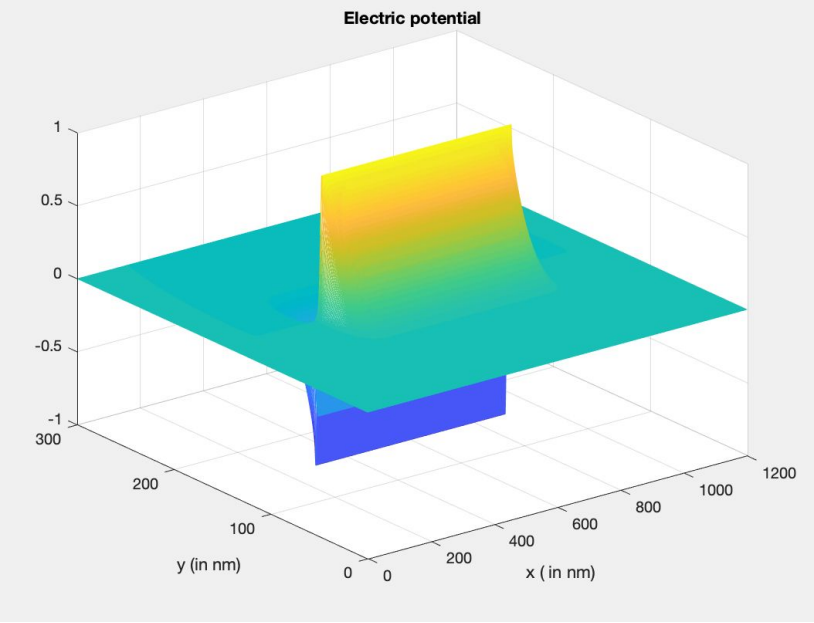
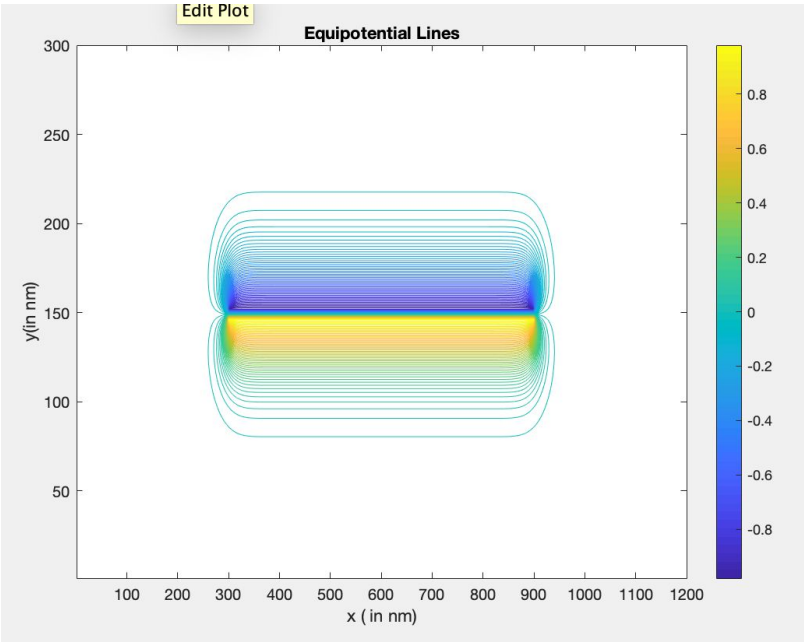
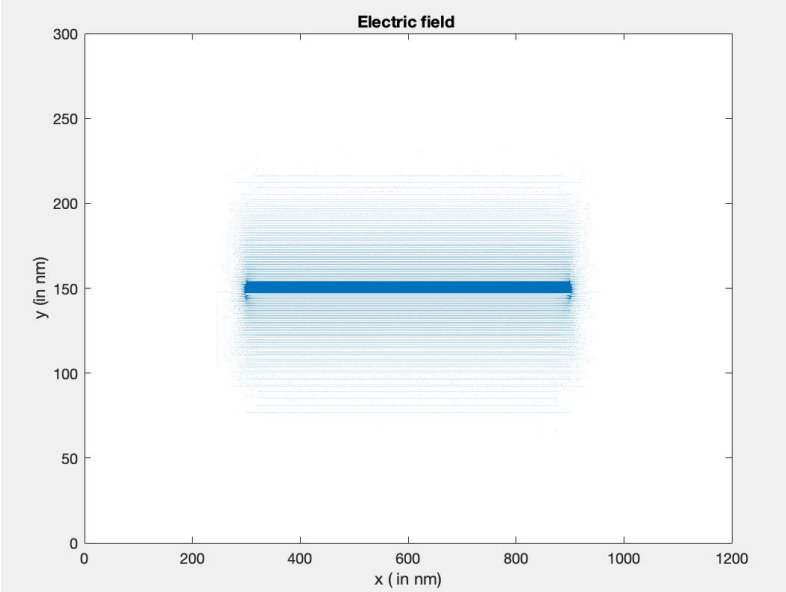
Assignment – 1

