九十四學年度___微機電系統工程研究所__系（所）____________組碩士班入學考試

科目_____電子學_____科號____2306____共____3__頁第_______頁 *請在試卷【答案卷】內作答

選擇題：一題十分；**請直接在答案卷上寫下答案，不需計算過程**。

1. (   ) The output resistance of the MOS current mirror shown in Fig. 1 can be expressed by the transistor transconductance g_m and the transistor output impedance r_{ds}. Which of the following answers is the correct value of R_o? (1) r_{ds3} (2) r_{ds2} (3) $r_{ds3}r_{ds2}$ (4) $r_{ds3}+r_{ds2}$ (5) $g_{m3}r_{ds3}^2$ (6) $g_{m2}r_{ds3}r_{ds2}$ (7) $g_{m2}g_{m3}r_{ds3}r_{ds2}$ (8) $g_{m3}r_{ds3}r_{ds2}$.

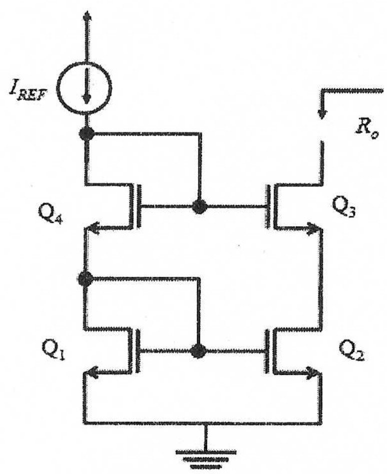

Figure 1

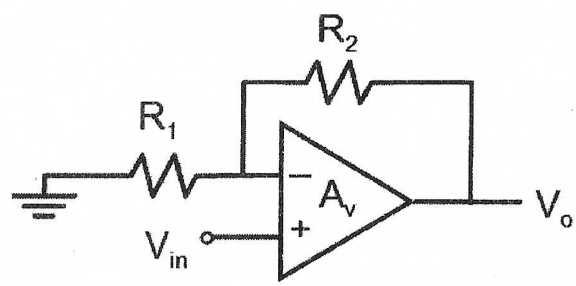

Figure 2

2. (   ) As shown in Fig. 2 is a voltage amplifier implemented by an op amp having an open-loop gain A_v = 1000 V/V. The resistors R_1 = 1 kΩ and R_2 = 10 kΩ. What is the voltage gain V_o/V_{in}? (1) 10.11 (2) 10.23 (3) 10.35 (4) 10.42 (5) 10.72 (6) 10.88 (7) 10.93 (8) 11.

3. (   ) For a pn junction that has an intrinsic carrier concentration $n_i = 1.5 \times 10^{10}/\text{cm}^3$, a p-type doping concentration $N_A = 10^{17}/\text{cm}^3$, and a n-type doping concentration $N_D = 10^{16}/\text{cm}^3$ at T = 300 K, what is the calculated junction built-in voltage? (1) $0.025 \cdot ln\left(\frac{10^{13}}{1.5}\right)$ (2) $0.025 \cdot ln\left(1.5 \cdot 10^{10}\right)$ (3) $0.025 \cdot ln\left(\frac{10^{10}}{1.5}\right)$ (4) $0.025 \cdot ln\left(\frac{10^{13}}{2.25}\right)$ (5) $0.025 \cdot ln\left(2.25 \cdot 10^{10}\right)$ (6) $0.025 \cdot ln\left(\frac{2.25}{10^{13}}\right)$ (7) $0.025 \cdot ln(1.5)$ (8) $0.025 \cdot ln\left(10^{33}\right)$.

4. (   ) Choose the correct common-mode rejection ratio (CMRR) for the difference amplifier shown in Fig. 3, where $R_1 = R_2 = R_4 = R$, and $R_3 = (1 + 0.1\%)\cdot R$. The op amp is ideal. (1) 1001 (2) 1501 (3) 2001 (4) 2501 (5) 3001 (6) 3501 (7) 4001 (8) 4501.

