國立雲林科技大學
101學年度碩士班暨碩士在職專班招生考試試題

系所：電子光電所
科目：工程數學(3)

1. Assumed that the uniform ice ball has a volume 1000 cm^3, its melting rate is proportional to its surface area. After one minute, the volume of the ice ball deceased to be 729 cm^3. How long will it takes that the volume is 125 cm^3. (15%)

2. The given equation: $(-xy\sin x + 2y\cos x)dx + 2x\cos x\,dy = 0$
   (a) Verify the D.E. is not exact. (3%)
   (b) Find the integrating factor u(x.y). (6%)
   (c) Find the solution of the D.E. (6%)

3. Given the equation $x^2y'' - 3xy' + 3y = 2x^4e^x$ find the general solution.(10%)

4. If the equation $f(t) = -1 + \int_0^t f(t-\alpha)e^{-3\alpha}\,d\alpha$, find $f(t)$ by Laplace Transformer. (10%)

5. Perform the indicated operation, give that

$$A=\begin{bmatrix}1 & 0 & -1\\ 2 & 3 & 1\end{bmatrix} \quad B=\begin{bmatrix}1 & 2 & 0\\ 0 & 4 & 3\end{bmatrix} \quad C=\begin{bmatrix}0 & 1\\ -1 & 0\\ 2 & 1\end{bmatrix}$$

   (a) (2A+B)C (b) If $2X+3(A-B)=0$, Find X. (10%)

6. If $A=\begin{bmatrix}4 & 0\\ 2 & -4\end{bmatrix}$, Please find A^2 and A^n. (10%)

7. $$A=\begin{bmatrix}2 & 0 & -2\\ 0 & 4 & 0\\ -2 & 0 & 5\end{bmatrix}$$

   (a) Find eigenvalues and eigenvectors of A.
   (b) Prove that these eigenvector are independent and orthogonal.
   (c) compute $-A^3+11A^2-34AI+30$ (15%)

8. If $\vec{A}=2\vec{i}+3\vec{j}-\vec{k}$, $\vec{B}=-\vec{i}+3\vec{j}+\vec{k}$, Find (a) $\vec{A}\bullet\vec{B}$ (b) $\vec{A}\times\vec{B}$ (c) The projection of $\vec{A}$ on $\vec{B}$ (15%)

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科目：電子學(2)

1. (a)(5%)

Figure 1(a) shows the equivalent circuit of an amplifier. Please derive the voltage gain V_o/V_s of amplifier as a function of frequency.

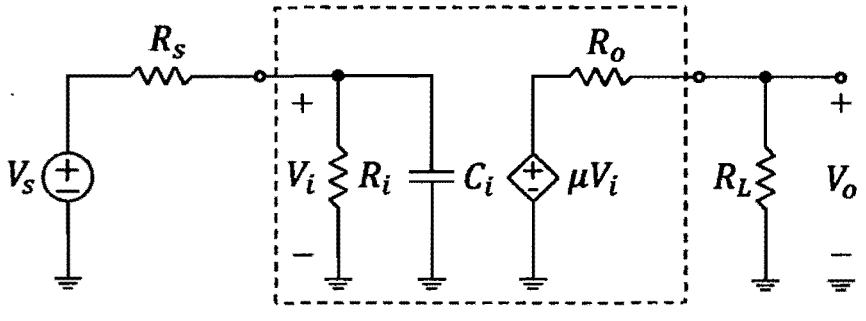

Fig. 1(a)

(b)(10%)

Figure 1(b) shows the bias circuit. Please derive DC voltage V_{REF}.

