國立雲林科技大學 110 學年度 碩士班招生考試試題

系所：電子系

科目：工程數學(3)

1. (15%) Please solve for $y = y(x)$.

   (a) $y' + 2y + 5 = 0$ (5%)

   (b) $y'' - 6y' + 10y = 0$ (5%)

   (c) $x^2y'' - xy' - 2y = 0$ (5%)

2. (15%) Find the integration factor and solution of the ODE equation $(e^{x+y} + ye^{y})dx + (xe^{y} - 1)dy = 0$

3. (10%) Solve ODE solution of $y'' - 6' + 9y = \dfrac{e^{3x}}{x^2}$

4. (10%) Laplace equation:

   (a) If $f(t) = 5 - 3e^{-4t} + 2t^3$, t≧0, please find $L[f(t)]$

   (b) $F(S) = \dfrac{1}{(S+2)(S+3)}$, please find $L^{-1}[F(S)]$。

5. (10%) Find all solutions of the system

$$\begin{aligned} x + 2y + 3z &= a \\ x + 3y + 8z &= b \\ x + 2y + 2z &= c \end{aligned}$$

   where a, b and c are arbitrary constants.

6. (25%) Let T be the linear transformation with respect to the standard basis and its transformation matrix $\mathbf{A}$ is as follows,

$$\mathbf{A} = \begin{bmatrix} 1/2 & -1/2 \\ -1/2 & 1/2 \end{bmatrix}$$

   (a) (10%) Find a vector $\mathbf{v}_1$ that spans the kernel of T and a vector $\mathbf{v}_2$ that spans the image of T.

   (b) (05%) Let $\mathcal{B}$ be the basis consisting of $\mathbf{v}_1$ and $\mathbf{v}_2$ that you found in (a). Find the new transformation matrix of T with respect to the basis $\mathcal{B}$.

   (c) (05%) Describe the transformation T geometrically and explain the reason that $\mathbf{A}$ is not invertible.

   (d) (05%) Prove $\lim_{n\to\infty} \mathbf{A}^n = \begin{bmatrix} 1/2 & -1/2 \\ -1/2 & 1/2 \end{bmatrix}$.

7. (15%) Using least squares to fit a linear function of the form $f = c_0 + c_1 t$ to the following data points (x, y): $(0,3)$, $(1,3)$ and $(1,6)$

   (a) (10%) Find f.

   (b) (05%) Find the least square error.

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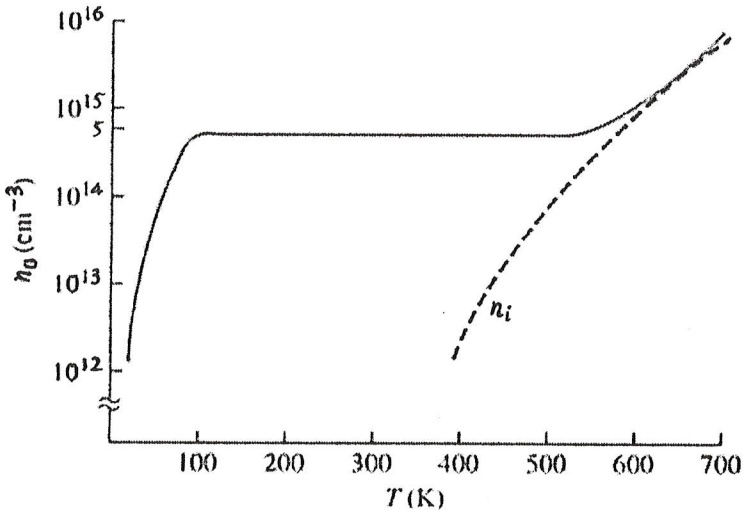
系所：電子系

科目：半導體元件

$h = 6.63 \times 10^{-34}$ J-s, $k = 8.62 \times 10^{-5}$ eV/K, $m_e = 9.11 \times 10^{-31}$ kg, $\ln 10 \approx 2.3$, $n_i = 10^{10}$ cm^{-3}