5. (   ) With transistors having defined transconductance g_m, length L, width W, and output impedance r_{ds}, the voltage gain V_o/V_i of the amplifier in Fig. 4 can be approximated as (neglect the body effect):

(1) $g_{m1}r_{ds1}$ (2) $-g_{m2}(r_{ds1}\,//\,r_{ds2})$ (3) $-g_{m2}r_{ds1}$ (4) $-g_{m2}r_{ds2}$ (5) $-\sqrt{\frac{(W/L)_1}{(W/L)_2}}$ (6) $-\sqrt{\frac{(W/L)_2}{(W/L)_1}}$ (7) $\sqrt{\frac{(W/L)_1}{(W/L)_2}}$ (8) $\sqrt{\frac{(W/L)_2}{(W/L)_1}}$.

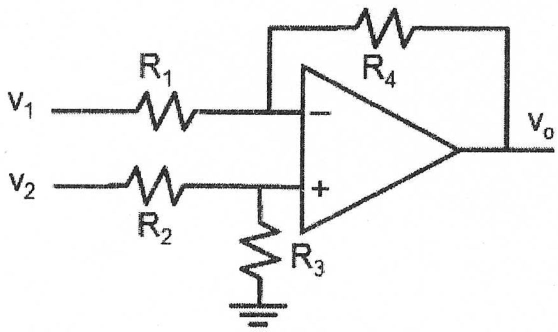

Figure 3

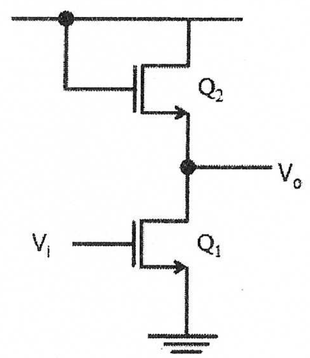

Figure 4

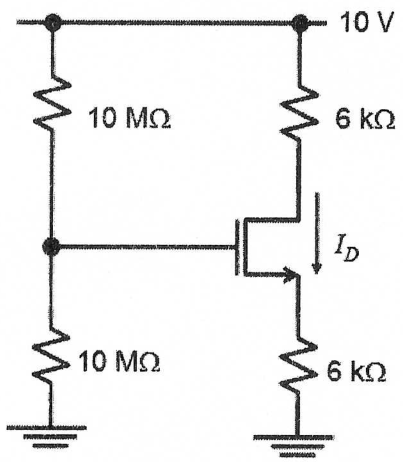

Figure 5

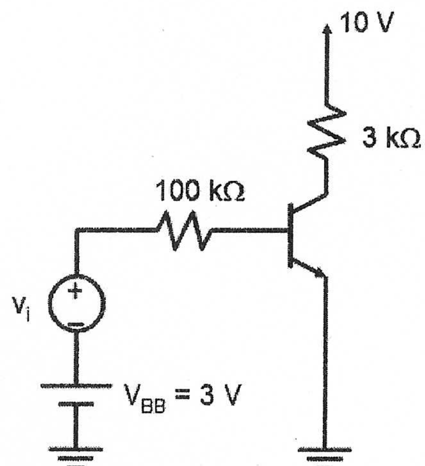

Figure 6

6. (   ) Given that the MOSFET threshold voltage $V_t = 1$ V, $\mu_n C_{ox} = 200\ \mu A/V^2$, and $(W/L) = 5$, determine the bias current I_D of the circuit in Fig. 5 (Note: neglect the channel-length modulation effect). (1) 0.12 mA (2) 0.19 mA (3) 0.28 mA (4) 0.35 mA (5) 0.5 mA (6) 0.62 mA (7) 0.75 mA (8) 0.89 mA.

7. (   ) Determine the small-signal voltage gain of the transistor amplifier in Fig. 6. Assume $\beta = 100$ and $V_{BE} =$ 0.7 V. (1) -1.23 (2) -3.04 (3) -3.79 (4) -4.68 (5) -4.84 (6) 2.89 (7) 3.65 (8) 4.94.

