

國立中央大學99學年度碩士班考試入學試題卷

所別：電機工程學系碩士班 固態組(一般生) 科目：電子學 共 2 頁 第 1 頁

電波組(一般生)

\*請在試卷答案卷(卡)內作答

\*本科考試禁用計算器

1. 計算題 (6 分)

In the circuit of Fig.1, we wish  $D_1$  to carry a current of 0.52 mA for  $I_x = 1.3$  mA. Determine the required saturation current  $I_s$  of  $D_1$ .

2. 繪圖題 (7 分)

Consider the circuit shown in Fig. 2, plot  $V_{out}$  as a function of  $V_{in}$ , assuming the diodes are ideal.

3. 計算題 (10 分)

Assume  $V_t = 0.4$  V,  $\mu_n C_{ox} = 200 \mu A/V^2$ , and  $\lambda = 0$  (or  $V_A = \infty$ ), compute  $W/L$  of  $M_1$  in Fig. 3 such that the device operates at the edge of saturation.

4. 問答題(15 分)

Please specify the corresponding configuration (common-emitter, common-base, or emitter-follower?) for each amplifier in Fig. 4. Assuming identical transistors in Fig. 4(a), Fig. 4(b), and Fig. 4(c), which  $R_{out}$  is the smallest? Which  $R_{in}$  is the smallest?

5. 計算題 (15 分)

Figure 5 shows a current-source circuit that is required to output a dc current  $I_O$  of 1 mA with  $V_{GS} = 0.8$  V. The MOSFET has  $V_t = 0.55$  V,  $V_A = 20$  V, and the body transconductance factor  $\chi = 0.2$ .

5-1 (10 分) Find the value of  $R_S$  that results in a current-source output-resistance of 200 k $\Omega$ .

5-2 (5 分) Determine the required dc voltage  $V_{BIAS}$ .

6. 計算題 (20 分)

Figure 6 shows a shunt-shunt feedback amplifier. The transistor has  $\beta = 100$ , and  $V_{BE} = 0.7$  V.

6-1 (10 分) Calculate the voltage gain  $v_o/v_s$ .

6-2 (5 分) Calculate the input resistance  $R_{in}$ .

6-3 (5 分) Calculate the output resistance  $R_{out} = R_{of}$ .

7. 計算題 (13 分)

Figure 7 shows a Wien-bridge oscillator having an ideal OA.

7-1 (7 分) Find the loop gain  $L(j\omega)$  in terms of  $\omega$ ,  $R$ ,  $R_1$ ,  $R_2$  and  $C$ .

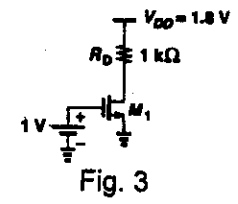
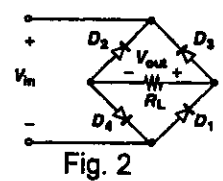
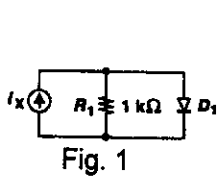
7-2 (6 分) For  $R = 12$  k $\Omega$ ,  $R_1 = 10$  k $\Omega$ , find  $R_2$  and  $C$  to obtain a sinusoidal oscillation at 30 kHz.

8. 計算題 (14 分)

