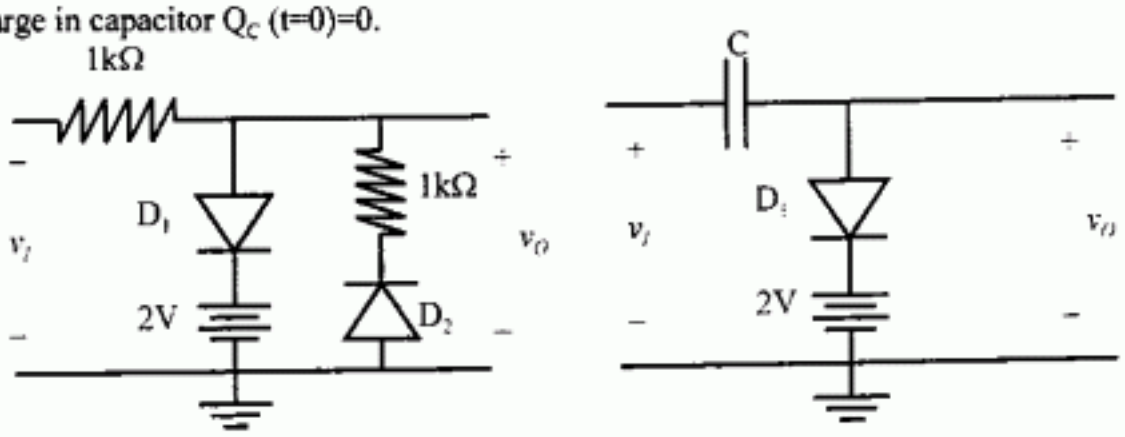
國 立 清 華 大 學 命 題 紙

九十一學年度 電機工程 研究所 甲乙 組 碩士班研究生入學考試

科目 電子學 科號 2303 2402 共 2 頁第 1 頁 *請在試卷(答案卷)內作答

1. **Sketch** v_O versus time for each circuit with v_I=10*sinωt* V for two cycle periods. **Label** the peak voltages. Assume the cut-in voltage V_γ =0.5V, the forward resistance R_f=0 for all the diodes and the initial charge in capacitor Q_C (t=0)=0.



(a) 10% (b) 10%

Fig. 1 for problem 1

2. Consider the basic current-mirror as shown in Fig. 2,
   (a) **Find** the ratio of I_O/I_{REF} with $L_2 = L_1$ and $W_2 = 5W_1$. (5%)
   (b) If Q_1 and Q_2 are identical transistor with $k_n' W/L = 40\ \mu A/V^2$, $V_t = 0.8$ V, and $V_A = 20$ V, what is the output voltage V_O for $I_O = I_{REF} = 10\ \mu A$? (5%)
   (c) Continue from part (b), what **will be** the changes in output current I_O corresponding to a + 2 V increases in the output voltage V_O? (5%)
   (d) What is the lowest possible output voltage V_O? (5%)

3. For the Pseudo-NMOS Logic as shown in Fig. 3, answer the following questions.
   (a) **Find** the logic Y=? 5%
   (b) If $\mu_n C_{ox}=2\mu_p C_{ox}=50\ \mu A/V^2$, $V_{tn}=|V_{tp}|=0$V, and VDD=5V, **find** the voltage for logic-1 (=?V) and the largest voltage for logic-0 (=?V) 10% Given $\sqrt{57} \approx 7.58$.
   (c) **Calculate** the static power dissipation for Y=logic-0 and Y=logic-1. 5%