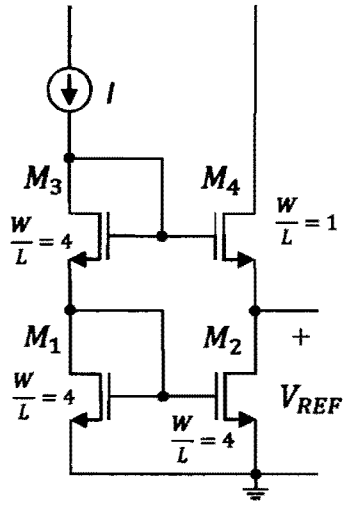

Fig. 1(b)

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2. Figure 2 illustrates an application of op-amp. Assume that the op-amp is ideal.
   (a)(5%) Find the resistances looking into node 1 to node 4, R_1 to R_4.
   (b)(5%) Find the currents I_1, I_2, I_3, and I_4 in terms of the input current I.

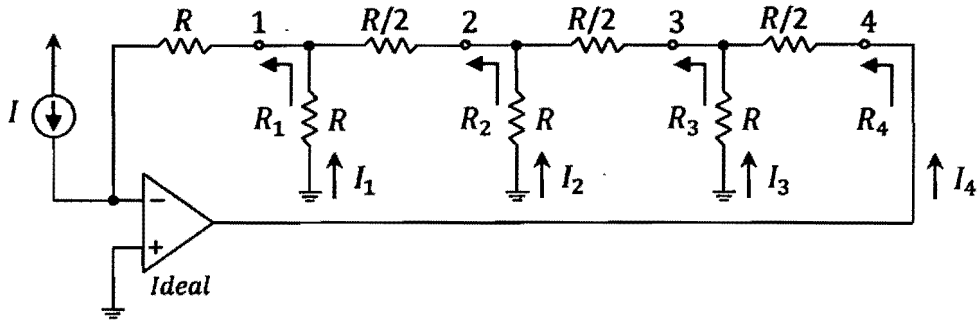

Fig. 2

3. Figure 3 shows an output amplifier. Assume that v_{IN} sweeps from -2.5V to +2.5V. Let $K_p' = 50\mu A/V^2$, $V_{tp} = -0.7V$, and $\lambda_p = 0.05V^{-1}$. Ignore bulk effects.
   (a)(5%) Find the maximum value of v_{OUT}.
   (b)(10%) Find the minimum value of v_{OUT}.
   (c)(10%) Find the positive and negative slew rate, SR+ and SR-, when v_{OUT}=0V.

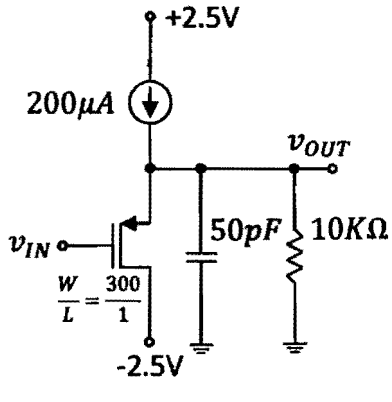

Fig. 3

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4. For the circuits in Fig. 4, $\mu_n Cox = 2.5\ \mu_p Cox = 20\ \mu A/V^2$, $|V_t| = 1$ V, $\lambda = 0$, $\gamma = 0$, $L = 10\ \mu m$ and $W = 30\ \mu m$.

(a)(10%) Find I_a and V_a in Fig. 4 (a).

(b)(10%) Find I_b and V_b in Fig. 4 (b).

(c)(10%) Find I_c and V_c in Fig. 4 (c) with $L = 10\ \mu m$ and $W = 75\ \mu m$ for M_5.