1. Explain the following terms: (a) Lattice (b) Lattice constant (10%)
2. Explain the following terms: (a) Elemental semiconductors (b) Compound semiconductors (10%)
3. Explain the following terms: (a) Allowed energy band (b) Forbidden energy band (10%)
4. Explain the following terms: (a) Lattice scattering (b) Ionized impurity scattering (10%)
5. The following figure plots the electron concentration (n_0) versus temperature (T) for an n-type semiconductor with the concentration of donor atoms $N_d = 5 \times 10^{14}$ cm^{-3}. The dashed line represents the concentration of n_i. Explain why n_0 varies with T in such a way as shown in the figure. (10%)



6. Explain or define the following terms:
   (a) Schottky barrier (5%)
   (b) Space charge region (5%)
   (c) Depletion-mode MOSFET (5%)
7. Find the quasi-Fermi levels for electron and hole referenced to intrinsic Fermi level if 10^{14} cm^{-3} excess carriers are present for n-type Si with $N_d = 10^{16}$ cm^{-3}. ($n_i = 10^{10}$ cm^{-3} for Si substrate.) (20%)
8. Explain the reasons why the low frequency C-V curve is approached to C_{ox} and the high frequency C-V curve is still maintaining minimum value at strong inversion condition. (15%)

國立雲林科技大學 110 學年度 碩士班招生考試試題

系所：電子系

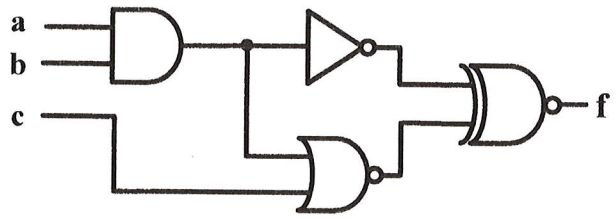
科目：計算機概論(1)

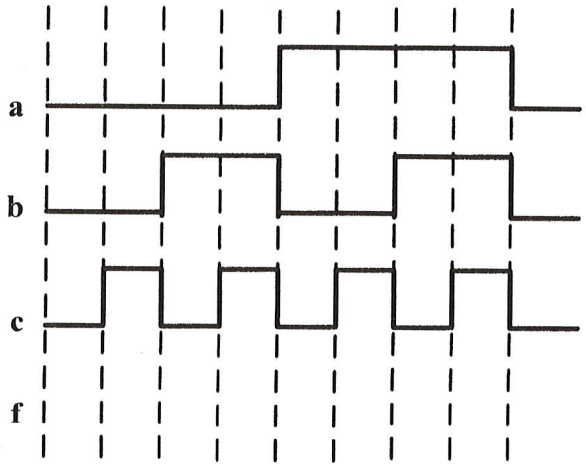
1. (10 pts) Convert these decimal numbers to 8-bit 2's complement binary numbers.
   (a) 102
   (b) 64
   (c) 33
   (d) -128
   (e) 127

2. (10 pts) Implement a 4-to-1 mux using only 2-to-1 mux making sure to properly connected all of the terminals. Remember that you will have 4 inputs, 2 control signals, and 1 output. Write out the truth table for this circuit.

3. (20 pts) Implement the XOR function by means of :
   (a) (10pts) NAND gates only.
   (b) (10pts) NOR gates only.
   Please draw the gate-level circuit.

4. (10 pts) Complete the timing diagram of the following circuit:
   Please draw the waveform of the output f.





5. (10 pts) Consider the instruction set architecture of a processor, which can be LC-3, MIPS, ARM, or some similar processor. Write down the stages of instruction cycle for a processor. Given an instruction "ST Label, R0", which is to store the content of register R0 at the memory location indicated by Label. Describe how this instruction is processed in each stage of an instruction cycle of the processor.

