Day 9: Thursday – 110 minutes

Lab 3 – single finite quantum well and periodic wells.

1. **Single quantum well:**
   Program will display eigenvalues and eigenfunctions (and probabilities) – computer calculates these by iterative process of integrating S’s equation to produce well-behaved wave function.

2. **Single quantum well:**
   Different number of solutions depending on width and depth of well. Shape of well changes the details but not the basic structure.

3. **Double quantum well:**
   Two energy levels closely spaced where single well had one. Splitting increases as wells get closer (as wave function overlap increases). Lower wave function is symmetric (higher, antisymmetric) combination of single well states.

4. **Multiple quantum wells:**
   Eigenvalues cluster in groups of $N$ where $N$ is the number of wells, and they cluster around the values of the energy for the single well.

5. **Multiple quantum wells:**
   Energy bands get wider as energy increases

6. **Multiple quantum wells:**
   Wave functions have very predictable structure. In $q$th band, the wave function within each of the wells is the same as the $q$th wave function of the single well. The overall amplitude is modulated by a sine function with 0, 1, 2, 3 … etc nodes i.e. $p$-1 nodes for the $p$th wavefunction from the bottom of the cluster. This is a manifestation of something called Bloch theorem.

7. **Multiple quantum wells with irregularity:**
   One energy level splits off from the others, and corresponding wave function is highly localized. Model of impurities in a semiconductor.

8. **Multiple quantum wells with electric field:**
   Adds a slope to bottom of well.