元智大學 103 學年度研究所 碩士班 招生試題卷

系(所)別：光電工程學系碩士班　組別：不分組　科目：電子學　用紙第 1 頁共 2 頁

●可使用現行『國家考試電子計算器規格標準』規定第二類之計算機

元智大學一百零三學年度 研究所考試 招生試題卷

系別：光電工程研究所　科目：電子學

Parameter: Vt= 0.026mV (T= 300 K), ln10=2.3, e^{-2}=0.37, e^{-3}=0.05

1. (5%)What is the reasonable value for the intrinsic carrier concentration in silicon at T=300 K: (a) 1.5×10^{10} cm^{-3} (b) 1.5×10^{18} cm^{-3}(c) 1.5×10^{5} cm^{-3}(d) 1.5×10^{25} cm^{-3}
2. (5%) What is the suitable doping species for the N-type Si: (a) N (b) AJ (c) B (d) As
3. (5%) What is the ideal gate current for the MOS filed-effect transistor: (a) 0 A (b) 1 mA (c) 10A (d) 1000 μA.
4. The hole concentration in silicon is given by $p(x)= 10^{4}+10^{15}\exp(-x/L_p)$, x>=0. The value of L_p is 10 μm. The hole diffusion coefficient is D_p = 15 cm^2/s. Determine the hole diffusion current density at (a) x=0, (3%) (b) x=10 μm (3%), and (c) x = 30 μm. (4%)
5. (5%) (a) The applied electric field in p-type silicon is E=10 V/cm. The semiconductor conductivity is σ= 1.5 $(ohm\text{-}cm)^{-1}$ and the cross-sectional area is $A=10^{-5}$ cm^2. Determine the drift current. (5%) (b) The cross-sectional area of a semiconductor is A = 1.2×10^{-3} cm^2 and the resistivity is ρ= 0.4 (ohm-cm). If the drift current is I= 1.2 mA, what applied electric field must be applied?
6. Consider the rectifier circuits shown in Figure 1 and 2. Assume the input voltage is from a 110 V (rms), 60 HZ ac source. The desired peak output voltage v_o is 9 V, and the diode turn on voltage is assumed to be V_γ =0.7 V. Compare the characteristics of (a) and (b) in these two full-wave rectifier circuits:
   (a) transformer turns ratio. (5%)
   (b) peak inverse voltage. (5 %)
   (c) Which rectifier is better? (5 %)
7. Determine the current in each diode (I_D1, I_D2, and I_D3) and the voltages of V_A and V_B in the multidiode circuit shown in Figure 3 .Let V_γ =0.7V for each diode. (10%)
8. (5%) (a) Please describe the "Body effect" in MOSFET.
   (5%) (b) Please describe the "Early Voltage" in Bipolar Junction Transistor.
   (5%) (c) For small signal consideration, an NMOS transistor biased in the saturation region, with a drain current of I_{DQ} , prove $g_m=2(K_nI_{DQ})^{1/2}$ in MOSFET.
9. For the circuit in Figure 4 let β =100，V_A = 200V，V_{CC}=10V，V_{BE}(on)=0.7V，R_C=15 kΩ，R_B=100 kΩ，and V_{BB}=0.96V. (a) Determine the small-signal hybrid-π parameters r_π，g_m，and r_o (10 %). (b) Find the small – signal voltage gain $A_v=V_o/V_s$. (5 %)
10. Determine the small-signal voltage gain of a common-source circuit containing a source resistor. Consider the circuit in Figure 5 with parameters: V_{TN} = 0.8V, K_n = $1mA/V^2$, and λ=0. (Note: V_{GSQ}=1.5V, I_{DQ} = 0.5 mA, and V_{DSQ}=6.25 V) (10%)

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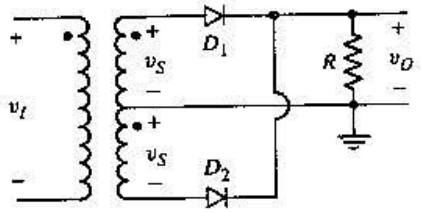

Figure 1

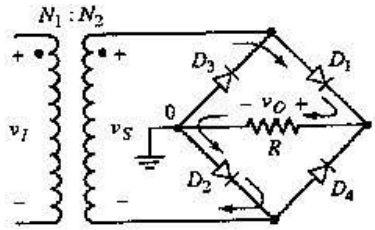

Figure 2

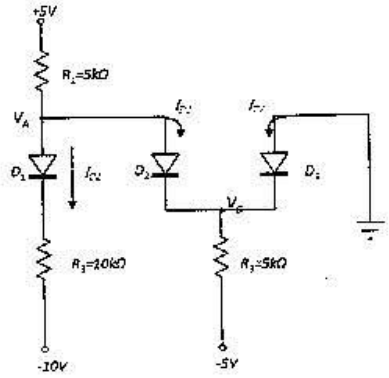

Figure 3

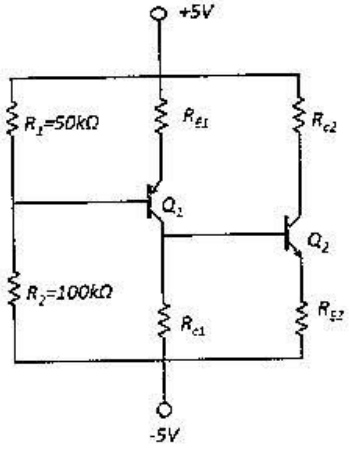

Figure 4

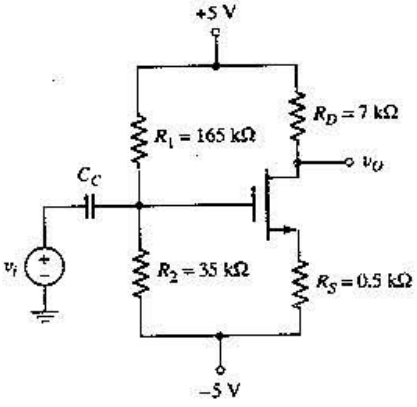

Figure 5