國立成功大學 105 學年度碩士班招生考試試題

系　　所：光電科學與工程學系

考試科目：電子學

考試日期：0228，節次：1

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (a)As shown in Figure 1, the five forward I-V curves correspond to five p-n junction diodes made from different semiconductors with corresponding energy band gap E_{g1},E_{g2}, E_{g3},E_{g4} and E_{g5}. Please identify which of the following item(s) is(are) true.(A) $E_{g3}>E_{g4}$(B) $E_{g5}>E_{g4}$(C) $E_{g3}<E_{g4}$ (D) $E_{g3}>E_{g2}>E_{g1}$ (E) $E_{g1}>E_{g2}>E_{g3}$(3%)

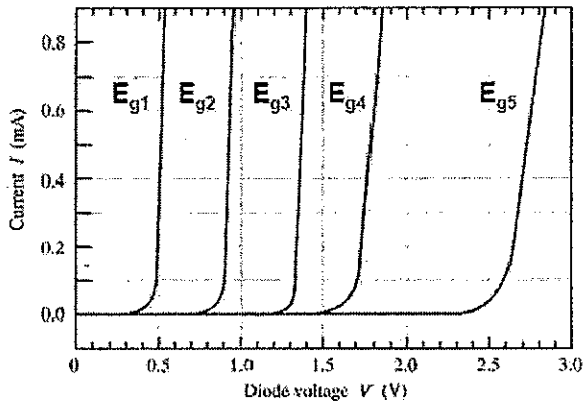

Figure 1

(b) As shown in Figure 2, if the five forward I-V curves correspond to a P-N diode operated at different temperatures, which of the following item(s) is(are) true.(A)$T_1>T_2$(B)$T_3>T_4$(C)$T_2>T_5$(D)$T_3>T_2$(E)$T_5>T_4$(2%)

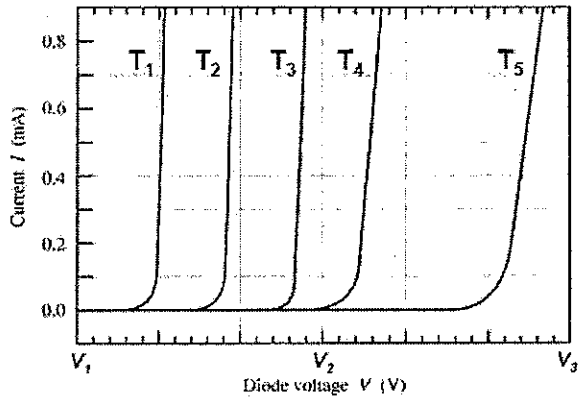

Figure 2

2. As shown in Figure 3, assuming the p-n and Zener diodes are ideal, and Vz =5V, please find V_2=____V and V_3 =____V when the voltage of V_1 is 6 V. (10%)

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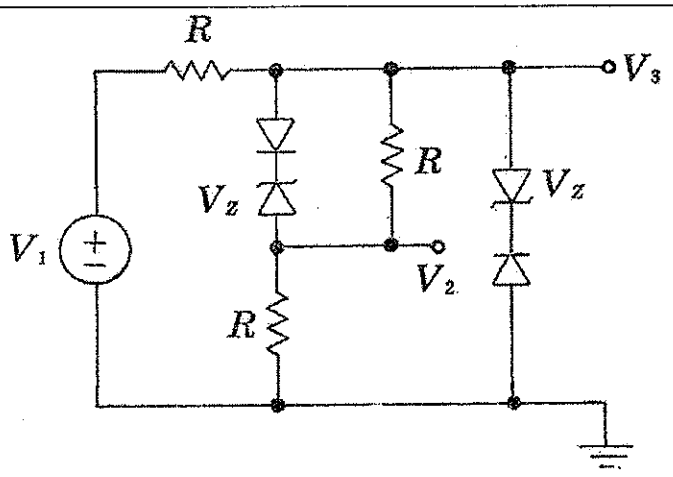