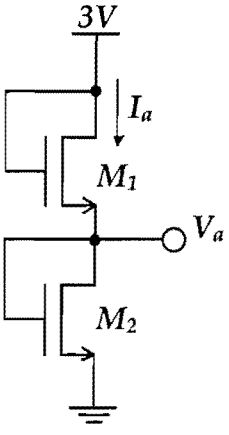

Fig. 4(a)

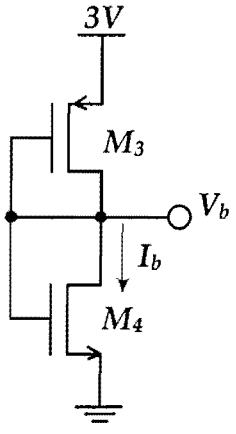

Fig. 4(b)

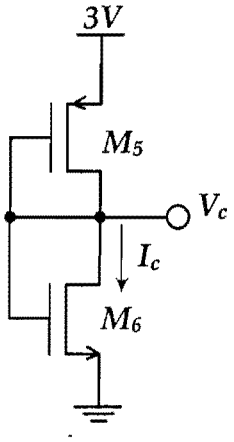

Fig. 4(c)

5. In the circuit of Fig. 5, transistor M_1 and M_2 have $V_t = 0.5$ V, and the process transconductance parameter $k_n' = 50\ \mu A/V^2$. Assuming $\lambda = 0$, find V_1, V_2 , and V_3 for each of the following cases:

(a)(4%) $(W/L)_1 = (W/L)_2 = 20$

(b)(4%) $(W/L)_1 = 2\ (W/L)_2 = 10$

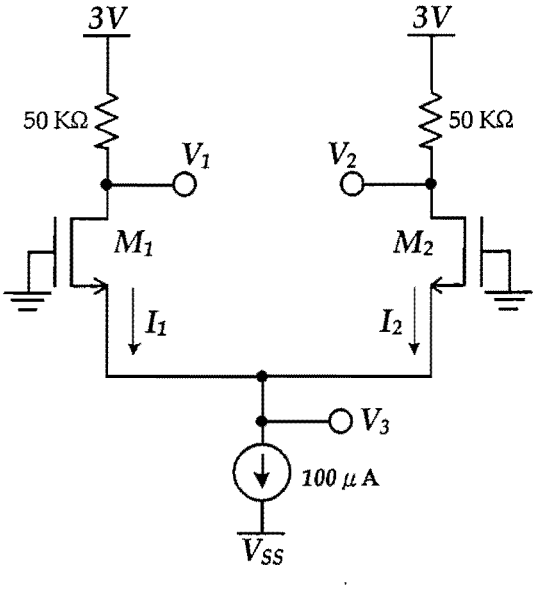

Fig. 5

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6. The shunt-shunt feedback amplifier in Fig. 6 has I = 1 mA and V_{GS} = 0.8 V. The MOSFET has V_t = 0.6 V and V_A = 30 V. For R_s = 10 KΩ, R_1 = 1 MΩ, and R_2 = 4.7 MΩ,

(a)(4%) find the voltage gain v_O/v_s.

(b)(4%) find the input resistance R_{in}.

(c)(4%) find the output resistance R_{out}.

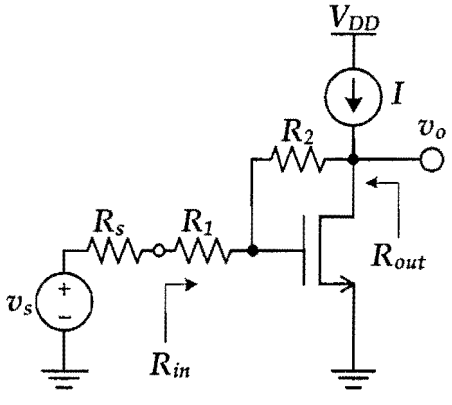

Fig. 6

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系所：電子光電所
科目：計算機組織(1)

