ECSE-2210 Microelectronics Technology
Fall 2005
Class Activity 16

1. What is the physical origin of the junction capacitance (or depletion layer capacitance)?

2. What is the physical origin of the diffusion capacitance?

3. Why is the diffusion capacitance negligible under reverse bias?

4. What is the value of the reverse-bias conductance for an ideal diode?

5. Write the equation for the reverse bias conductance for a real p^+-n diode if $I_{R\text{-}G}$ is dominating in reverse bias.

6. Given a planar p^+-n Si step junction diode with an n-side doping of $N_D = 10^{15}$ cm^{-3} at $T = 300$ K, determine the junction capacitance at –1 V reverse bias. Assume that the Fermi-level is at the valence band edge in the p^+-region. Junction area $A = 1$ cm^2. At zero bias, will the junction capacitance be higher or lower than the one calculated above? (Hint: Calculate V_{bi}, then W and then the junction capacitance).

7. A particular ideal p^+-n junction has a reverse saturation current of 10^{-14} A. The hole lifetime in the n-side is 10^{-6} s. What will be the diode diffusion admittance at a forward bias of 0.6 V? (Write the answer in terms of ω). Draw the small signal equivalent circuit for the diode.

8. Consider three p^+-n junctions as shown below. Which one will have the highest junction capacitance? Which one will have the lowest junction capacitance? Try to understand the physical reasoning.