國立雲林科技大學
95學年度碩士班入學招生考試試題
系所：電子系
科目：電子學

1. The transfer function of filter circuit is given by $H(S) = \dfrac{20\,S}{S^2 + 20\,S + 10^4}$,

(10%) (a). Find ω_0, Q, and damping ratio.

(10%) (b). Sketch the gain Bode plot with detailed calculation.

2.

(3%)(a). In the Fig.1, find differential-mode gain, A_d, if $R_1 = R_1^*, R_2 = R_2^*, R_3 = R_3^*$

(7%)(b). In the Fig.1, find v_o if $R_1 \neq R_1^*, R_2 \neq R_2^*, R_3 \neq R_3^*$.

(7%)(c). In the Fig.1, explain that how to optimize common-mode rejection ratio if

$R_1 \neq R_1^*, R_2 \neq R_2^*, R_3 \neq R_3^*$ and R_3 is adjustable.

(3%)(d). In the Fig.2, find v_o.

3. A FET-based Colpitts oscillator is shown in Fig.3. The gate resistance is very large, C_G and C_S are very large coupling and bypass capacitors.

(15%)(a) Find the oscillation frequency if the high-frequency mall signal model is used.

(5%)(b) Find the started condition of oscillation.

4. A CMOS inverter is shown in Fig.4-1.

(4%)(a). The transfer curve of inverter is shown in Fig.4-2. Try to complete the Table 4-1.

		Operation region		Operation region
I	NMOS		PMOS	
II	NMOS		PMOS	
III	NMOS		PMOS	
IV	NMOS		PMOS	
V	NMOS		PMOS	

Table 4-1

(8%)(b). Assume $|V_{tn}| = |V_{tp}| = 1V$, $K_n = 4K_p = 100\dfrac{\mu A}{V}$ where V_{tn} and V_{tp} are threshold voltage of NMOS and PMOS, $K_n = \dfrac{1}{2}\mu_n C_{OX}(\dfrac{W}{L})_n$ and $K_p = \dfrac{1}{2}\mu_p C_{OX}(\dfrac{W}{L})_p$. Try to find V_{th}, V_A, V_B.

(4%)(c). Apply a 1MHz square wave swept between 0V and 5V to Vin and find average power consumption at Vout.

(4%)(d). In most real case, why $(\frac{W}{L})_n \neq (\frac{W}{L})_p$?

5. A CMOS feedback amplifier is shown in Fig.5. If the DC input voltage is zero, please calculate the following parameters:

(14%)(a) The overall gain $\frac{v_o}{v_i}$.

(6%)(b) The output resistance.

Use $\mu_n C_{OX} = 60\frac{\mu A}{V^2}$, $\mu_p C_{OX} = 30\frac{\mu A}{V^2}, V_{tn} = 0.8V, V_{tp} = -0.8V, \lambda = \frac{1}{V_A} = 0.03$. The dimensions of M1, M2, M6, M7, M8 are $\frac{W}{L} = \frac{40}{1}$ and M3, M4, M5 are $\frac{W}{L} = \frac{20}{1}$.