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系所：電子系

科目：計算機概論(1)

6. (10 pts) Given an undirected graph G(V, E) with vertices V and edges E, write down pseudo code to implement depth-first search to find a path from root vertex v0 to a destination vertex vd. Demonstrate the algorithm with an example.

7. (10 pts) Write down pseudo code to do bubble sorting of a given array of n integers into increasing order. Demonstrate this algorithm with an example.

8. (10 pts) Write down pseudo code to implement the Euclidean algorithm to find out the greatest common divisor of two given positive integers. Illustrate this algorithm with two examples.

9. (10 pts) Write down pseudo code to multiply two given matrices M1 with r1 rows and c1 columns and M2 with c1 rows and c2 columns, and output the result M3 with r1 rows and c2 columns, e.g., M1=[[1, 2, 3], [2, 4, 6]] has 2 rows and 3 columns, M2=[[1, 2], [1, 2], [1, 2]] has 3 rows and 2 columns, the resulting output MM will be [[6, 12], [12, 24]]. Use this example to demonstrate your algorithm.

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系所：電子系

科目：電子學

本試題共五題，每題得分如各題中所示，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. As Fig. P1 shows, a "10-mA diode D1" (i.e., one with v_D = 0.6 V at i_D = 10 mA) is connected in series with a 10 kΩ resistor to two supply voltages 3.3 V and 2.0 V, respectively.
   (a) (5 分) Estimate the current i_1.
   (b) (10 分) find the value of the output voltage V_{out}.

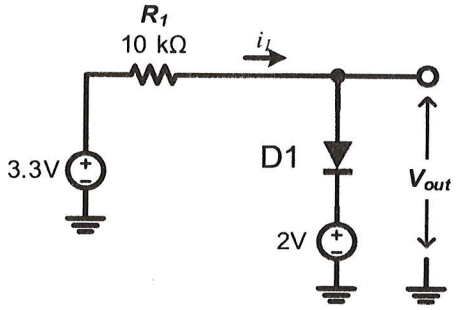

Fig. P1

2. When the NMOS transistor working in the saturation region, the drain current is modeled as $I_D = \frac{1}{2}k_n\frac{W}{L}(V_{GS} - V_t)^2(1 + \lambda V_{DS})$.
   (a) (5 分) - From the I_D equation, what are the terms of k_n ?
   (b) (5 分) - Consider for operation in the triode region, show the I_D equation.
   (c) (5 分) -Explain the term $(1 + \lambda V_{DS})$ from the I_D equation briefly.

3. In the circuits shown in Fig. P3 M_1 and M_2 are characterized by $|V_t|$ = 0.4 V, $k_p\frac{W}{L} = 1\ \text{mA/V}^2$, and λ = 0.
   (a) (10 分) find the voltage V_1
   (b) (10 分) find the voltage V_2

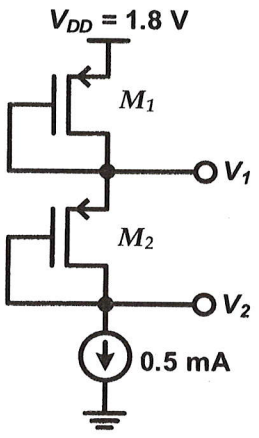

Fig. P3

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系所：電子系

科目：電子學

4 (30 分) The transistor operates in the saturation region with a drain current of 1mA. (a) What is its trans-conductance? (b) Calculate the low-frequency small-signal voltage gain. (c) Calculate the small-signal voltage gain at 160 MHz. Some related parameters are: $\lambda = 0$, R_D=10 kΩ, $\mu_n C_{ox} = 100 \times 10^{-6}$ A/V^2, $W/L = 100$, and $C_L = 1.0$ pF, while the parasitic capacitances of transistor are negligible and ignored.

