Problem 1. Textbook 14.1 (part b only).

Problem 2. Prove equations 11.41 and 11.42 from the textbook. Note: you should start with Ebers Mall equations (11.45)-(11.46), make some approximations and get 11.41 and 11.42.

Problem 3 (do not hand in). A J-FET is constructed with the gate-to-gate doping profile shown in Figure 15.6 (see the Textbook, pp. 560). Assume that the doping concentration in the p⁺-region is much higher than the maximum n-region doping. Find the pinch-off voltage $V_p$.

Problem 4. Consider a n-type JFET with $L_Z$, $\mu_n$, $a$, $L$, $N_D$, $V_{bi}$, and $V_p$. Suppose that the transistor is biased below pinch-off ($V_D < V_{Dsat} = V_G - V_p$).

(a) Compute the transconductance $g_m = \left. \frac{\partial I_D}{\partial V_G} \right|_{V_G = \text{const.}}$ and the drain conductance $g_d = \left. \frac{\partial I_D}{\partial V_D} \right|_{V_G = \text{const.}}$.

(b) Compute the gate capacitance $C_G = \frac{dQ}{dV}$ if the applied potential on the gate is $V_G < V_p$, while the source and drain are grounded.

(c) Compute the cutoff frequency, which is defined by $f_T = \frac{g_m}{2\pi C_G}$. 