$(\sqrt{480000} = 692.82$ and $\sqrt{960000} = 979.8)$

國立雲林科技大學
95學年度碩士班入學招生考試試題

系所：電子系
科目：電子學

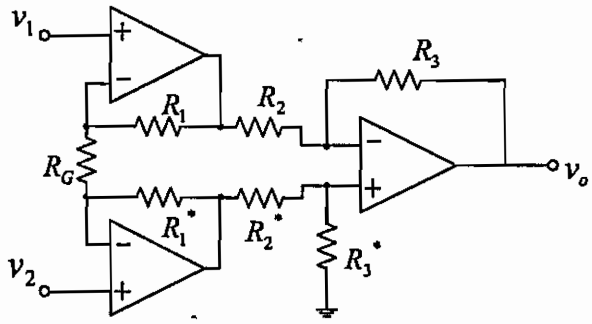

Fig.1

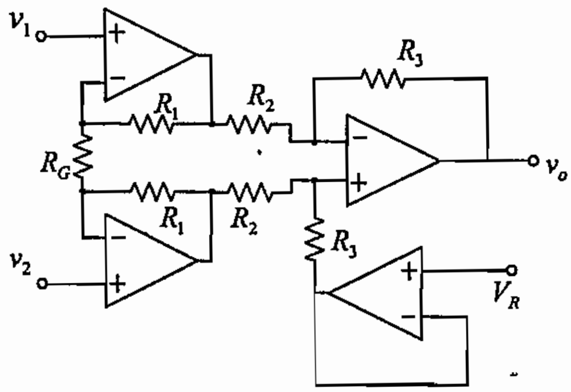

Fig.2

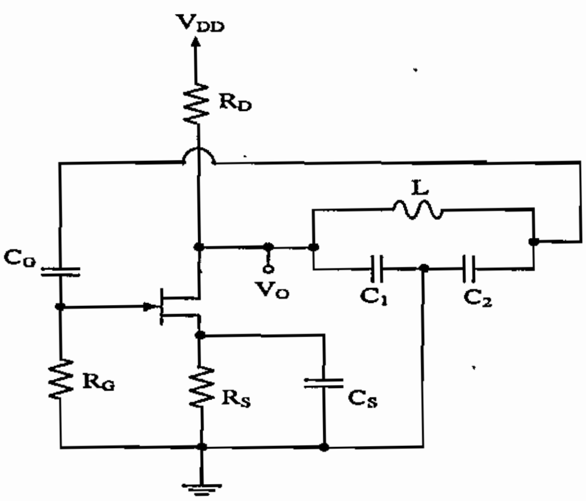

Fig.3

國立雲林科技大學
95 學年度碩士班入學招生考試試題

系所：電子系
科目：電子學

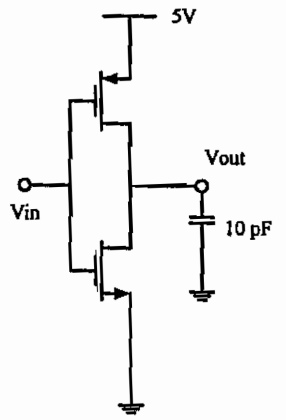

Fig. 4-1

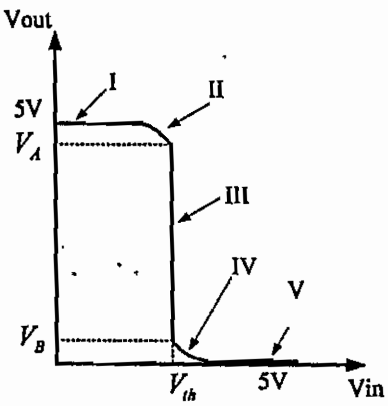

Fig. 4-2

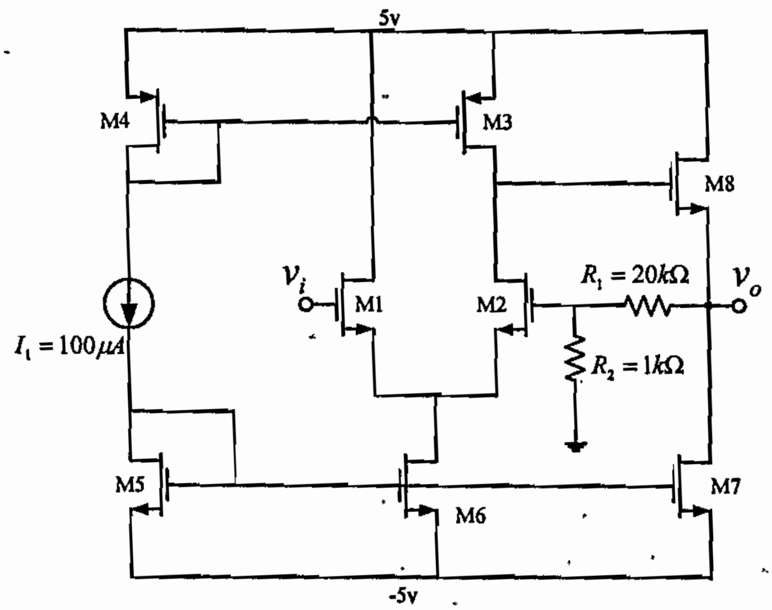

Fig. 5

國立雲林科技大學
95學年度碩士班入學招生考試試題

系所：電子系
科目：積體電路設計

1. Given the 4-variable K-map as Fig. P1, circuits the 1's and write the minimized expression. (10%)

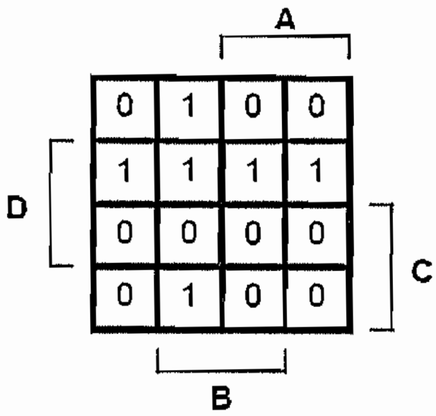

Fig. P1

2. (a) Using only one level of logic, draw the static CMOS circuit schematic for the function:

