INF5350

Obligatory exercises following lecture #3

Please submit latest 27-Sep-2019 to Tohid (tohidm@ifi.uio.no)

1. Derive the formula that defines the cut-off wavelength of a semiconductor.
2. Briefly explain why N or P doping does not change the cut-off wavelength of a semiconductor.
3. Calculate the cut-off wavelength of SiGe assuming Eg=0.84eV.
4. Calculate the quantum efficiency of a sensor that receives 5.54fW of green (550nm) light and generates 100 electrons of signal during a 10ms exposure. Assume Planck’s constant to be h=6.6E-34Js.
5. Briefly explain why is QE of CMOS image sensors relatively low at UV wavelengths.
6. Calculate the built-in potential at room temperature in an NP diode with NA=1E14cm-3 and ND=1E15cm-3. Assume Ni=1E10cm-3, and PHIt=kT/q=26mV.
7. Calculate (Efn-Ei) and (Ei-Efp) for the above diode. Assume q=1.6E-19C
8. Calculate the depletion depth of the above diode at zero bias and at VR=2V reverse bias. Assume =1E-10F/m, q=1.6E-19C
9. Given the above diode, which side of the PN junction has largest depletion width, and why?
10. Calculate Vbi and the total depletion width of a zero biased n+p diode with NA=2E15cm-3. Assume the n+ region is degenerate, ie ND>>NA and RT.
11. Calculate the junction capacitance of above n+p diode assuming the area is 1um2.
12. Calculate the pin potential (Vpin) of a photodiode that is 2um deep and uniformly n-doped with Phosphor of ND=1E15cm-3. The p-epi substrate is NA=2E14cm-3.