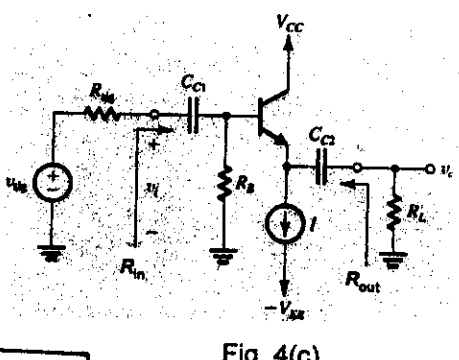
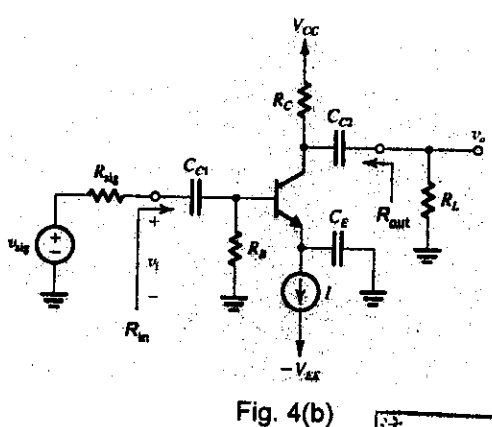
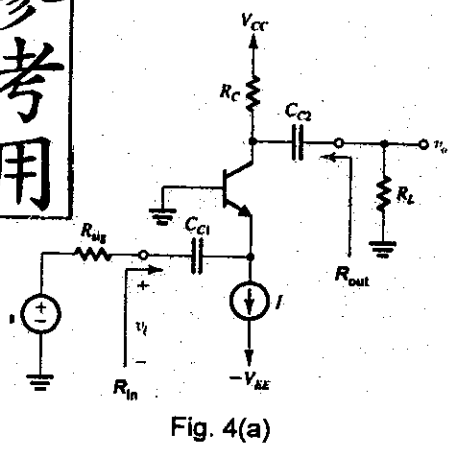
Figure 8 shows a CMOS logic circuit. Let  $n$  and  $p$  denote the  $(W/L)$  ratios of NMOS and PMOS transistors, respectively, of a basic inverter. Assume that for the basic inverter  $n = 1.5$  and  $p = 5$  and that the channel length is 0.25  $\mu$ m. For transistor  $Q_{NA}$ , the selected  $(W/L)$  ratio is equal to that of the NMOS transistor in the basic inverter:  $W/L = n = 1.5 = 0.375 \mu$ m / 0.25  $\mu$ m. Please provide the proper transistor  $(W/L)$  ratios of  $Q_{NB}$ ,  $Q_{NC}$ ,  $Q_{ND}$ ,  $Q_{PA}$ ,  $Q_{PB}$ ,  $Q_{PC}$ , and  $Q_{PD}$  for the shown logic circuit to have current-driving capability in both directions at least equal to that of the basic inverter.

Operation	NMOSFETs	PMOSFETs
Saturation	$I_d = k_n(V_{GS} - V_t)^2$	$I_d = k_p(V_{SD} + V_t)^2$
Triode	$I_d = k_n[2(V_{GS} - V_t)V_{DS} - V_{DS}^2]$	$I_d = k_p[2(V_{SD} + V_t)V_{SD} - V_{SD}^2]$
Transition Point	$V_{DS(tran)} = V_{GS} - V_t$	$V_{SD(tran)} = V_{SD} + V_t$
	$k_n = W\mu_n C_{ox} / 2L$	$k_p = W\mu_p C_{ox} / 2L$
Small signal parameters:	$g_m = 2\sqrt{k_n I_{DQ}}$ , $r_o = V_A / I_{DQ}$	

$e^2 = 7.4;$   
 $e^3 = 20;$   
 $e^{10} = 22026.5;$   
 $e^{20} = 4.85 \times 10^8;$   
 $e^{30} = 1.07 \times 10^{13}$



參考用



注意：背面有試題

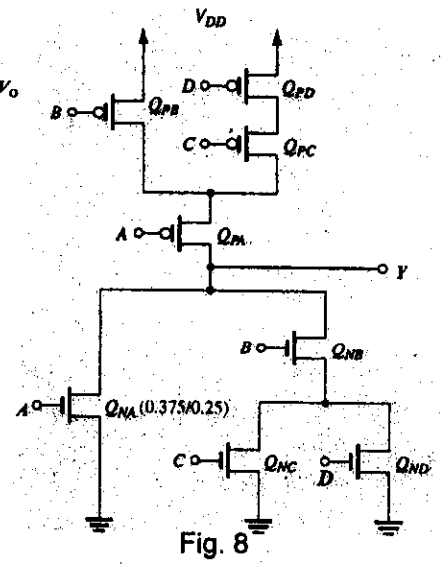
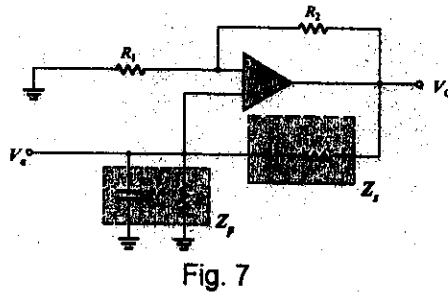
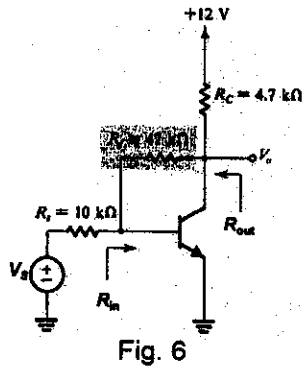
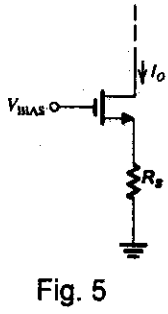
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