   $Z = \overline{[A(B + C) + DE + F]}$

   Draw your circuit in such a way that the number of transistor drains at the output node is minimized. (10%)

   (b) What is the logic gate function in Fig. P2 ? (5%)

   (c) Draw the static CMOS circuit schematic for the logic gate in Fig. P2. (5%)

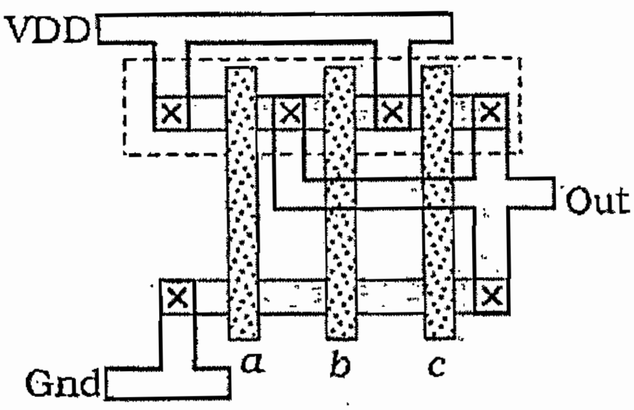

Fig. P2

3. A proposed edge-triggered D-type flip-flop is shown in Fig. P3. (The weak inverter has a weak PMOS and a weak NMOS.)

   (a) Is this a rising-edge triggered or falling-edge triggered flip-flop? (5%)

   (b) Is Z the true or the complement Q output? (5%)

   (c) For the 4 possible combinations (current value of Z, next D to be stored), state what will happen at node X and node Y during the evaluate phase.(10%)