Figure 3

3. As shown in Figure 4, the current meter (M) with a full scale of 50 μA and a negligible resistance. (a)Assuming the transistor has V_{BE}=0.7 V at I_E=1 mA, what value of R_C would establish a resistor current of 1 mA? (b) what value of β would result in the current meter(M) at a full-scale reading ?(c) what is β the if the meter reading is 5 μA?(15%)

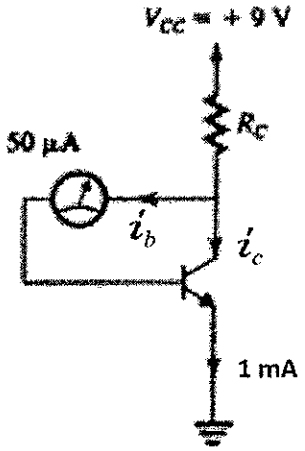

Figure 4

4. Figure 5 shows a CMOS amplifier. $|V_{TN}| = |V_{TP}| = 1V$, $K_n = 4K_p = 100\mu A/V^2$, V_{TN} and V_{TP} are the threshold voltages of the NMOS and PMOS FETs, respectively. $K_{n(p)} = \mu_{n(p)} C_{ox} W/2L$, where $\mu_{n(p)}$ is the electron(hole) mobility, C_{OX} is the oxide capacitance, W is the gate width, and L is the gate length. (a)what is the V_D=___V , and drain bias current I_D=_____ mA. (10%) (b)Assuming the output resistance of NMOS and PMOS FETs are infinite, what is the small signal gain v_o/v_i=____, and input resistance, R_{in}=____Ω. (10%)

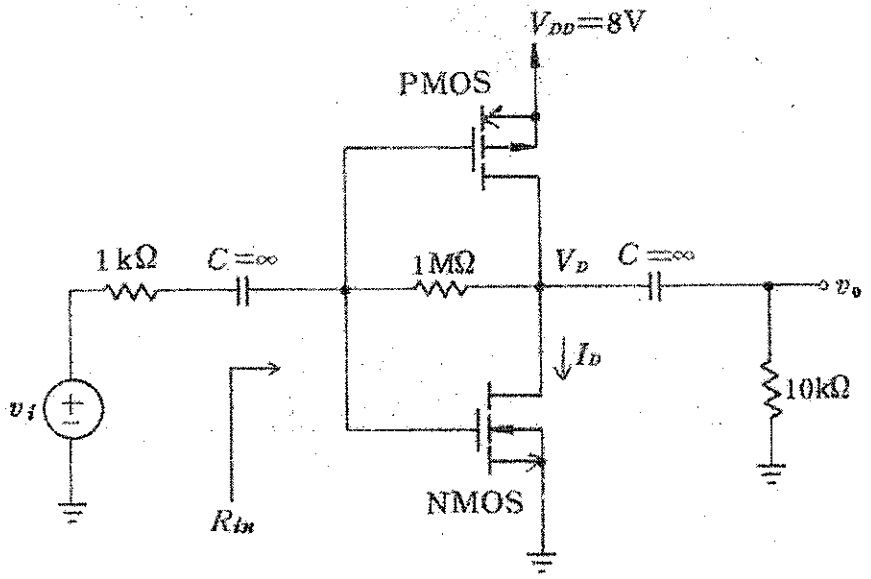

Figure 5

5. Figure 6 shows an ideal amplifier having a gain of -100 V/V with an impedance Z connected between its output and input terminals. Find the Miller equivalent circuit when Z is (a) a 1-MΩ resistance and (b) a 1-pF capacitance. In each case, please plot the equivalent circuit and use the equivalent circuit to determined V_o/V_{sig}. (10 %)