Q1. Consider a system of two parallel plates as shown in Figure 1.
(a) Find out the capacitance (per unit width) of the structure by numerically solving the 2d Poisson's equation.
Capacitance comes out to be : 9.7505e-10 Si units
(b) Plot the electrostatic potential and equipotential surfaces.





(c) Plot the 2d electric field profile.



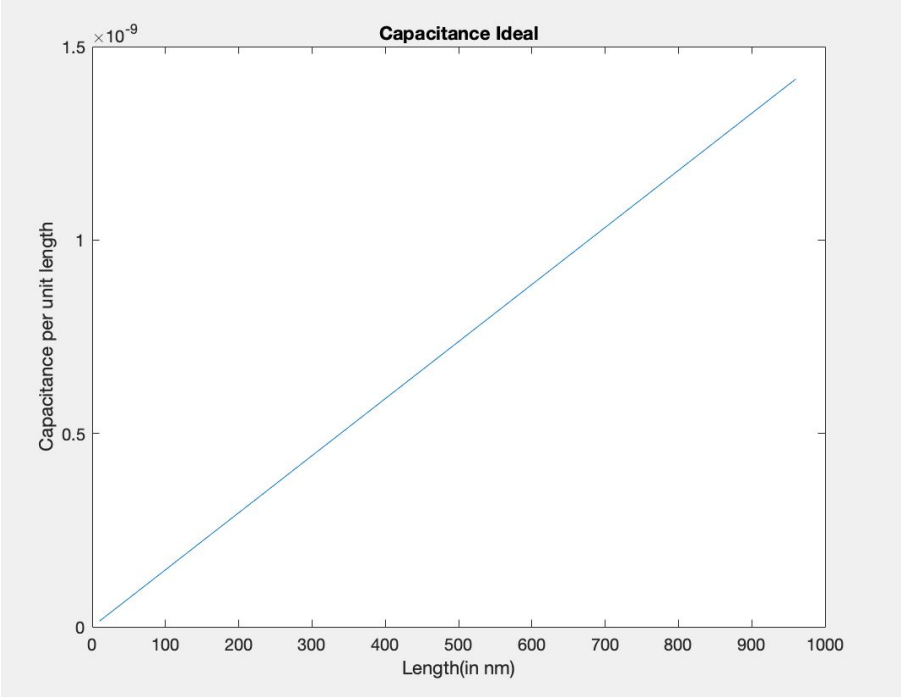
(d) Compare the simulated capacitance with the theoretical value ($Cth = \epsilon l$). Which one is d smaller/larger and why?

