DEVICE PHYSICS (NUMERICAL SOLVER)

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Assignment 1

Note:

um : Micro-meter

A_e_b: a* 10^{b} (for instance, 5e17 = $5*10^{17}$)

NDn: Donor conc.

NAp: Acceptor conc.

ni: Intrinsic charge carrier conc.(take 10^{10})

SOME INSTRUCTIONS:

- Be honest and submit the results and do as much as you can.
- DO NOT share the complete codes to your friends and submit the same results, as it completely defeats the purpose of the assignment.
- However, you are free and welcome to discuss ideas and overall approach on solving the assignment with us and your friends as well.
- Make sure you don't use AI tools heavily, but rather to look-up for correct usage of codes, overall flow of ideas and for syntaxes.

1) Create 1n 1D mesh (0,50um) with 100 node points in between and metallic contacts at the ends. Simulate a **Resistor**. You have to find out the net

doping profile (NDn - NAp) for the device given (upto a constant factor “c1” and “c2”. i.e c1*Ndn - c2*Nap).
For example, if a step donor doping profile has to be created at x = 25um,
Ndn = step_function(x-25).
Nap = 0.
NDn = c1*Ndn
NAp = c2*Nap
(The constants c1 and c2 can be of your choice)
Net doping = NDn - NAp (Donor atom conc. - Acceptor atom conc.)

2) Apply zero bias and plot potential, excess carrier conc. (both electrons and holes) as a function of x and explain the results with the help of all theoretical formulae required from Fonstad.
3) Now, apply 0.3V bias and repeat part (2)

4) Now, create another 1D mesh with the same specifications as part (1), but instead of a resistor, create a pn-junction Diode, with the junction exactly midway, with donor and acceptor conc. = 10^{17} in their respective regions.

   (Hint: you have to make use of step function to realise the profile)

5) Apply zero bias, Forward bias of 0.1V, 0.3V, 0.5V and reverse bias of 0.1V, 0.3V, 0.5V and analyse potential, excess carrier conc. As a function of x.

BONUS:

6)Try to find out the syntax and the code required to get the current values from the contacts using the documentation.
7)Try to plot the IV- characteristic curve for the diode created in part (4) by sweeping the voltage bias from -0.7V to 0.7V.