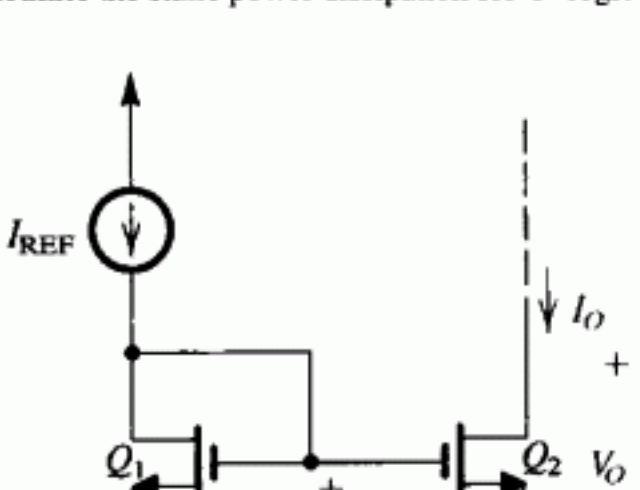


Fig. 2 For Problem 2

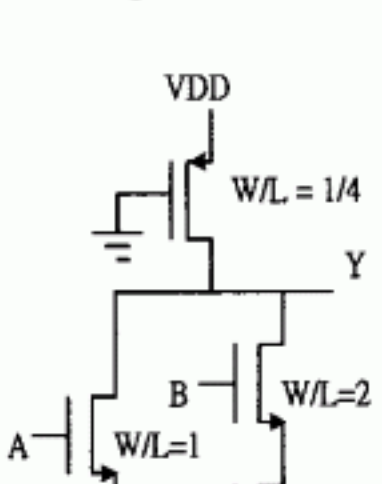


Fig. 3 for Problem 3

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4. Fig. 4 is the MOS OTA. Two sides of differential path, like *M1-M2*, *M3-M4*, are identical. Neglecting the body effect, please **use** the small signal parameters, i.e., gm, ro, Vt, $V_{DS\,(sat)}$, ... to **answer** the following questions:

(a) small signal differential gain (3%)

(b) common mode gain (3%) (current source impedance = Rss)

(c) input common mode range (3%)

(d) output signal swing range (3%)

(e) dominate pole position (3%)

(f) the method to make this amplifier stable when this OTA is in switched-capacitor network.(5%)

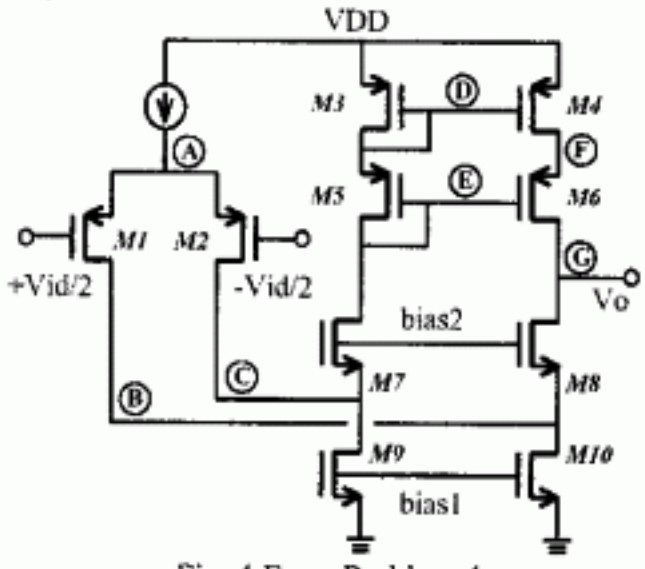

Fig. 4 For Problem 4

5. A current circuit is connected as shown in Fig. 5 with ideal OpAmp. The BJT has parameters $\beta=\infty$ and $V_{CE,sat}=0.3V$. The circuit components are $R_1=1K\Omega$, $R_2=10k\Omega$, $R_3=10\Omega$, $V_1=1V$, and $V_2=1.2V$.

(a) **Find** the output current I_o.(10%)

(b) What **is** the minimum operating voltage for V_o?(10%)

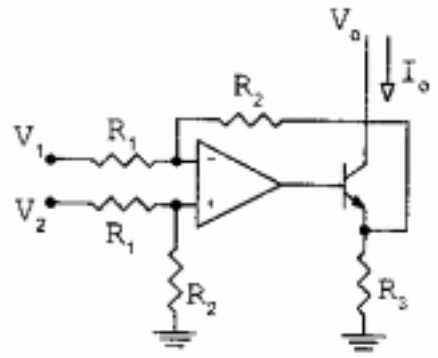

Fig. 5 for Problem 5