明新科技大學 98 學年度研究所招生考試 試題卷

系所名稱	類別	科目	節次	准考證號碼(考生請填入)	考試日期
電機工程研究所	碩　士在職專班	電子學	第一節		98/5/3

※ 答案須寫在答案卷內，否則不予計分。

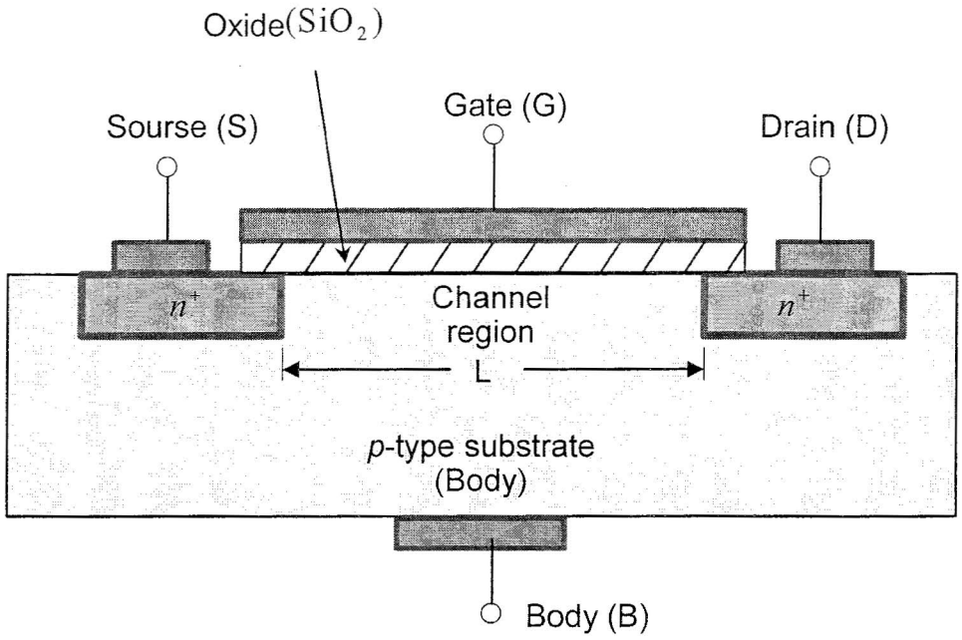

Fig. 1

1. The physical structure's cross section of the enhancement NMOS transistor is shown in Fig. 1, please choose the correct answer on each of the following questions. (10 %)

(1) How to induce the n-channel on the p-type substrate? (V_t is the threshold voltage of the NMOS transistor.) (2%)

(a) $v_{DS} > 0$, (b) $v_{DS} < 0$, (c) $v_{GS} > 0$, (d) $v_{GS} < 0$, (e) $v_{GS} > V_t$, (f) $v_{DS} > V_t$, (g) $v_{GS} < V_t$, (h) $v_{DS} < V_t$

(2) How to make the current flow through the channel induced? (2%)

(a) $v_{DS} > 0$, (b) $v_{DS} < 0$, (c) $v_{GD} > 0$, (d) $v_{GD} < 0$

(3) What is the current carried by? (a) free electrons, (b) free holes, (c) neutrons, (d) protons. (2%)

(4) What is the current carriers flow direction? (a) from gate to source, (b) from drain to source, (c) from source to drain, (d) from drain to gate. (2%)

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(5) Which one is correct for the gate current i_G? (a) $i_G < 0$, (b) $i_G > 0$, (c) $i_G = 0$ (2%)

2. Please answer the following questions about the small-signal model of the NMOS transistor. (20 %)

(1) Please plot the low-frequency small-signal model of the NMOS transistor. (4%)

(2) What is the input resistance? (4%)

