1. (25%) The dimension of a semiconductor is d=0.001 cm, L=0.1 cm, and W=0.05 cm. Please identify this semiconductor is n or p-type, and calculate the majority carrier concentration and mobility by the following Hall effect parameters. I_x= 2 mA, V_x= 10 V, B_Z=600 gauss=0.006 tesla, and V_H=7 mV.

2. (25%) Consider a p-n diode at T = 300 K with doping concentrations of $N_a = 10^{19}$ cm^{-3} and $N_d = 10^{15}$ cm^{-3}. The electron and hole diffusion coefficient is D_n=20 cm^2/s and D_p = 10 cm^2/s, respectively. The electron and hole lifetime is $\tau_{n0} = 10^{-6}$ s and $\tau_{p0} = 10^{-7}$ s, respectively. The cross-sectional area is $A = 10^{-3}$ cm^2. Calculate the reverse saturation current and the diode current at a forward-bias voltage of 0.60 V.

3. Please describe the following items：
   (a) Filling factor for solar cell. (5%)
   (b) Photodetector. (5%)
   (c) Avalanche breakdown. (5%)
   (d) Early effect in the BJT. (5%)
   (e) Mass-action law. (5%)

4. (a) Please completely explain how to obtain a Schottky contact for the metal /N-type Si junction. (12%)
   (b) Please plot the relation of electron mobility in Si versus temperature and explain why. (13%)