current Z	next D	node X and Y during the evaluate phase

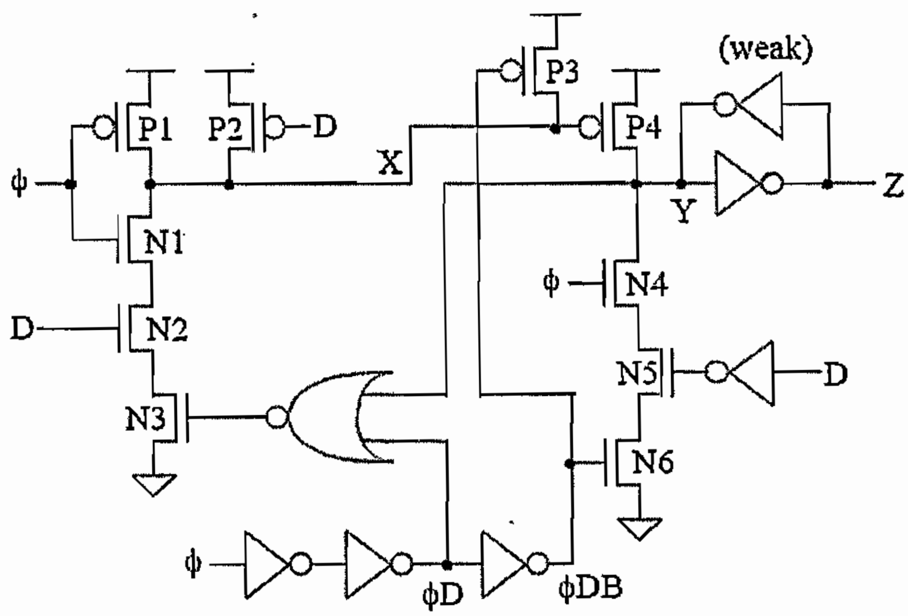

Fig. P3

國立雲林科技大學
95學年度碩士班入學招生考試試題
系所：電子系
科目：積體電路設計

4. For the amplifier given in Fig. P4, what is the small-signal voltage gain? All transistors are biased in the saturation region. Neglect the channel-length modulation and body effect. (10%)

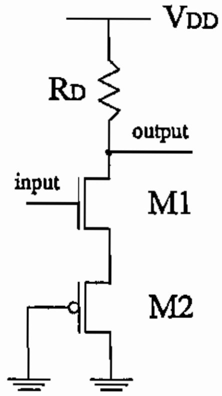

Fig. P4

5. An amplifier is shown in Fig. P5. The NMOS transistor is biased in the saturation region. Neglect the channel-length modulation effect. Find the transresistance gain $\frac{v_{out}}{i_{in}}$. (20%)

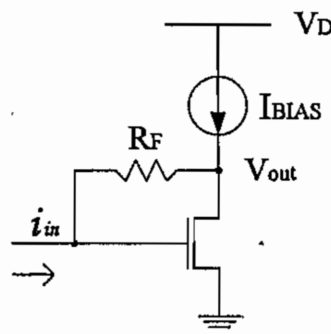

Fig. P5

6. For the circuit given in Fig. P6, M1 is an NMOS transistor and A is an operational amplifier. $V_{GS} = 0.67V$, $R1 = 10k\Omega$, $R2 = 6k\Omega$, $R3 = 2k\Omega$. Please calculate I_{DS} of M1. (20%)

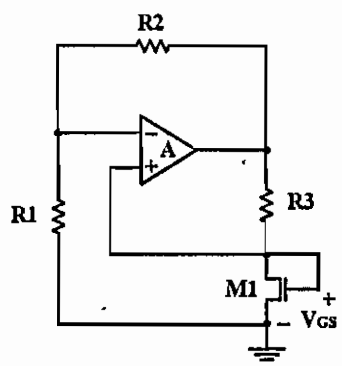

Fig. P6

國立雲林科技大學
95 學年度碩士班入學招生考試試題

系所：資工所、電子系
科目：線性代數

1. Three vectors $\vec{b}$, $\vec{v}_1$ and $\vec{v}_2$ are in $\mathbb{R}^3$. (10%)
   (a) What's the condition that $\vec{b}$ is called linear combination of the vectors $\vec{v}_1$ and $\vec{v}_2$? (5%)
   (b) Is the vector $\begin{bmatrix}-3 & 0 & 3\end{bmatrix}^T$ a linear combination of $\begin{bmatrix}1 & 2 & 3\end{bmatrix}^T$ and $\begin{bmatrix}4 & 5 & 6\end{bmatrix}^T$? (5%)

