October 3, 2013

In Class Exercise ECE 505

Answer the following questions in a concise mode. These questions will be graded by Prof. Menoni. Each question is worth 10 points. Open book and notes.

1. Valence electrons in a crystal are modeled using the Free Electron Model. What are the characteristics of the eigenstates and eigenergies solutions to the wave equation?
2. Using a E-k diagram show how the process of conduction is visualized. From the E-k diagram, show how the electron group velocity in the conduction band calculated?
3. How is the current calculated for a macroscopic wire and for a channel of dimensions comparable to the electron mean free path?
4. Using the band picture of quasi-free electrons, schematically show the process of absorption and emission in a crystal for a direct gap and an indirect gap material.
5. Which are the conditions that govern such processes?
6. Plot the absorption versus photon energy for a bulk semiconductor. What does this function mainly identifies?
7. What is the concept of an exciton? In the band picture, how are the excitonic states modeled?