5/6 (2)

國立成功大學 76 學年度 電機 研究所碩士班入學 考試（物理學 試題） 共 1 頁 第 1 頁

1. Calculate the intrinsic impedance and the wave velocity for a conducting medium in which $\sigma_c = 5\times10^{7}\ (\Omega\cdot cm)^{-1}$ and $\mu = \mu_0$ at a frequency $\omega = 2\pi\times10^{8}$ rad/s ($\mu_0 = 4\pi\times10^{-7}$ h/m, $\epsilon_0 = 8.85\times10^{-12}$ f/m). (16%)

2. Assume a rectangular conducting sheet of conductivity σ, width a, and height b. Voltages V_1 and V_2 are applied to the left and right side, respectively, as shown in Fig. 1. Find

(a) the potential distribution, (8%)

(b) the current density everywhere within the sheet. (6%)

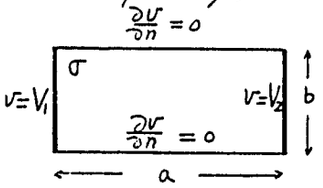

Fig. 1

3. Describe briefly the following items : (18%)

(a) gradual-channel approximation (b) Gummel number

(c) Schottky effect (d) short-channel effect

(e) crystal defects (f) quasi-Fermi level

4. (a) State the usual methods used to measure the barrier height of a Metal-semiconductor contact. (4%)

(b) How to determine whether avalanche or Zener breakdown is occuring in a junction. (4%)

(c) Describe briefly the condition for an ideal M-S contact be ohmic. (4%)

5. For an ideal silicon N^+P abrupt junction with $N_D = 10^{19}\ cm^{-3}$ and $N_A = 5\times10^{14}\ cm^{-3}$,

(a) sketch the energy-band diagram, quasi-Fermi level and carrier distribution under reverse-biased conditions. (9%)

(b) calculate the built-in voltage and the total depletion width under thermal equilibrium condition. (8%)

(c) find the stored minority carriers in the neutral P-region when a forward bias of 0.5 V is applied (assume the length of neutral region is 2um, $L_n = 5um$). (7%)

6. An ideal MOS diode with the following parameters : oxide thickness d, doping concentration N_A, the applied voltage V, oxide and semiconductor permitivity are ϵ_{ox} and ϵ_s, respectively,

(a) derive : $C = C_0\left(\sqrt{1+\frac{2\epsilon_{ox}^2 V}{qN_A\epsilon_s d^2}}\right)^{-1}$, where $C_0 = \frac{\epsilon_{ox}}{d}$. (8%)

(b) assume $N_A = 10^{16}\ cm^{-3}$, $d = 500\text{Å}$, $\epsilon_{ox} = 3.9\epsilon_0$, $\epsilon_s = 11.9\epsilon_0$, calculate V_T and C_{min}. (8%)