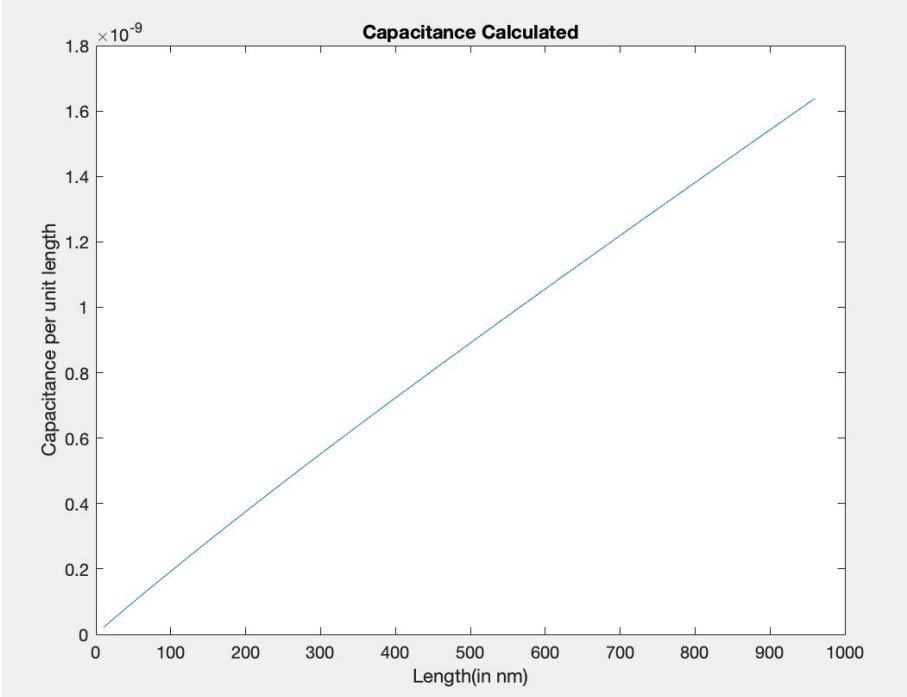
The net capacitance calculated through iterative method is larger than Cth. This occurs because in Cth we do not consider the fringe capacitance

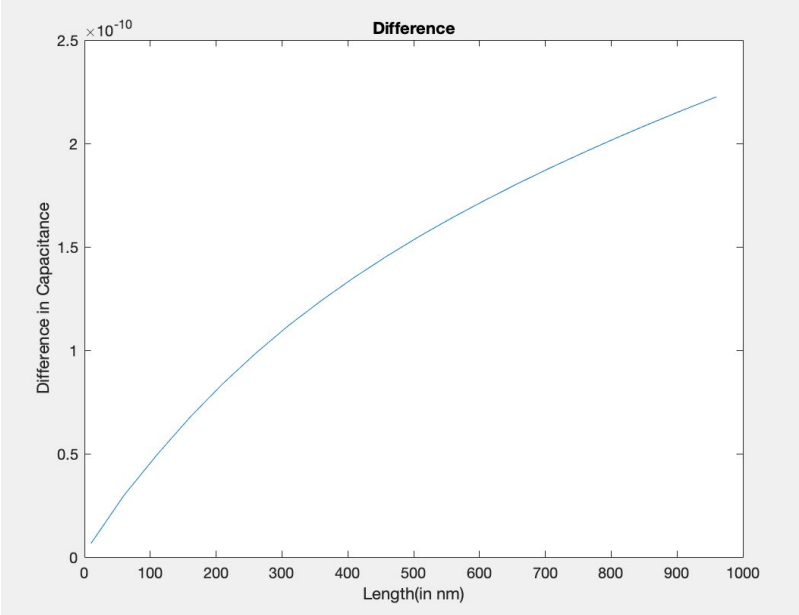
Q2. For the structure mentioned in Q1,

(a) Vary l from 10 nm to 1000 nm in steps of 50 nm. Plot C as a function of l.

