1. Please explain the following items：
   (a) Quasi-Fermi level. (5%)
   (b) Stimulated emission in LASER. (5%)
   (c) Schottky contact for the junction of p-type semiconductor/metal. (5%)
   (d) Base width modulation. (5%)
   (e) Strong inversion for ideal MIS diode. (5%)
   (f) Filling factor for solar cell. (5%)

2. Describe and plot the energy band diagram as well as the I-V characteristics for the "tunnel diode" under various biasing conditions. (20%)

3. (20%) Consider silicon at T=300K. A Hall effect device is fabricated with the following geometry: $d=5\times10^{-3}$ cm, $W=5\times10^{-2}$ cm, and L=0.5 cm. The electrical parameters measured are: I_x = 0.5mA, V_x = 1.25V, and B_x = 6.5×10^{-2} telsa. The Hall field is E_H = -16.5 mV/cm. Determine (a) the Hall voltage, (b) the conductivity type, (c) the majority carrier concentration, and (d) the majority carrier mobility.

4. (15%) In a p-type silicon semiconductor at T=300K, excess carriers are being generated by light illumination at the end of the semiconductor bar at x=0. The doping concentration is $N_a=5\times10^{16}$ cm^{-3} and $N_d=0$. The steady-state excess-carrier concentration at x = 0 is 10^{15} cm^{-3} (Neglect surface effects). The applied electric field is zero. Assume that $\tau_{n0}=\tau_{p0}=8\times10^{-7}$s, $\mu_n=1050$ cm^2/V-s, and $\mu_p=400$ cm^2/V-s.
   (a) Derive an express for excess electron concentration.
   (b) Calculate the electron and hole diffusion current densities at x = 0.

5. (15%) A one-sided n^+p silicon diode at T=300 K with a cross-sectional area of 10^{-3} cm^2 is operated under forward bias. The doping levels are $N_a=10^{16}$ cm^{-3} and $N_d=10^{18}cm^{-3}$, and the minority carrier parameters are $\tau_{p0}=10^{-8}$s, $\tau_{n0}=10^{-7}$s, $D_p=10cm^2/s$, and $D_n=25cm^2/s$. The maximum diffusion capacitance is to be 1 nF. Determine (a) the maximum current through diode, (b) the maximum forward-bias voltage, and (c) the diffusion resistance.