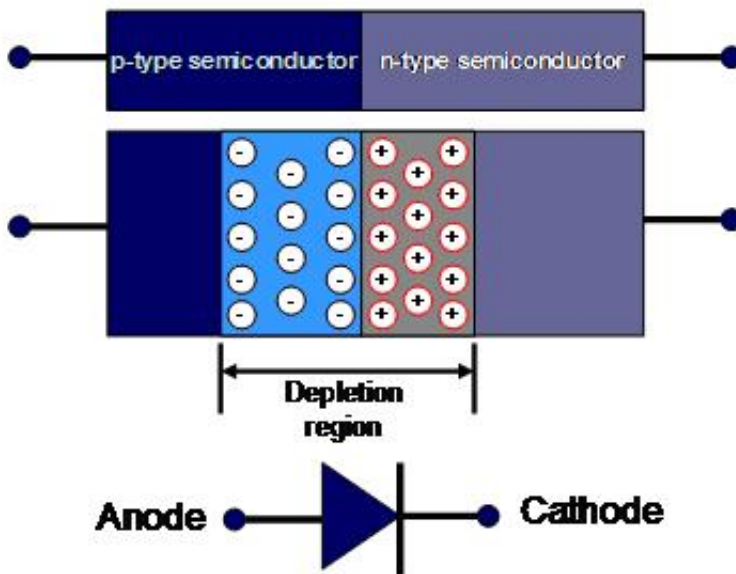
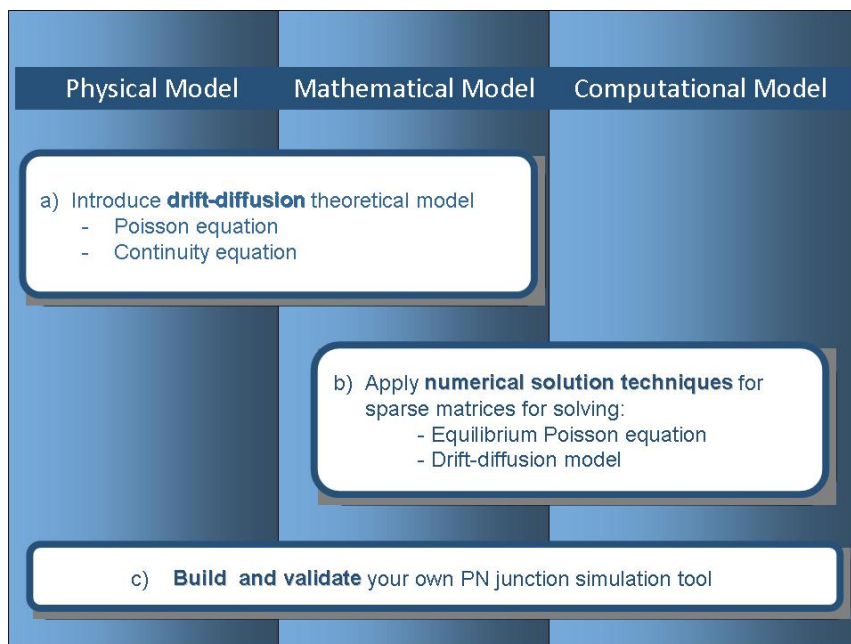


## PN Junction Lab Learning Materials



By completing the PN-Junction Lab in [ABACUS - Assembly of Basic Applications for Coordinated Understanding of Semiconductors](#), users will be able to: a) conduct drift-diffusion modeling, b) describe the physical and mathematical operation of PN-Junctions, and c) build and validate a simple PN Junction simulation tool.

The specific objectives of the PN-Junction Lab are:



## Recommended Reading

Users who are new to the physics of pn-junctions and their modeling should consult the following resources:

1. Rober F. Pierret. (1996). *Semiconductor Device Fundamentals*. 2nd ed. Reading, MA: Addison-Wesley. (Specifically on the theory of pn-diodes)
2. Michael Shur. (1990). *Physics of Semiconductor Devices*. Englewood Cliffs, NJ: Prentice Hall. (Specifically on theory of pn-diodes)
3. Dragica Vasileska, Stephen M. Goodnick and G. Klimeck. (2010). *Computational Electronics: Semiclassical and Quantum Device Modeling and Simulation*. Boca Raton, LA: CRC Press. (Specifically on the modeling of pn-diodes)

## Demo

[PN Junction Lab: First-Time User Guide](#)

[PN Junction Lab Demonstration: Asymmetric PN Junctions](#)

## Theoretical descriptions

- \* [Tutorial\\_PADRE\\_Simulation\\_Tools.pdf](#) (tutorial)
- \* [Physical and Analytical Description of the Operation of a PN Diode](#) (physical, analytical model)
- \* [PN junction in forward bias](#) (simulation)
- \* [Numerical solution of the Drift-Diffusion Equations for a diode](#) (computational model)
- \* [Drift-Diffusion Modeling and Numerical Implementation Details](#) (implementation details and source code dissemination)

## Tool Verification

Verification of the PN-Junction tool is done by comparison of the simulation results for the electric field in equilibrium with the depletion charge approximation results. This verification process can be done only while running the tool, as it superimposes the depletion charge approximation results.

[Verification of the Validity of the PN Junction Tool](#)

### Examples

The following [Worked Examples for a PN Diode](#) are described in detail:

Example 1: Equilibrium PN-Junction

Example 2: PN-Junction Under Bias

Example 3: Non-Symmetric Junction

Example 4: Series Resistance

### Exercises and Homework Assignments

1. [Basic operation of a PN diode - Theoretical exercise](#)
2. [Homework for PN Junctions: Depletion Approximation \(ECE 305\)](#)
3. [PN Junction Lab Exercise: Non-Idealities in a PN Diode](#)
4. [PN Diode Exercise: Series Resistance](#)
5. [Exercise: PIN Diode](#)
6. [PN Diode Exercise: Graded Junction](#)
7. [PN diode - Advanced theoretical exercises](#)
8. [Schottky diode - Theoretical exercises](#)

### Solutions to Exercises

Solutions are provided only to instructors!

### Evaluation

This test will assess the users conceptual understanding of the physical, mathematical and computational knowledge related to the operation and modeling of PN Junctions.

[ABACUS: Test for PN Junction Lab](#)

### Challenge

Users are challenged to integrate what they have learned about PN Junctions.

[Solve a Challenge for a PN Diode](#)