8. (   ) Consider a MOSFET process technology for which the threshold voltage $V_t = 0.7$ V and $\mu_n C_{ox} = 194\ \mu A/V^2$. For a MOSFET with $W/L = 10\ \mu m / 1\ \mu m$, find the value of V_{GS} required to cause the device to operate as a 1 kΩ resistor in the triode region with a very small V_{DS}. (1) $V_{GS} = 1.22$ V (2) $V_{GS} = 1.18$ V (3) $V_{GS} = 1.14$ V (4) $V_{GS} = 1.10$ V (5) $V_{GS} = 1.06$ V (6) $V_{GS} = 1.02$ V (7) $V_{GS} = 0.98$ V (8) $V_{GS} = 0.94$ V.

9. (   ) Consider the circuit in Fig. 7a with the input signal V_i in Fig. 7b. The switch is opened at t = 0. The op amp is ideal with a full-power bandwidth of 10 kHz and a corresponding ±10 V output. What slew rate does the op amp have? (1) 0.1 V/μs (2) 1000 V/s (3) 0.001 V/s (4) 6.28×10^{-3} V/s (5) 6283 V/s (6) 0.314 V/μs (7) 0.628 V/μs (8) 3.14×10^{-3} V/s.

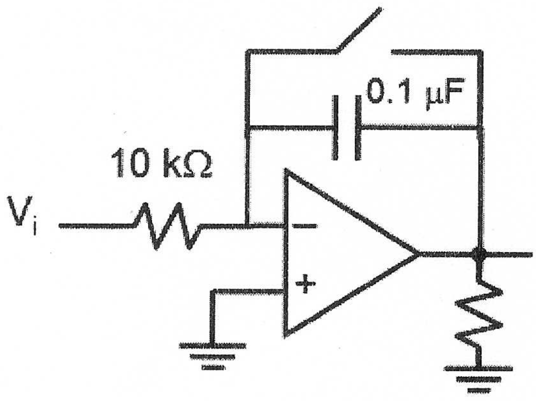

Figure 7a

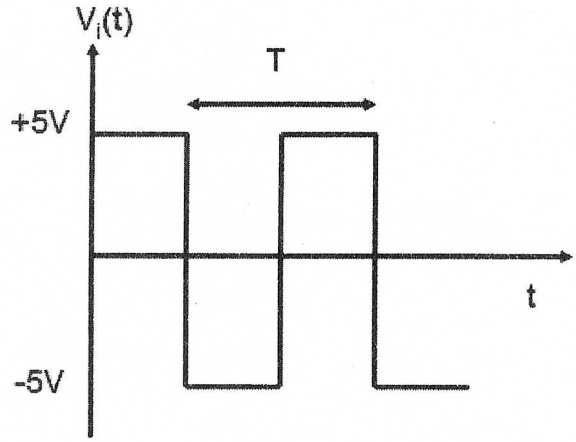

Figure 7b

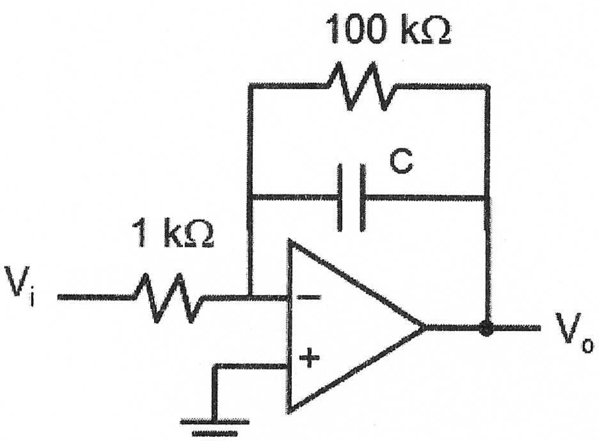

Figure 8

10. (   ) For the closed-loop frequency response of the circuit in Fig. 8 to have a 3-dB frequency at 1 kHz, what is the value of the capacitance? (1) 1.59 nF (2) 10 nF (3) 159 nF (4) 1.45 nF (5) 1 F (6) 0.01 F (7) 6.28 F (8) 0.0628 F.