2. $\mathbf{V}_i$ are sets in the vectors space $\mathbb{R}^3$. (10%)

$$\mathbf{V}_1 = \{(x_1, x_2, x_3) \mid x_2 \geq 0\},$$
$$\mathbf{V}_2 = \{(x_1, x_2, x_3) \mid x_1 = x_2 = 2x_3\},$$

   (a) State the requirements of a set can be a subspace. (5%)
   (b) Whether $\mathbf{V}_i$ are subspaces of the vectors space $\mathbb{R}^3$. (5%)

3. Let T be a linear transformation form $\mathbb{R}^2$ to $\mathbb{R}^2$ that projects any vector orthogonally onto the line L spanned by the vector $\begin{bmatrix}4 & 3\end{bmatrix}^T$. (15%)
   (a) Find the eigenvalues and their corresponding eigenvectors for T. (10%)
   (b) By using the eigenvectors you found in (a) as the basis, find a transformation matrix **A** for T. (5%)

4. A linear system is as following: (15%)

$$\mathbf{A}\vec{x} = \vec{b}, \text{ where } \mathbf{A} = \begin{bmatrix}1 & -1 \\ 1 & 3 \\ 1 & 3 \\ 1 & -1\end{bmatrix} \text{ and } \vec{b} = \begin{bmatrix}-2 \\ 0 \\ 0 \\ -2\end{bmatrix}$$

   (a) Find an orthonormal basis $\{\vec{u}_1, \vec{u}_2\}$ of im(A), where im(A) is the image of A. (5%)
   (b) To find the least-square solution $\vec{x}^*$ of the system. (5%)
   (c) Graph the geometric relationship among $\mathbf{A}\vec{x}^*$, im(A), and $\vec{b}$. (5%)

國立雲林科技大學
95學年度碩士班入學招生考試試題
系所：資工所、電子系
科目：線性代數

5. The color of light can be represented in a vector $\begin{bmatrix} R \\ G \\ B \end{bmatrix}$, where R = amount of red, G = amount of green, and B = amount of blue. The human eye and the brain transform the incoming signal into the signal $\begin{bmatrix} I \\ L \\ S \end{bmatrix}$, where intensity $I = \dfrac{R+G+B}{3}$ (10%)

long-wave signal $L = R - G$

short-wave signal $S = B - \dfrac{R+G}{2}$.

(a) Find the matrix P representing the transformation from $\begin{bmatrix} R \\ G \\ B \end{bmatrix}$ to $\begin{bmatrix} I \\ L \\ S \end{bmatrix}$. (5%)

(b) Consider a pair of yellow sunglasses for water sports that cuts out all blue light and passes all red and green light. Find the 3 × 3 matrix A that represents the transformation incoming light undergoes as it passes through the sunglasses. (5%)

6. Consider the linear transformation $T(f) = f' + f''$ from P_2 to P_2, where P_2 is the set of all polynomials of degree ≤ 2. Please find a 3 × 3 matrix B for this linear transformation T. Note that f' and f'' are the first order and second order derivatives of f, respectively. (10%)

7. Find the derivative of the function (10%)

$$f(x) = \det\begin{bmatrix} 1 & 1 & 2 & 3 & 4 \\ 9 & 0 & 2 & 3 & 4 \\ 9 & 0 & 0 & 3 & 4 \\ x & 1 & 2 & 9 & 1 \\ 7 & 0 & 0 & 0 & 4 \end{bmatrix}.$$

8. Find an orthogonal matrix S and a diagonal matrix D such that $S^{-1}AS = D$. (10%)

$$A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$$

9. Let L be a lower triangular 3 × 3 matrix with positive entries on the diagonal. Please find L such that $A = LL^T$, where $A = \begin{bmatrix} 4 & -4 & 8 \\ -4 & 13 & 1 \\ 8 & 1 & 26 \end{bmatrix}$. (10%)