Periodic Potential Lab Learning Materials

By completing the Periodic Potential Lab in ABACUS - Assembly of Basic Applications for Coordinated Understanding of Semiconductors, users will be able a) to understand the Kronig-Penney model and the formation of energy bands and energy gaps due to the underlying periodic interaction potential, b) to understand the concept of the effective mass, and c) to create their own Kronig-Penney solver.

The specific objectives of the Periodic Potentials Lab are:

<table>
<thead>
<tr>
<th>Physical Model</th>
<th>Mathematical Model</th>
<th>Computational Model</th>
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<tbody>
<tr>
<td>a) Introduce the Kronig-Penney model to explain:</td>
<td>b) Apply numerical solution techniques for solving the Kronig-Penney model for:</td>
<td>c) <strong>Build and validate</strong> your own Periodic Potentials simulation tool</td>
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<td>- Formation of energy bands and energy gaps in carriers’ dispersion relation $E(k)$</td>
<td>- Rectangular periodic potential</td>
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<td>- The concept of the effective mass</td>
<td>- Coulombic periodic potential</td>
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<td></td>
<td>- Triangular periodic potential</td>
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**Recommended Reading**

Users who are new to periodic potentials, bandstructure, or the concept of the effective mass
should consult the following resources:


**Demo**

- [Periodic Potential Lab: First-Time User Guide](#)
- [Periodic Potential Lab Demonstration: Standard Kroenig-Penney Model](#)

**Theoretical Descriptions**

* [Energy Bands In Periodic Potentials](#)
* [Periodic Potential](#)
* [Periodic Potentials and the Kronig-Penney Model](#)

**Tool Verification**

[Nanoelectronic Modeling Lecture 14: Open 1D Systems - Formation of Bandstructure](#)

**Examples**

1. [Periodic Potential Lab Worked Examples](#)

**Exercises and Homework Assignments**

1. [Homework Assignment: Periodic Potentials](#)
2. [Periodic Potentials and Bandstructure: an Exercise](#)

**Solutions to Exercises**

Solutions to exercises are provided only to instructors!

**Evaluation**

This resource will evaluate the user’s conceptual understanding of the physical, mathematical and computational knowledge related to periodic potentials and formation of bandstructure in crystals.
Challenge

In this final challenge, users will integrate what they have learned about the Kronig-Penney model.

Periodic Potentials Exercise