國立雲林科技大學
96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.(10%)(a) In the class-A power stage of Fig. P1(a). Please derive the equation of maximum power efficiency, $\eta = \frac{P_{ac}}{P_S}$, where P_S is the power delivered by the dc power and P_{ac} is the ac power that can be delivered to the load.

(5%)(b) In the class-A power stage of Fig. P1(b). What is the function of R_E and derive the equation of maximum power efficiency again.

(15%)(c)Please describe the behavior of circuit in Fig. P1(c), and find the T_{OS}.
(Hint: Initial condition is T_2 on and T_1 off)

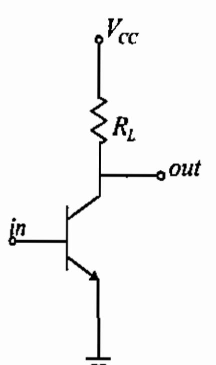

Fig. P1(a)

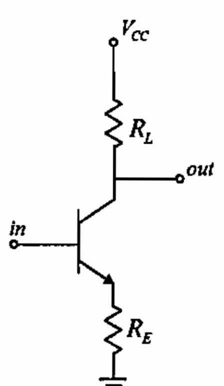

Fig. P1(b)

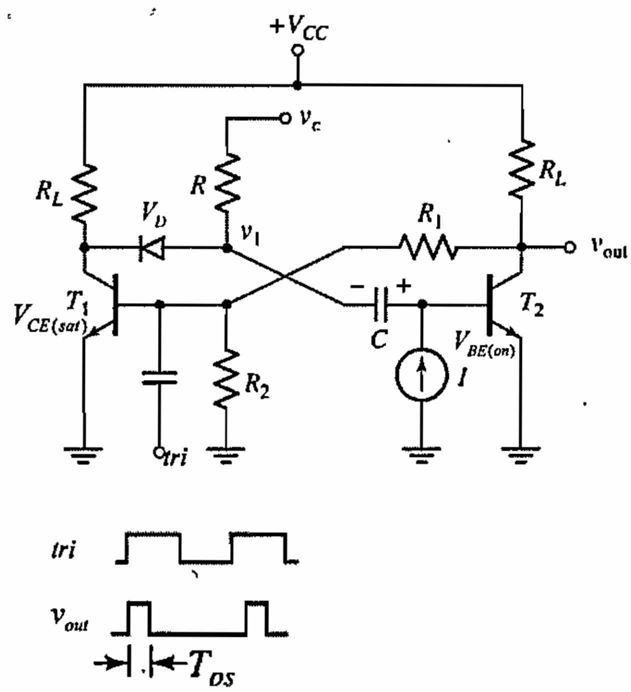

Fig. P1(c)

2.(10%)Consider the amplifier shown in Fig.P2, where $R_D = 1k, R_F = 10k$, $gm1 = gm2 = 0.01, C_A = C_X = C_Y = 100fF$. Neglecting all other capacitances, compute the phase margin of the circuit.

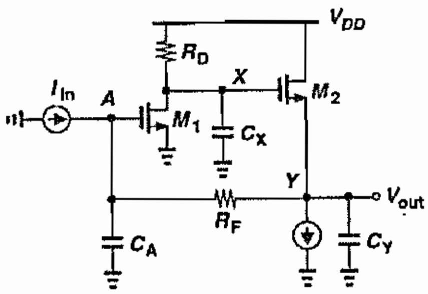

Fig. P2

3.(10%)Derive the transfer function of circuit shown in Fig. P3, roughly sketch its frequency response, and find the resonant frequency, ω_0, and quality factor, Q.

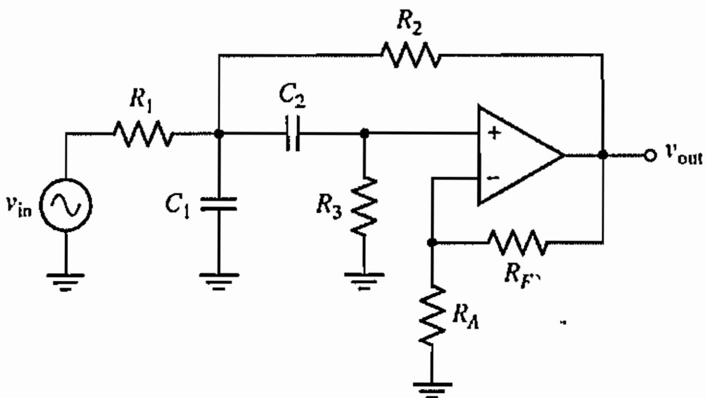

Fig. P3

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4. $\mu_n C_{ox} = 60\mu A/V^2$, $\lambda_n = 0.1V^{-1}$, $(\frac{W}{L})_{M1} = 10$, $V_{DD} = 5V$, $R_D = 100k\Omega$, and $V_{tn} = 0.7V$. The DC or bias voltage of the input is 1V. μ is the carrier mobility. C_{ox} is the gate-oxide capacitance. λ is the channel-length modulation coefficient. $(\frac{W}{L})$ is the aspect ratio of MOSFET. V_t is the threshold voltage.

