ECE 230A/B – AP/EDM (Grad)
MS Comprehensive Exam FA10

Problem 1

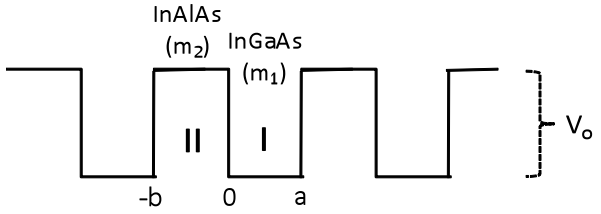
For the 1-D GaAs/AlGaAs superlattice, the effective mass for InGaAs and InAlAs are denoted as m_1 and m_2, respectively.

(a) Find the general solution of the Schordinger equation in regions I and II.

(b) Write the boundary conditions that allow us to solve the coefficients and the eigenvalue (energy) E. Note that in this case, the effective mass of electron in InGaAs and InAlAs is different.

(c) Draw a typical wavefunction across the superlattice based on your answer in (b).

(d) Can E be greater than V_o? If your answer is yes, draw a typical wavefunction with $E > V_o$. If your answer is no, give your explanation.



Problem 2

Problem: For an npn BJT, describe what happens to the collector current, the base current, and the current gain under each of the following scenarios:

(a) Double the emitter doping (everything else unchanged).

(b) Reduce the base width to half (everything else unchanged).

(c) Increase the emitter-base junction forward bias by 0.1 V (everything else unchanged).

(d) Replace the Si base with a uniform SiGe base of bandgap 0.1 eV smaller than that of Si (everything else unchanged).