Problems

1. Consider a gold-GaAs Schottky diode with a capacitance of 1 pF at -1 V. What is the doping density of the GaAs? Also calculate the depletion layer width at zero bias and the field at the surface of the semiconductor at -10 V. The area of the diode is 10^{-5} \text{ cm}^2.

2. Consider two Schottky diodes with built-in potential $\phi_i = 0.6$ V. The diodes are connected in series and reversed biased. The diodes are identical except that the area of one is four times larger than that of the other one. Calculate the voltage at the middle node, $V_{out}$, as a function of the applied voltage, $V_{in}$. Assume there is no dc current going through either diode so that the charge at the middle node is independent of the applied voltage.

3. Using the work functions listed in table 3.2.1, predict which metal-semiconductor junctions are expected to be ohmic contacts. Use the ideal interface model.

4. Design a platinum-silicon diode with a capacitance of 1 pF and a maximum electric field less than $10^4$ V/cm at -10 V bias. Provide a possible doping density and area. Make sure the diode has an area between $10^{-5}$ and $10^{-7}$ cm$^2$. Is it possible to satisfy all requirements if the doping density equals $10^{17}$ cm$^{-3}$?

5. A platinum-silicon diode (area = $10^{-4}$ cm$^2$, $N_d=10^{17}$ cm$^{-3}$) is part of an LC tuning circuit containing a 100 nH inductance. The applied voltage must be less than 5 V. What is the tuning range of the circuit? The resonant frequency equals $f = \frac{1}{2\pi \sqrt{LC}}$, where $L$ is the inductance and $C$ is the diode capacitance.