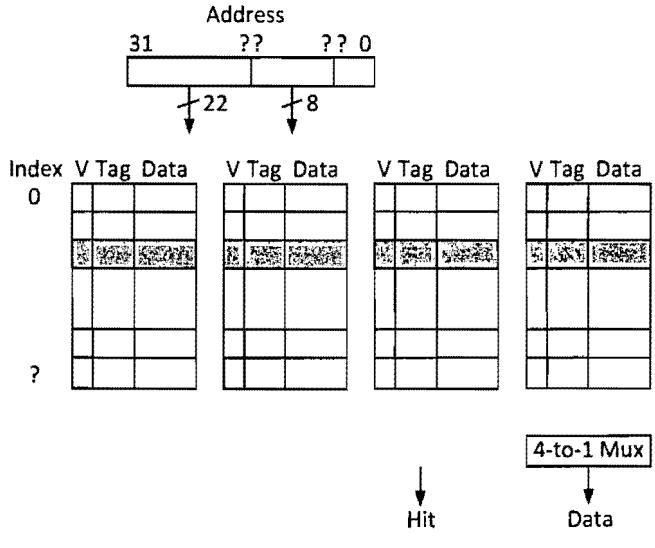
1. Number system conversion (10%)
   (a) Binary to octal number : $(10010001101011.110100000110)_2 = (\ ?\ )_8$
   (b) Hexadecimal to binary number : $(316.C)_{16} = (\ ?\ )_2$
   (c) Please find the 1's complement of $(1001000)_2 = (\ ?\ )$
   (d) Please find the 10's complement of $(243700)_{10} = (\ ?\ )$
   (e) Binary number to Gray Code: $(1011001)_2 = (?)$

2. Explain the following abbreviations. (10%)
   (a) RISC (3%)
   (b) CISC (3%)
   (c) VLIW (2%)
   (d) SIMD (2%)

3. Design and draw the schematic of a 4-bit carry lookahead adder. (10%)

4. Trace the Booth's algorithm step b y step for the multiplication of 3x(-6). (10%)

5. Complete the following figure for implementation of a four-way set-associative cache with four comparators and a 4-to-1 multiplexor. (10%)



6. Given the memory values below and a one address machine with an accumulator, what values do the following instructions load into the accumulator? (10%)
   - Memory word 20 contains 40
   - Memory word 30 contains 50

- Memory word 40 contains 60
- Memory word 50 contains 70.

(a) LOAD IMMEDIATE 20
(b) LOAD DIRECT 20
(c) LOAD INDIRECT 20
(d) LOAD IMMEDIATE 30
(e) LOAD DIRECT 30
(f) LOAD INDIRECT 30

7. For the 16 bit binary number 1001 0101 1100 0011, show the effect of (10%)
   (a) A right shift of 4 bits with zero fill
   (b) A right shift of 4 bits with sign extension
   (c) A left shift of 4 bits
   (d) A left rotate of 4 bits
   (e) A right rotate of 4 bits.

8. Consider each instruction has 5 stages in a computer with pipelining techniques. Each stage takes 4ns. (10%)
   (A) What is the maximum number of MIPS that this machine is capable of with 5-stage pipelining techniques?
   (B) What is the maximum number of MIPS that this machine is capable of in the absence of pipelining?
   (C) From the above questions (A) and (B), we can know that the pipelining allows a tradeoff between latency and processor bandwidth. Please explain what is latency and what is bandwidth?

9. There are two computers A and B with the following performance information. (10%)
   Computer A: Cycle time = 250 ps, Cycle per instruction = 2.0
   Computer B: Cycle time = 600 ps, CyclE per instruction = 1.2
   If both computers have the same instruction set architecture, which computer is faster? How many times is one faster as the other?

10. Computer A has 2GHz clock. It takes 10s CPU time to finish one given task. We want to design Computer B to finish the same task within 5s CPU time. The clock cycle number for Computer B is 2 times that of Computer A. So, what clock rate should be designed for Computer B? (10%)

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系所：電子光電所
科目：半導體元件

1. Explain or define the following terms:
   (a) Ionization energy of acceptors in a semiconductor (5%)
   (b) Mobility of charge carriers (5%)
   (c) Fermi energy level in a semiconductor (5%)
   (d) Effective mass of electrons (5%)