(5%) (a) Calculate g_m. (transconductance)

(5%) (b) Calculate low-frequency small-signal voltage gain.

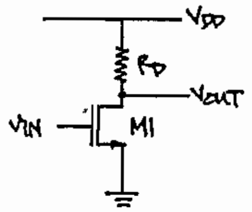

Fig.P4

5. (20%) $\mu_n C_{ox} = 60\mu A/V^2$, $\mu_p C_{ox} = 30\mu A/V^2$, $\lambda_n = 0.5V^{-1}$, $\lambda_p = 0.5V^{-1}$, $(\frac{W}{L})_{M1} = 100$, $(\frac{W}{L})_{M2} = 12$, $\gamma_n = 0.4V^{1/2}$, $|2\phi_F| = 0.7V$, $V_{IN} = 4V$, $V_B = 1.5V$, $V_{DD} = 5V$, $R_D = 100k\Omega$, and $V_{tn_0} = |V_{tp_0}| = 0.7V$. The current source I_0 consumes a voltage legroom of 0.5V. Please calculate the low-frequency small-signal voltage gain. γ is the body effect coefficient of MOSFET.

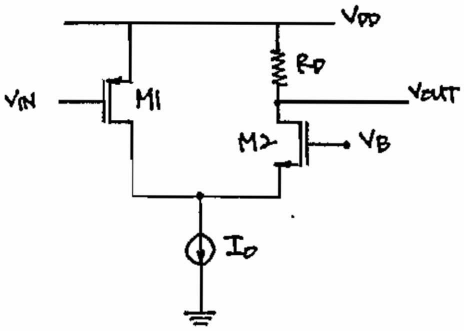

Fig.P5

6. (20%) $\mu_n C_{ox} = 60\mu A/V^2$, $\mu_p C_{ox} = 30\mu A/V^2$, $\lambda_n = 0V^{-1}$, $\lambda_p = 0V^{-1}$, $V_{IN} = 1.7V$, $V_B = 3.3V$, $V_{OUT} = 3V$, $V_{DD} = 5V$, $(\frac{W}{L})_{M1} = 10$, $(\frac{W}{L})_{M2} = 2.4$, $(\frac{W}{L})_{M3} = 16$, and $V_{tn_0} = |V_{tp_0}| = 0.7V$. What is the low-frequency small-signal voltage gain of the amplifier?

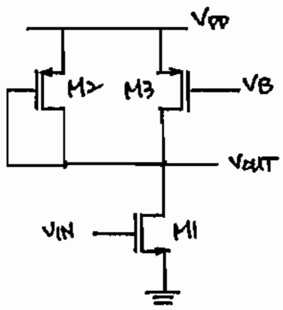

Fig.P6

國立雲林科技大學
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系所：電子系
科目：積體電路設計

本試題共6題，第1題及第5題每題10分，其餘每題20分，共計100分，請依題號作答並將答案寫在答案卷上，違者不予計分。

1. On the layout diagram Fig.1, indicate the metal connections required to create a complex CMOS logic gate implementing the function $F = \overline{AB + C + D}$. (10pt)

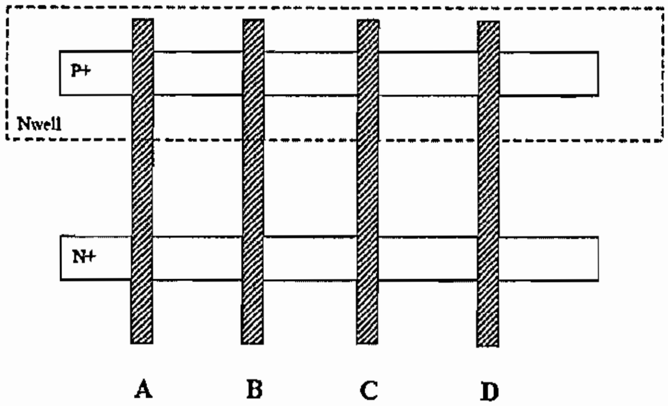

Fig. 1

2. For the following questions, choose the **best** response. (20pt)

(I) The input to a VLSI block is 01110011. If the output is 10111001, then the block's function is: (a)Rotate Left (b) Rotate Right (c) Shift Left (d) Shift Right (e) Barrel Shift

(II). If both a NAND gate and a NOR gate are made with ALL minimum size MOSFETs, which will have the faster rise time? (a) NAND (b) NOR (c) Same (d) Indeterminate

(III). If both a NAND gate and a NOR gate are made with ALL minimum size MOSFETs, which will have the larger mid-point voltage for simultaneous switching? (a) NAND (b) NOR (c) Same (d) Indeterminate

(IV) Compared to a ripple carry adder, the area of a carry look ahead adder is : (a) Larger (b) Smaller (c) Same (d)Indeterminate

