

ETH master program

Module: Physical Modeling and Simulation

Project: 1-D FEM Analysis of a simple bipolar transistor (Topic 25)

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Description:

Starting from the available 1-D FEM solver for Laplace problems (in the attachment) it is necessary to solve a 1-D Poisson-Drift-Diffusion (PDD) problem of a simple n-p-n bipolar transistor (Fig. 1). The expected outcome of the project:

- Theoretical description of the 1-D FEM for the PDD problem
- Definition of the transistor geometry and triangular mesh
- Static simulation with open electrodes in order to obtain the depletion regions
- Computing the static I-U characteristics (Fig. 1) of the defined n-p-n transistor
- Visualization of the fields (p , n , J , etc.) at one chosen static operating point
- The corresponding Matlab code.

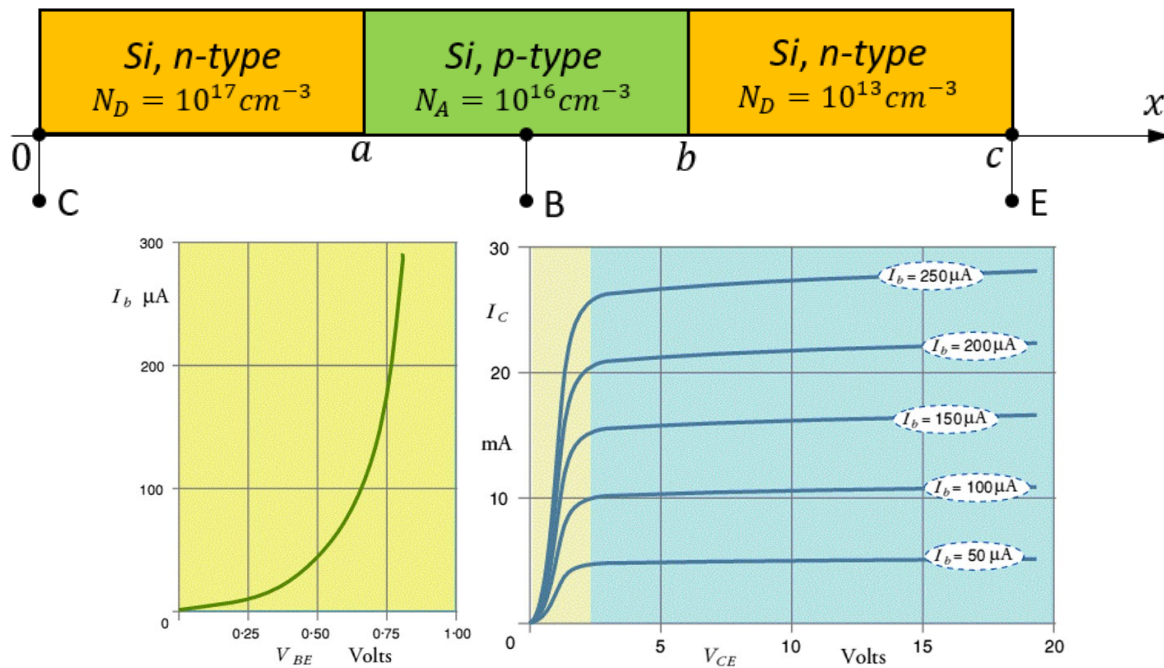


Figure 1. Geometry of a simple 1-D n-p-n bipolar transistor (top) and its input (bottom, left) and output characteristics are presented.

The geometric parameters have the following values:

$$a = 1 \mu\text{m}, b = 2.5 \mu\text{m}, c = 4 \mu\text{m}.$$