2-D Plot of Current with smaller conductivity

Increasing conductivity allows more current to move through boxes while decreasing it forces more current to travel in between the boxes.

**ASSIGNMENT#3**

**P1.Q1-3.**

Text

Description automatically generated with medium confidence

Figure 22. Code for E and Acceleration

The force term is in the last line above (EfieldX \* q\_0)

E = 5.000000000000001e+05 V

F = 8.010882650000002e-14 N

A = 3.382346531085494e+17 m/s

**P1.Q4.**

Chart, line chart

Description automatically generated

Figure 23. 2-D plot tracking electrons

Chart, line chart

Description automatically generated

Figure 24. 2-D plot tracking current

**P1.Q5.**

Chart

Description automatically generated

Figure 25. 3-D plot of density of electrons

Chart, histogram

Description automatically generated

Figure 26. 3-D plot of Temperature

**P2.Q1.**

Chart, surface chart

Description automatically generated

Figure 27. 3-D V field

**P2.Q2.**

A picture containing text, indoor

Description automatically generated

Figure 28. 2-D E field

**P3.Q1.**

Table

Description automatically generated

Figure 29. Values from Accel in X due to E Field

The values obtained were very low even at 0.8 V and hence had little effect on the plots.

Chart

Description automatically generated

Figure 30. 2-D Electron Trajectories

Chart

Description automatically generated

Figure 31. 3-D Density Map

The most noticeable thing in the Density map is the lack of electrons in the squares.