PHYS 563 HW #4

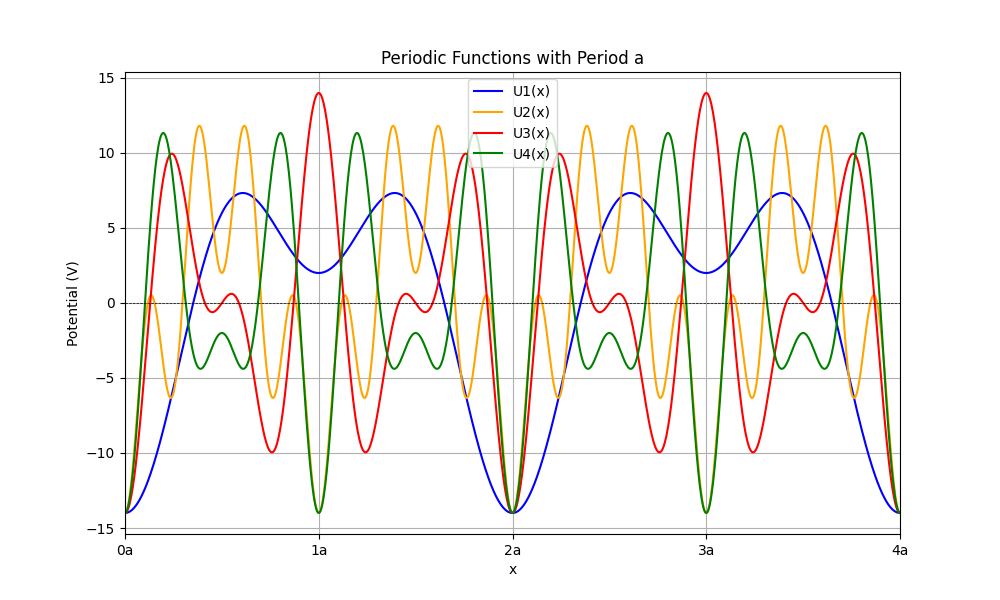
Name: Wen-Hua Wu

ID: S01470274

Email: [aw106@rice.edu](mailto:aw106@rice.edu)

Problem 1

We plotted the potential functions with python and have the following graph.



We can see clearly that U2, U4 are periodic function with period of a,

But U1 and U3 have a larger period of 2a.

The reason is that U2 and U4 only have even integers multiplied with in their cosine functions, and we know that , so after a period of a, U2 and U4 can return to the original value.

But for U1 and U3, they have odd numbers integers multiplied with in their cosine functions, which will have a larger period of 2a.

And since the one dimensional chain has a lattice constant of a, its potential must also have a period of a.

Thus only U2 and U4 satisfy the condition.

Problem 2b

Here we set , and , (free electron case). We plotted the first three bands of the confined case () and free electron case ().

We can see that the confined case have significant band gaps near the Brillioun Zone edge while the free electron case has continuous dispersion curve following the free-electron Hamiltonian:

