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EE 210 **MID-SEM P1** **24.2.21**

The fab line data for an n-channel MOSFET: $N_A = 10^{16}$ cm^{-3}, $t_{ox} = 30$ nm, $V_{TN0} = 0.7$ V, $\mu_n = 430$ cm^2/V-sec, and (λ, C_{gs0}, C_{gd0}) $\rightarrow$ 0. Other relevant data: $V_T = 26$ mV, $\varepsilon_0 = 8.854 \times 10^{-14}$ F/cm, $\varepsilon_r(Si) = 11.7$, $\varepsilon_r(SiO_2) = 3.9$, $q = 1.6 \times 10^{-19}$ C, $n_i = 1.5 \times 10^{10}$ cm^{-3}.

a) Design the values (in μm) of W and L, such that with the device biased in saturation with the lowest allowed values of the gate overdrive voltage and the corresponding V_{DS}, it should have unity-gain cutoff frequency (f_T) of 5 GHz and device power dissipation of 100 nW. **8**

b) If the designed device is biased with $V_G = 3$ V, $V_D = 1.5$ V, $V_S = 1$ V, and $V_B = 0$ V, determine the drain current I_D. **4**

c) If the values of V_G and V_S are maintained as in part b), but now V_D is changed to 3 V, determine the required value of V_B that will make the device operate with a body factor (χ) of 0.1. **3**