# 6.012 Microelectronic Devices and Circuits

## Tutorial #2

**Problem 1 – Drift Conduction**

Current generation integrated circuits process technologies for Microprocessors and Dynamic Random Access Memories (DRAM) have physical gate lengths of 23 nm (0.023 $\mu$m). For this part of the problem assume that the active device cross-sectional area is $(0.023\ \mu m)^2$ and the acceptor doping concentration of $N_a = 4 \times 10^{18}\ cm^{-3}$.

a) Estimate the velocity of the holes in the channel if the voltage drop across the channel is 0.2 V. Assume the potential drop is linearly distributed and the operating temperature is 300K.
b) How long does it take the holes to travel across the channel?
c) What is the hole current?

**Problem 2 — Silicon Resistor and Sheet Resistance (based on P2.7)**

Figure P2.7 is a top view of a Si region which has metal electrical contacts on two sides, across which a voltage of 2V is applied. The Si layer is doped with $10^{13} cm^{-3}$ As and is 2um thick. At 300K,

a) What is the sheet resistance R□?
b) What is the resistance R?
c) Find the value of the electric field $E_x$ in the Si.