(V) If the spacing between NMOS and PMOS FETs in a output pad is decreased, the probability of latch-up will : (a) Increase (b)Decrease (c) No Change (d) Indeterminate

3. Sketch 2-input NOR gates built using: (a) clocked CMOS logic, (b) domino logic, (c) pseudo-NMOS logic, (d) CVSL logic (20pt)

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4. Explain why NMOS pass **weak high** and **strong low**, and PMOS pass **weak low** and **strong high**. Use the circuits shown in Fig. 5-1 and Fig. 5-2 to help your answers. (20pt)

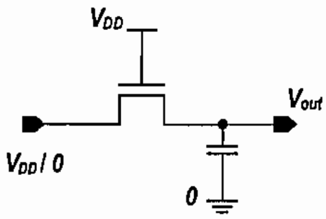

Fig. 5-1

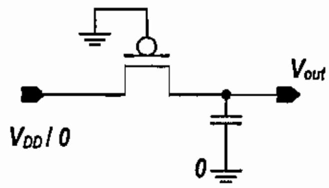

Fig. 5-2

5. Show the Boolean function of Fig. 6-1 and Fig. 6-2. (10pt)

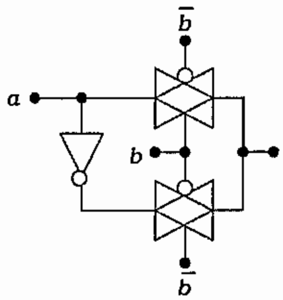

Fig. 6-1

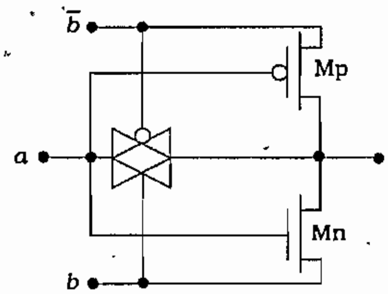

Fig. 6-2

6. Explain following terms: (a) Moore's Law, (b) SoC, (c) Body Effect, (d) LDD MOSFET. (e) DRC, ERC, LVS. (20pt)

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系所：資工所、電子系
科目：線性代數

1. If $x_1, x_2, \ldots, x_n$ are numbers, then show by induction that

$$\begin{vmatrix} 1 & x_1 & \cdots & x_1^{n-1} \\ 1 & x_2 & \cdots & x_2^{n-1} \\ & & \cdots & \\ 1 & x_n & \cdots & x_n^{n-1} \end{vmatrix} = \prod_{i<j}(x_j - x_i),$$

the symbol on the right meaning that it is the product of all terms $x_j - x_i$ with $i<j$ and i, j integers from 1 to n. (10%)

2. Determine the sign of the following permutations. At the same time, write the inverse of the permutation. (10%)

(a) $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{bmatrix}$; (b) $\begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 1 & 4 & 3 \end{bmatrix}$.

3. Compute the eigenvalues of the following matrix in complex numbers. (10%)

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

4. Let $X_1 = \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}$, $X_2 = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$, and $X_3 = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$. Please get an orthonormal base for $\{X_1, X_2, X_3\}$. (10%)

5. Let $A = \begin{bmatrix} 1 & 4 & -2 \\ 0 & 2 & 3 \\ 4 & -1 & 1 \end{bmatrix}$. Please get the adjoint of **A** (*adj***A**). (Note that if **A** is a $n \times n$ square matrix, then $A \bullet adjA = adjA \bullet A = \det A \bullet I_n$.) (10%)

6. Give 5 statements that are equivalent to a square $n \times n$ matrix being invertible. (10%)

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7. Let a transformation T

$$T\begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} = \begin{bmatrix} 2x_2 - x_1 - 2x_3 \\ x_1 - x_2 \end{bmatrix}$$

(a) (5%) Show that T is a linear transformation.

(b) (5%) Find the transformation matrix of T with respect to the standard basis.

(c) (10%) Find an orthonormal basis for the kernel of the matrix of T, ker(T). Give the orthogonal decomposition of the vector $\begin{bmatrix} 1 & 1 & -1 \end{bmatrix}^T$ with respect to ker(T).

8. Suppose $\mathbf{u}$, $\mathbf{v}$, and $\mathbf{w}$ are linearly independent vectors. Show that $\mathbf{u}$, $\mathbf{u}+\mathbf{v}$, and $\mathbf{u}+\mathbf{v}+\mathbf{w}$ are linearly independent. (10%)

9. Let T is a transformation from $\mathbf{R}^2$ to $\mathbf{R}^2$ and

$$T\left(\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}\right) = \begin{bmatrix} x_1\cos\theta - x_2\sin\theta \\ x_1\sin\theta + x_2\cos\theta \end{bmatrix} = \mathbf{Ax}$$

(a) (5%) Find the inverse transformation of T.

(b) (5%) Use the inverse transformation found in (a) to solve the system given by

$\mathbf{Ax} = \mathbf{b}$ where $\mathbf{b} = \begin{bmatrix} 1 & -1 \end{bmatrix}^T$ and $\theta = \pi$.