Name: **Id#**

COE 360, Principles of VLSI Design, Term 981
Quiz# 1 – Sec 3

Date: Monday September 28

(I) Indicate if the following is true or false:

(a) An intrinsic silicon semiconductor has 3, 4, or 5 valence electrons (True, False).

(b) Current density increases with the increase in the total charge and the decrease in area (True, False).

(c) The applied voltage across a semiconductor increases with the decrease in the length of the semiconductor (True, False).

(d) With the addition of acceptor atoms to an intrinsic semiconductor, the hole concentration increases while the electron concentration remains the same (True, False).

(e) A p-type semiconductor is doped with prevalent impurity while an n-type semiconductor is doped with trivalent impurity (True, False).

(f) The mass-action-law states that $n=p=n_i^2$ (True, False).

(g) The charge neutrality law states that $N_A + p = N_D + n$ (True, False).

(h) With increasing temperature, the mobility and resistivity decrease (True, False).

(i) The potential between two points depends on the concentration between the points and on their separation (True, False).

(j) In a pn-junction, free electrons will diffuse from the n to the p side leaving negative ions, and free holes will diffuse from the p to the n side leaving positive ions (True, False).

(k) The width of the depletion region and the transition capacitance decrease with the increase in the doping concentration (True, False).

(l) In a forward-biased pn-junction, the depletion region width is larger than in the reverse-biased pn junction (True, False).

(m) V_{OH} is the maximum input voltage which can be interpreted as high while V_{OL} is the minimum input voltage which can be interpreted as low (True, False).

(II) A piece of silicon is 4 mm long and has a rectangular cross section of 60X1000 μm. The material is doped with Boron at a density of $4X10^{14}$ atoms/cm^3. At 300 K, determine the electric field intensity in the bar and the voltage across the bar when a steady current of 2 μA is measured. *Assume the following: Electron mobility at 300 K=1500 cm^2/V.s, Hole mobility at 300 K = 475 cm^2/V.s, Intrinsic concentration at 300 K=1.45X10 ^{10} cm^{-3}* , and q= 1.6X*10^{-19} C.*