Homework 2

1. Assume doping such that the Fermi level is 0.3 eV from the majority carrier band edges. If you have to assume anything beyond what is stated in this problem, clearly declare your assumptions.

   A) Draw the band diagram of a GaAs pn junction under equilibrium and forward bias. Include the Fermi and quasi-Fermi levels, as appropriate and show the direction of photocurrent.

   B) Using open and closed circles for electrons and holes indicate how the electrons and holes are separated.

   C) What parameter limits the maximum voltage the device can generate?

2. Answer parts 1A-C from 1 but with a n-type GaAs Schottky solar cell.

3. Answer parts 1A-C from 1 but with a p-type GaAs Schottky solar cell.

4. Answer parts 1A-C from 1 but with a nP InGaN/GaN solar cell. For simplicity, assume the InGaN has a bandgap of 2.3 eV and an electron affinity of 2.5 eV, GaN has a bandgap of 3.4 eV and an electron affinity of 2 eV. Assume no polarization effect initially then repeat the drawing with a polarization discontinuity that creates a 0.5 eV “electron well” at the interface.

5. Describe in 4 sentences or less the method of forming an ohmic contact using a Schottky barrier.

6. Describe in 8 sentences or less the electrical model of the solar cell. Be sure to describe what each element represents and how it responds to light bias.