2. Make a comparison between the p-type and the n-type semiconductors. (15%)

3. Describe the effects of the dopant concentrations on the built-in potential of a p-n junction diode. (15%)

4. Draw the typical log(J)-V characteristics of an ideal pn diode and indicate the current components from reversed- to forward-biases . (15%)

5. The charge distribution in a device is showed in Fig. 1, where $Q_1+Q_2=Q_3$. Draw the curves of electric field vs. distance and electric potential vs. distance. (20%)

6. Explain (a) flat band voltage, (b) fixed oxide charge and (c) surface potential. (15%)

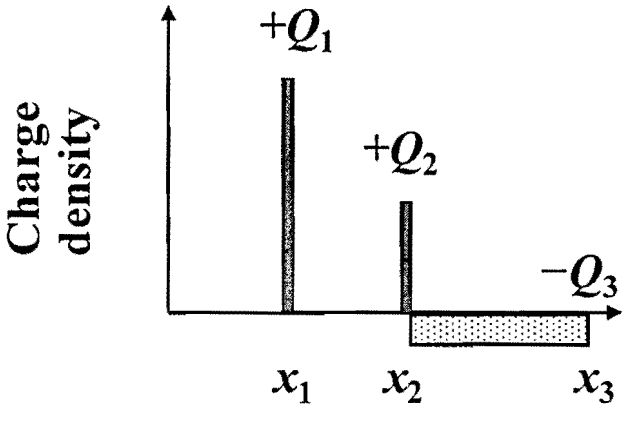

Fig.1

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系所：電子光電所
科目：電磁學

1. Suppose a propagating electric field is given by
$E(z, t) = 34e^{-0.002z}\cos(2\pi\times10^9 t - 10\pi z + 45°)$ V/m. Find
(a) the initial amplitude, (b) the attenuation constant, (c) the wave frequency,
(d) the wavelength and (e) the phase shift in radians, including the unit. (15%)

2. (a) Find out the integral $\int\frac{dx}{(x^2+a^2)^{3/2}}$ (5%)

(b) A segment of line charge ρ_L = 10 nC/m exists on the x-axis from x = -3.0 m to x = +3.0 m. Determine **E** at the point (0.0, 3.0, 0.0)m. (12%)

3. (a) Find the inductance per unit length (L/h) internal to a solid conductive wire with radius a, and with current I distributed evenly over the cross section. (6%)
(b) A coaxial cable (coax) consists of a pair of cylindrical metallic shells of inner radius a and outer radius b. Determine the inductance per unit length (L/h) of the coax. (6%)
(c) Consider a coaxial cable with solid inner conductor of radius a and a conductive outer shell at radius b, filled with nonmagnetic material (μ_r = 1). Find the total inductance per unit length (L/h). (6%)

4. The magnetic flux density increases at the rate of 10 Wb/m^2/s in the z direction. A 10×10 cm square conducting loop, centered at the origin in the x-y plane, has 10 Ω of distributed resistance. Determine the direction (with a sketch) and magnitude of the induced current in the conducting loop. (12%)

5. Find $\bar{H}$, if a uniform current density $\bar{J} = \hat{a}_z J_0(\text{A/m}^2)$, or a vector magnetic potential

$\bar{A} = \hat{a}_z \frac{-\mu_0 J_0}{4}(x^2 + y^2)(\text{Wb/m})$ are given. (12%)

6. If $\bar{D} = 2r\hat{a}_R C/m^2$, find the total electric flux leaving the surfaces of the cube where $0 < x, y, z < 0.4$m. (10%)

7. What are the Maxwell equations in integral form? (8%)

8. The surface x = 0 separates two perfect dielectrics (no free charge). For x > 0, let ε_{r1} = 3, while ε_{r2} = 5 where x < 0. Find $\bar{D}_2$, for x < 0, if $\bar{E}_1 = 80\hat{a}_x - 60\hat{a}_y - 30\hat{a}_z$ V/m for x > 0. (8%)