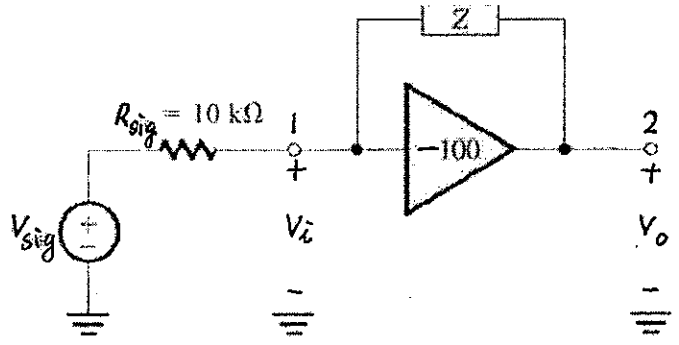

Figure 6

6. (20 %) (Frequency Response) Consider the common-emitter amplifier of Figure 7 under the following conditions: R_{sig}=5 kΩ, R_1=33 kΩ, R_2=22 kΩ, R_E=3.9 kΩ, R_C=4.7 kΩ, R_L=5.6 kΩ, V_{CC}=5 V. The dc emitter current can be shown to be $I_E \cong 0.3$ mA, at which β=120, r_0=300 kΩ and r_x=50Ω.

(a) If the transistor is specified to have f_T=700 MHz and C_μ=1 pF, find the upper 3-dB frequency.

(b) Design the coupling and bypass capacitors for a lower 3-dB frequency of 100 Hz. Design so that the contribution of each of C_{C1} and C_{C2} to determining is only 5%.

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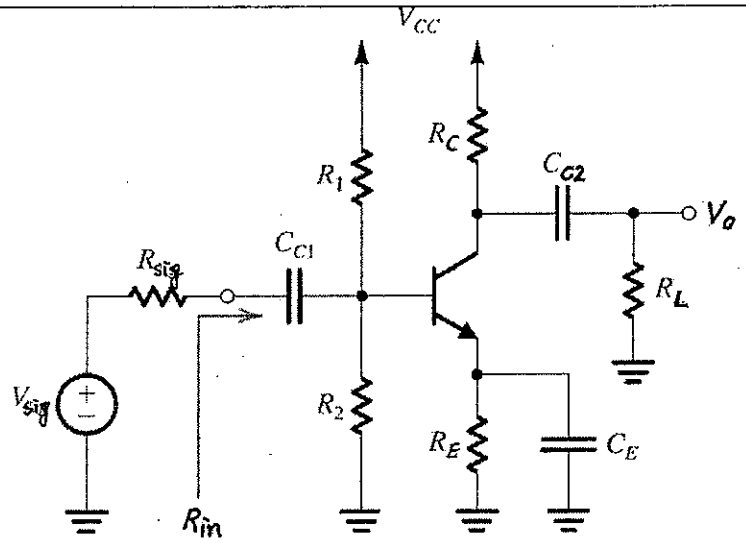

Figure 7

7. (10 %) Consider the Op-amp circuit shown in Figure 8, where the op amp has infinite input resistance and zero output resistance but finite open-loop gain A.

(a) Replace the op-amp with its equivalent circuit model and show that $\beta=R_1/(R_1+R_2)$

(b) If R_1=10 kΩ, find R_2 that results in A_f=10 V/V for the following three cases: (i) A=1000 V/V; (ii) A=100 V/V; (iii) A=12 V/V.

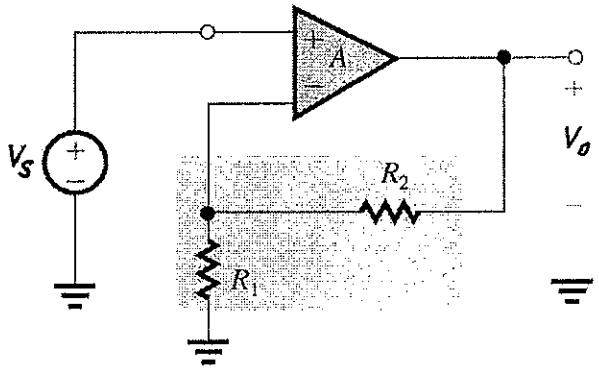

Figure 8

8. (10 %) For the negative-feedback loop, find the loop gain $A\beta$ for which the sensitivity of closed-loop gain to open-loop gain is -20 dB. For what value of does the sensitivity become 1/2?