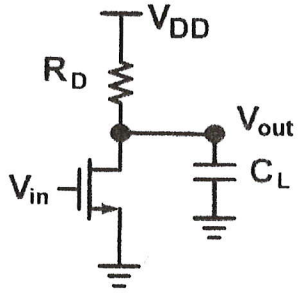

Fig. P4

5 (20 分) All transistors operate in the saturation region. The sizes of both NMOS transistors are the same. The sizes of both PMOS transistors are the same. Calculate (a) the small-signal resistances of NMOS and PMOS transistors, respectively, due to their channel-length modulation effect, and (b) the low-frequency voltage gain of the amplifier. Some related parameter values are: $g_{mN} = 2.0 \times 10^{-3}$ A/V, $g_{mP} = 1.0 \times 10^{-3}$ A/V, $C_L = 100 \times 10^{-15}$ F, $\lambda_N = 0.1$ V^{-1}, $\lambda_P = 0.2$ V^{-1}, and $I_{SS} = 1$ mA.

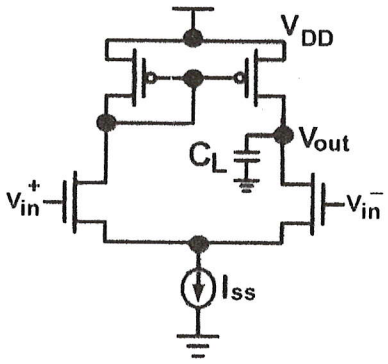

Fig. P5

國立雲林科技大學 110 學年度 碩士班招生考試試題

系所：電子系

科目：電磁學

Useful physical constants: $\varepsilon_0 \approx \frac{10^{-9}}{36\pi}$ (F/m); $\mu_0 = 4\pi \times 10^{-7}$ (H/m)

1. 兩電荷的位置與所帶電量分別為 Q1(0.00, 0.00, 0.00) = 100. nC 與 Q2(4.00 m, 3.00m, 0.00) = 3.00 nC. 請計算電荷 Q2 所在的位置，由電荷 Q1 產生的電場強度 **E**，包括大小與方向。(10%)

2. 電通量密度 $\mathbf{D} = 10\mathbf{a}_\rho + 5\mathbf{a}_\varphi$ C/m^2，請計算通過以下曲面的電通量，曲面： $\rho = 6$ m，$0 \le \varphi \le 90^\circ$，與 $-2 \le z \le +2$ m。(10%)

3. 有限長帶電荷直線的線電荷密度為 $\rho_L = 10$ nC/m，位於 Y 軸從 $y = -4.0$ m 到 $y = +4.0$ m。計算此電荷分布在位置 (4.0 m, 0.0, 0.0) 形成的電場強度 **E**，包括大小與方向。(10%)

4. 在 $z = 0$， x-y 平面無限大平板的電荷密度為 $\rho_s = 100$ nC/m^2，請計算

   (a) 將一個 2.0-nC 電荷從 P(-5.0, 10.0, 4.0)m 移動至 Q(2.0, 3.0, 2.0)m 所需要做的功。(10%)

   (b) 承上，計算電位差 $V_{QP} = V_Q - V_P$。(10%)

5. 請寫出 4 個 Maxwell's eq's 以及所代表的物理意義。 (10%)

6. (a) 請寫出磁場強度(**H**)、磁通量密度(**B**)的單位。 (10%)
   (b) 請寫出磁場強度和磁通量密度的關係式。 (10%)

7. 兩個無限延伸的電流平面，其中一個位於 $z = -2.0$ m，電流密度為 $\mathbf{K} = -5.0\,\mathbf{a}_x$ A/m。另一個電流平面位於 $z = +2.0$ m，電流密度為 $\mathbf{K} = +5.0\,\mathbf{a}_x$ A/m。求以下兩個位置的磁場強度 **H**。
   (a) (0, 0, 4 m) (10%)
   (b) (0, 0, 0) (10%)