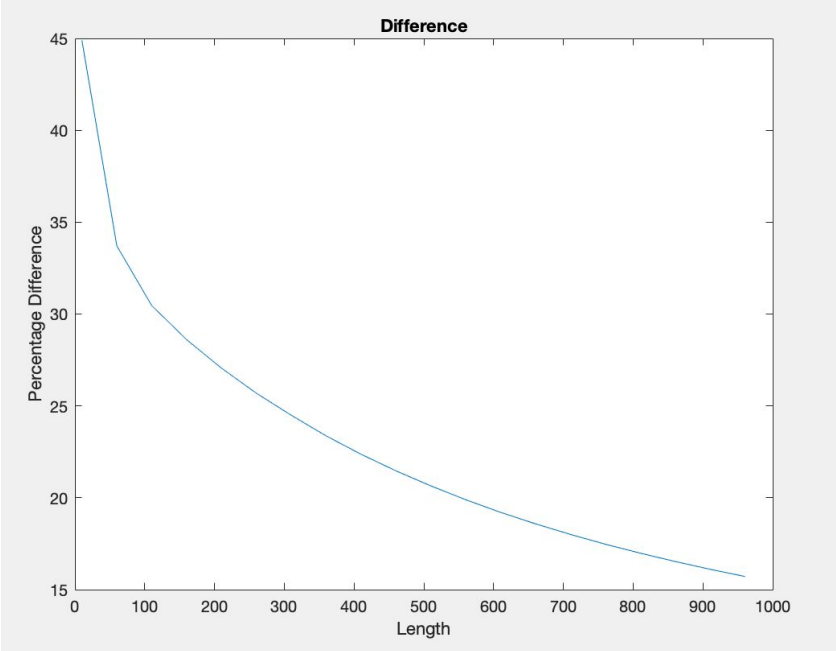
(b) Calculate the parasitic capacitance Cp(l) = C(l) − Cth(l) and plot it as a function of l. Qualitatively explain the nature of the plot.


Capacitance Ideal
×10^-9
1.5
1
0.5
0
Capacitance per unit length
0
100
200
300
400
500
600
700
800
900
1000
Length(in nm)


Capacitance Calculated
×10^-9
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Capacitance per unit length
0
100
200
300
400
500
600
700
800
900
1000
Length(in nm)



We see that the difference in capacitance in increasing as we increase the length. But this is happening because the overall capacitance is increasing. But if we see the percentage difference between the two capacitances then we find that the percentage is decreasing .

