214、213,227 國立成功大學九十七學年度碩士班招生考試試題

系所:微電子工程研究所,電机架下3.7.戊級,電通价多丁超 科目:電子學

本試題是否可以使用計算機: ☑可使用 , □不可使用 (請命題老師勾選)

編號:

考試日期:0301,節次:1

- 1. A doped silicon sample is 3 mm long and has a rectangular cross section of $50\times100~\mu\text{m}^2$. The donor concentration is $5\times10^{14}~\text{cm}^{-3}$. A steady current of 1 μA exists in the bar. Determine the conductivity and voltage across the bar. (if the related parameters are: $\mu_n=1500~\text{cm}^2/\text{V·s}$, $\mu_p=475~\text{cm}^2/\text{V·s}$, and $n_i=1.5\times10^{10}~\text{cm}^{-3}$) (12%)
- 2. An NMOS inverter with a depletion-type load is shown in Fig. 1. The related parameters of this circuit are $V_{\rm DD}$ =5 V, $K_{\rm D}$ =90 $\mu A/V^2$, $V_{\rm TD}$ =1 V, $K_{\rm L}$ =30 $\mu A/V^2$, and $V_{\rm TL}$ =-2 V. Determine the noise margins (NM_L and NM_H) of this circuit. (20%)

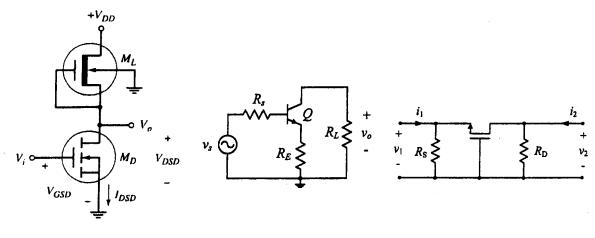


Fig. 1

Fig. 2

Fig. 3

- 3. Calculate gain-bandwidth product (GBP) and cutoff frequency of the amplifier shown in Fig. 2 for the case of $R_E = 0 \, k\Omega$ and $R_E = 0.1 \, k\Omega$, respectively. Assume $R_s = 0.5 \, k\Omega$, $R_L = r_\pi = 1 \, k\Omega$, $C_\pi = 50 \, pF$, $C_\mu = 1 \, pF$, and $\beta = 100 \circ (16\%)$
- 4. (a) Find the midband gain in dB and bandwidth in Hz for the amplifier described by $A(s) = \frac{2.5 \times 10^7 (s + 2 \times 10^5)}{(s + 10^5)(s + 5 \times 10^5)}$. What type of amplifier is this? (6%)
 - (b) Write the g-parameter description of the common-gate amplifier shown in Fig. 3. What are the values of g_{12} and g_{21} if $R_S = 20 \text{ k}\Omega$, $R_D = 100 \text{ k}\Omega$, $g_m = 400 \text{ }\mu\text{S}$, and $r_o = 400 \text{ k}\Omega$. (12%)

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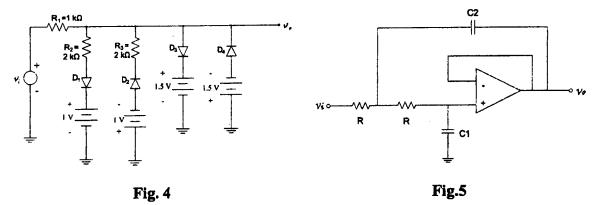
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- 5. An amplifier with a single-pole low-pass transfer function with a DC gain of 400 and a pole at 1 kHz also has $R_i=1$ k Ω and $R_o=750$ Ω . We want to use this amplifier in a negative-feedback connection to produce a close-loop amplifier with a gain of 10. We want to achieve the smallest input resistance and largest output resistance possible
 - (a) What type of feedback connection should we use? (4%)
 - (b) What value of feedback factor, β , is required? (4%)
 - (c) What are the resulting values of the input resistance and output resistance for the feedback amplifier? (4%)
 - (d) What is the resulting closed-loop bandwidth? (4%)
- 6. Consider the circuit shown in Fig. 4. Assume that the diodes are ideal. Plot the transfer characteristic of this circuit, v_o/v_i , for $-2V \le v_i \le 2V$. (6%)



- 7. Consider the OP-Amp circuit shown in Fig. 5. Assume that the OP-Amp is ideal.
 - (a) Find the transfer function, $T(s) = \frac{v_0(s)}{v_i(s)}$. (6%)
 - (b) Sketch the Bode plots of the magnitude and phase of the transfer function for $R=100 \text{ k}\Omega$, $C_1=56.3 \text{ pF}$, $C_2=113 \text{ pF}$. (6%)