

# EE 735

## Assignment – 1

7<sup>th</sup> Aug 2019

### Hints, assumptions and instructions:

1. Assume that all the capacitors are enclosed in a big box, whose boundaries are maintained at zero potential i.e. 0 V.
2. Assume that the thickness of the plates is 1 nm.
3. The entire dielectric region is charge free and  $\epsilon_r = 1$
4.  $V(x, y) = \frac{V(x+h, y) + V(x-h, y) + V(x, y+h) + V(x, y-h)}{4}$  in the charge free region.
5. Specify any physical quantity with the units.
6. It is mandatory to submit your code with the report (in pdf) in a single zip folder. Name the file as "RollNumber\_Assignment1" for this assignment.

### Questions:

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.
- (b) Plot the electrostatic potential and equipotential surfaces.
- (c) Plot the 2d electric field profile.
- (d) Compare the simulated capacitance with the theoretical value ( $C_{th} = \frac{\epsilon l}{d}$ ). Which one is smaller/larger and why?

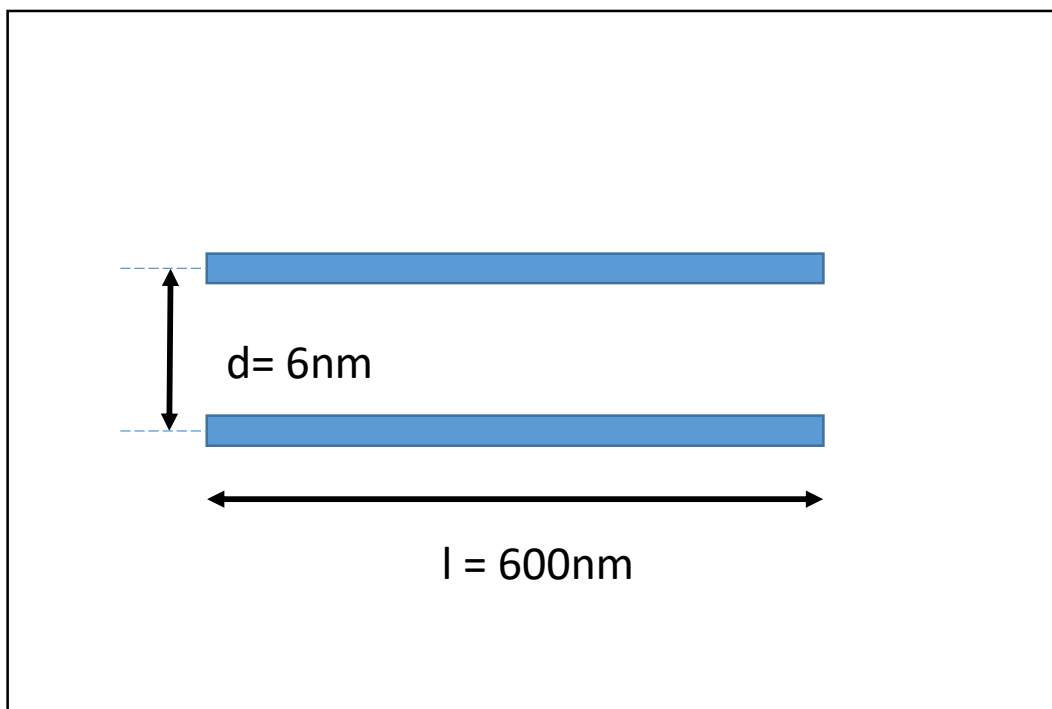
Q2. For the structure mentioned in Q1,

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

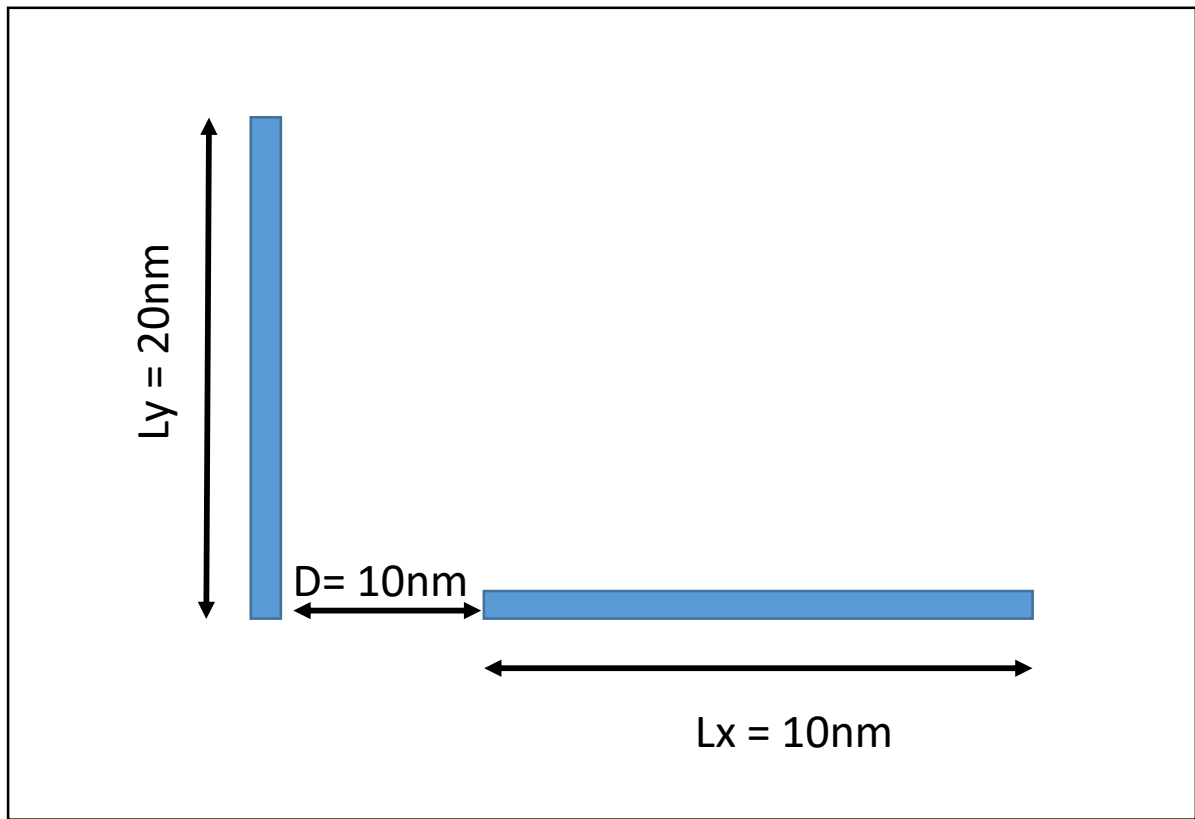
(b) Calculate the parasitic capacitance  $C_p(l) = C(l) - C_{th}(l)$  and plot it as a function of  $l$ . Qualitatively explain the nature of the plot.

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

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



**Figure 1.**



**Figure 2.**