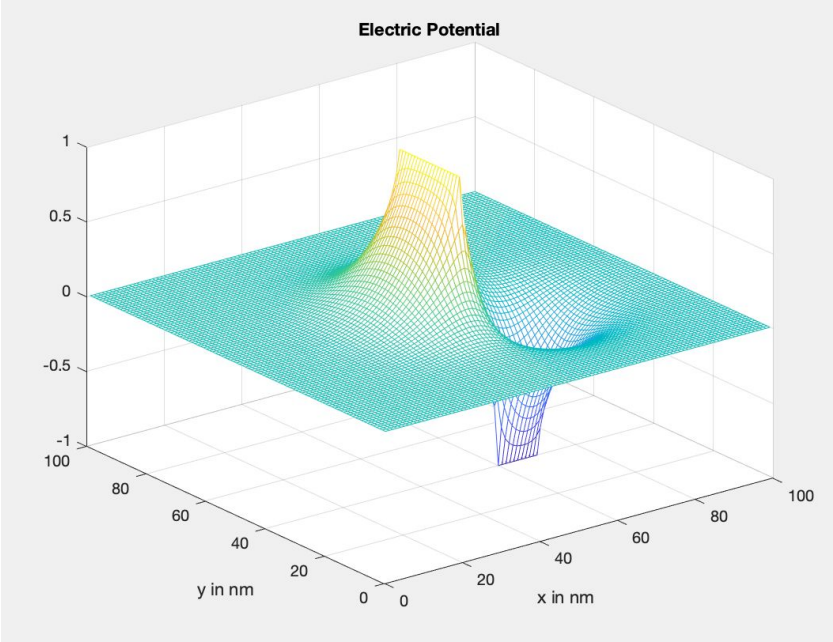


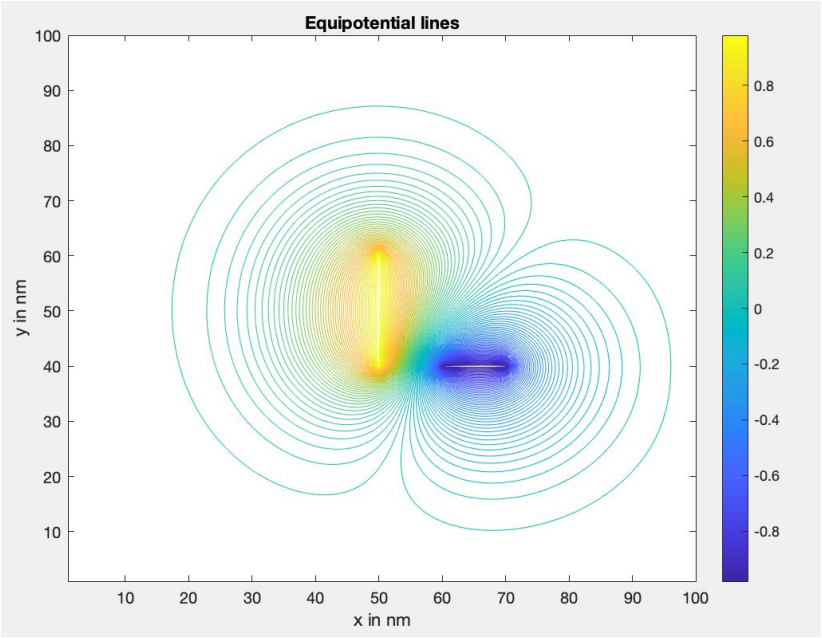
Q3. Consider an inclined plate capacitor as shown in Figure 2.

(a) Find out the capacitance (per unit width) of the structure.

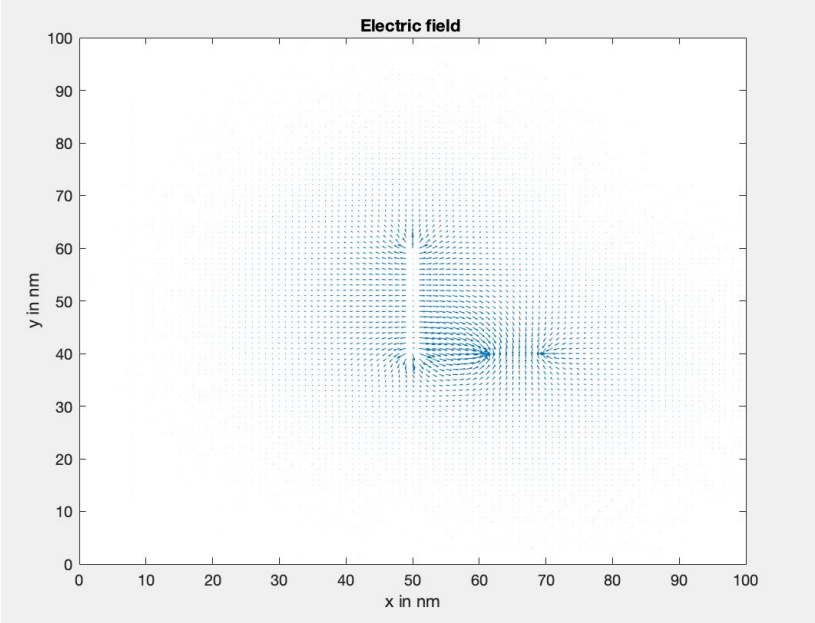
Capacitance = 1.2540e-11

(b) Plot the electrostatic potential and equipotential surfaces.





(c) Plot the 2d electric field profile.



(d) Find out the position where the magnitude of electric field is maximum.

Maximum magnitude of electric field : 0.3241 SI units

Position : 59,40