
**P7.1** The $i_D$ vs. $v_{DS}$ curves are given to the right for a PMOS device. Estimate the threshold voltage $V_{tp}$ and $K_p$ for the device. Assume $\lambda = 0$ and $v_{BS} = 0$.

**P7.2** J&B Problem 4.54

**P7.3** J&B Problem 4.56

**P7.4** Calculate $v_{CE,SAT}$ for an NPN transistor with $I_C = 1mA$, $I_B = 0.1mA$, $\beta_F = 100$, and $\beta_R = 10$. Use Matlab to plot $v_{CE,SAT}$ and $v_{BE,ON}$ as $I_B$ is swept from 0.1mA to 10mA with $I_C = 1mA$ and $I_S = 10^{-15}A$.

**P7.5** Assume the NPN circuit below can be approximated as a linear amplifier. From the plots of $v_{BE}(t)$ and $v_{CE}(t)$ below, what are $v_{be}(t)$, $V_{BE}$, $v_{ce}(t)$, and $V_{CE}$? Assume the signals are oscillating at a frequency $\omega_0$. 
P7.6 Assume the NFET circuit below can be approximated as a linear amplifier. From the plots of $v_{GS}(t)$ and $v_{DS}(t)$ below, what are $v_{GS}(t)$, $V_{GS}$, $v_{ds}(t)$, and $V_{DS}$? Assume the signals are oscillating at a frequency $\omega_0$.

![P7.6 Diagram](image)

P7.7 Calculate the DC bias current $I_D$ for the circuit on the right assuming $K_n = 250\mu A/V^2$, $V_{tn} = 1V$, and $\lambda = 0$. Calculate the new value of $I_D$ and the percentage change in $I_D$ resulting from a 5% increase in $K_n$ ($K_n = 262.5\mu A/V^2$). Calculate the new value of $I_D$ and the percentage change in $I_D$ resulting from a 5% decrease in $V_{tn}$ ($V_{tn} = 0.95V$).

![P7.7 Diagram](image)

P7.8 Calculate the DC bias current $I_D$ for the circuit below assuming $K_p = 100\mu A/V^2$, $V_{tp} = -1V$, and $\lambda = 0$. Calculate the new value of $I_D$ and the percentage change in $I_D$ resulting from a 5% increase in $K_p$ ($K_p = 105\mu A/V^2$). Calculate the new value of $I_D$ and the percentage change in $I_D$ resulting from a 5% decrease in $V_{tp}$ ($V_{tp} = -0.95V$).

![P7.8 Diagram](image)