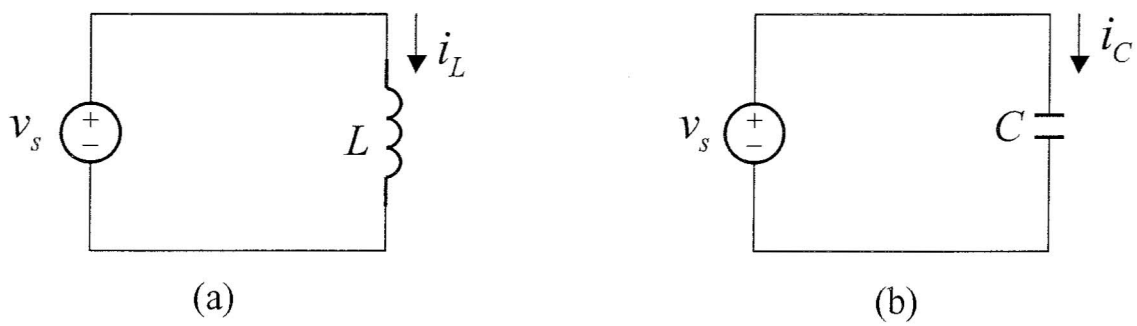
(3) What is the output resistance? (4%)

(4) What is the small-signal gain? (4%)

(5) What is the condition such that the small-signal model can be used for analysis of an NMOS amplifier? Please choose the correct answer as follows: (4%)

(a) $v_{gs} > 0$, (b) $v_{gs} << 0$, (c) $v_{gs} << 2(V_{gs} - V_t)$, (d) $v_{gs} >> 2(V_{gs} - V_t)$,

(e) $v_{gs} >> (V_{gs} - V_t)$



(a) (b)

Fig. 2

3. (1) For the circuit in Fig.2(a), where $v_s = \sin t, L = 1\,\mathrm{H}$. What is the value of $i_L(t)$? (3%)

(2) Please plot the waveforms of $v_s(t)$ and $i_L(t)$ in (1). What is the difference of phase angle between the $v_s(t)$ and $i_L(t)$? (3%)

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(3) For the circuit in Fig.2(b), where $v_s = \sin 10t$, $L = 1\ \mu\text{F}$, What is the value of $i_C(t)$? (4%)

4. Using an ideal operation amplifier and two resistors R_1 and R_2, to design the following circuits:

(a) an inverting amplifier with the gain of -10. (3 %)

(b) a non-inverting amplifier with the gain of 10. (3 %)

(c) a voltage follower. (4 %)

5. An integrator is shown in Fig. 3, in which the OP amplifier is ideal. $R = 10\ \text{k}\Omega$, $C = 1\ \mu\text{F}$.

Please answer the following questions:

(a) $T(s) = \dfrac{V_o(s)}{V_i(s)}$. (4 %)

(b) Plot the Bode plot which includes the magnitude and phase. (6 %)

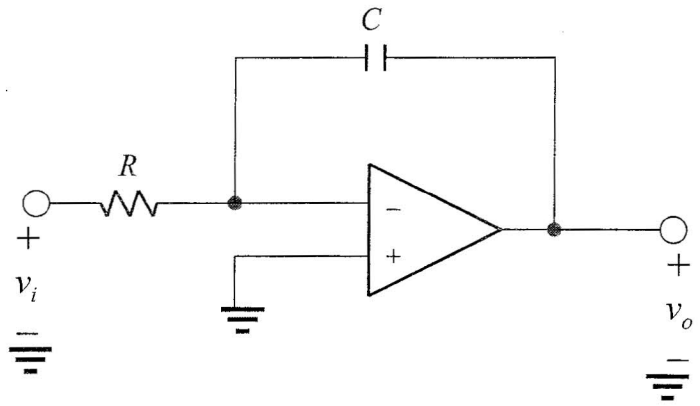

Fig. 3

6. A limiter circuit is shown in Fig. 4, where the input signal is $v_I(t) = 10\sin\omega t$. The zener diode has $V_{z1} = V_{Z2} = 6\ \text{V}$ and 0.7V voltage drop when conducting in forward direction.

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(a) Please plot the input-output transfer characteristic curve of the circuit. (5 %)

(b) Please plot the output voltage waveform。 (5 %)

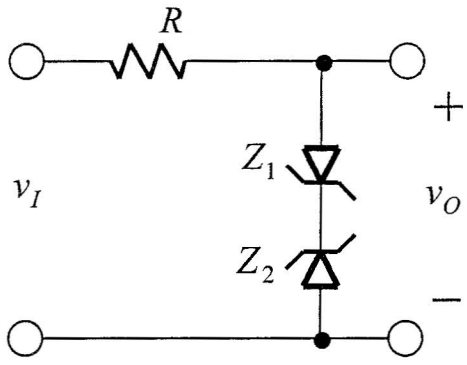

Fig. 4

7. An amplifier is shown in Fig. 5, where $R_s = 1\,\text{k}\Omega$, $R_i = 100\,\text{k}\Omega$, $C_i = 100\,\text{pF}$, $\mu = 100\,\text{V/V}$, $R_o = 100\,\Omega$, $R_L = 1\,\text{k}\Omega$. Please answer the following questions:

(a) $T(s) = \dfrac{V_o(s)}{V_s(s)}$. (4 %)

(b) What is the dc gain? (3 %)

(c) What is the 3-dB frequency? (3 %)

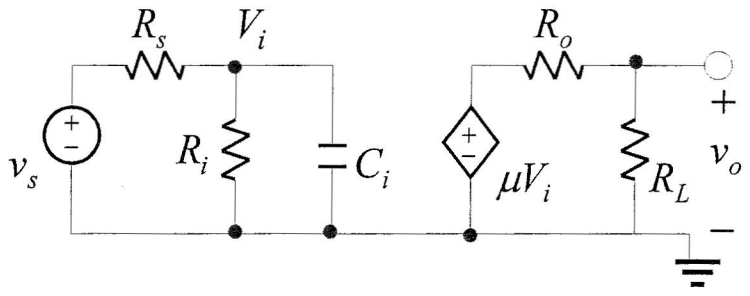

Fig. 5

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8. An NMOS Amplifier circuit is shown in Fig. 6.

$V_t = 2.0\ \text{V}, K_n = \frac{1}{2}K_n' \frac{W}{L} = 0.5\ m\text{A/V}^2, \lambda = 0.01\ \text{V}^{-1}$

$V_{DD} = 12\ \text{V}, R_1 = 90\ \text{K}\Omega, R_2 = 30\ \text{K}\Omega, R_D = 5\ \text{K}\Omega, R_{Si} = 4\ \text{K}\Omega.$

$I_{DQ} = K_n(V_{GSQ} - V_t)^2, \quad g_m = 2K_n(V_{GSQ} - V_t), \quad r_o \approx \frac{1}{\lambda I_{DQ}} = \frac{V_A}{I_{DQ}}.$

Please answer the following questions:

(a) What is the amplifier configuration belong to? (Common source, common gate, or common drain) (2 %)

(b) Find the dc or quiescent gate-to-source voltage, V_{GSQ}, and the quiescent drain current, I_{DQ}. (4 %)

(c) Please plot the small-signal model of the circuit, with the resistance r_o included..(4%)

(d) Find the voltage gain: $A_v = v_o / v_i$ (4%)

(e) Find the input resistance R_{in}. (3 %)

(f) Find the output resistance R_{out}. (3 %)

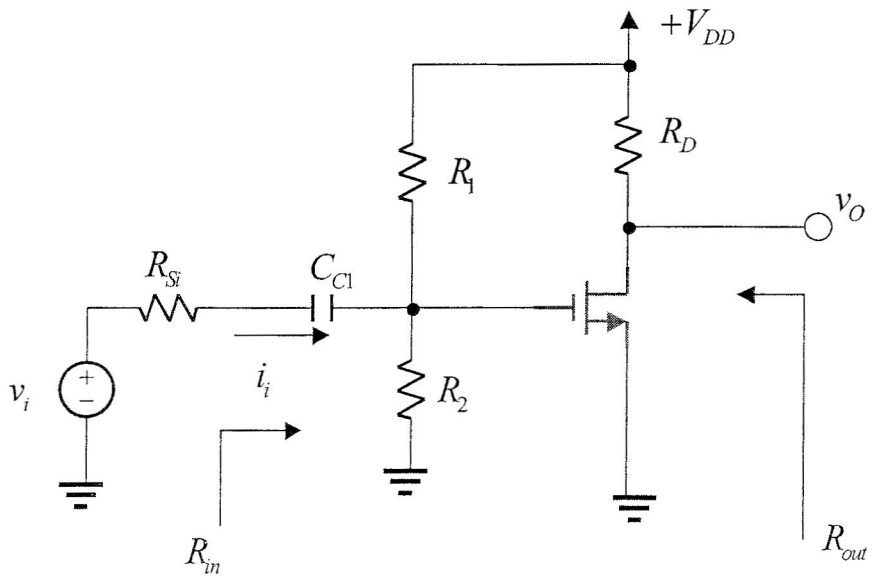

Fig. 6