國立雲林科技大學 109 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%) The delta function is defined as follows,

$$\delta(t-a)=\begin{cases}\infty & \text{for } t=a\\ 0 & \text{otherwise}\end{cases}$$

(a) (5%) Find the Laplace transform $\mathcal{L}\{\delta(t-a)\}=e^{-as}$

(b) (10%) There is a differential equation $y''+2y'+10y=\delta(t),\ y(0)=0$ and $y'(0)=1$. Solve the differential equation using Laplace transform.

2. (10%) Solve the differential equation $2xy^2+4=2(3-x^2y)y',\ y(-1)=8.$

3. (10%) Solve the differential equation $y''+2y'+y=4e^{-x}.$

4. (15%) Solve the differential equation system $\begin{cases}y_1'=-2y_1+5y_2\\ y_2'=\ y_1+2y_2\end{cases}$ and sketch its phase portraits on the phase plane.

5. (15%)Perform the indicated operation, give that:

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

(a) A^T (b) (A+B)C (c)If $2X-4(2A-B)=0$, Find X

6. (10%)IF $\begin{bmatrix}1\\ 2\end{bmatrix}=\begin{bmatrix}\cos\theta & -\sin\theta\\ \sin\theta & \cos\theta\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix}$, Please find $\begin{bmatrix}x\\ y\end{bmatrix}$

7. (10%)Solve the system using either Gaussian elimination with back-substitution.

$6x-2y+z=29$

$0x+4y-2z=2$

$4x+8y-4z=24$

8. (15%)Find eigenvalues and eigenvectors of A square matrix.

$$A=\begin{bmatrix}2 & 2 & 1\\ 1 & 3 & 1\\ 1 & 2 & 2\end{bmatrix}$$

國立雲林科技大學 109 學年度 系所：電子系
碩士班招生考試試題 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. A pure resistance circuit shown in Fig. P1.
   (a) (5 分) find the equivalent resistance to ground, R_{eq}.
   (b) (10 分) If R_2 is raised to 12kΩ, what does Req become?
   Hint: To do this apply a voltage Vx between terminal X and ground and find the current drawn from Vx.

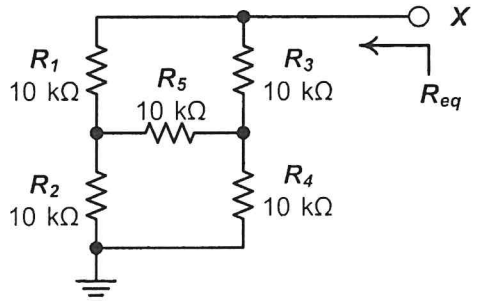


Fig. P1

2. Consider the circuit shown in Fig. P2 with $R_1 = R_2 = R_4 = 1\text{M}\Omega$, and assume the OPA to be ideal. Find the values for R_3 to obtain the following gains:
   (a) (5 分) -10 V/V
   (b) (5 分) -100 V/V
   (c) (5 分) -2 V/V

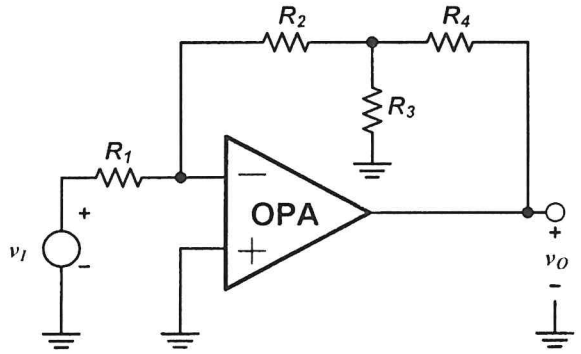


Fig. P2

3. An NMOS transistor having $V_t = 1\text{V}$ operated in the triode region with v_{DS} small. With $V_{GS} = 1.5\text{V}$, it is found to have a resistance r_{DS} of 1kΩ.
   (a) (10 分) What value of V_{GS} is required to obtain $r_{DS} = 200\Omega$?
   (b) (10 分) Find the corresponding r_{DS} values obtained with a device having twice the value of the channel width when the $V_{GS} = 1.5\text{V}$.

國立雲林科技大學 109 學年度 碩士班招生考試試題

系所：電子系

科目：電子學

4. (30 分) Both transistors of the symmetrical NMOS differential pair operate in the saturation region. (a) What is the output bias voltage? (b) Calculate the small-signal differential voltage gain if λ=0. (c) Calculate the small-signal differential voltage gain if λ=0.2 V^{-1}. Some parameter values are: $V_{DD} = 1.8$ V. $I_{SS} = 1.11 \times 10^{-3}$ A. R_D=360 Ω. $\mu_n C_{ox} = 100 \times 10^{-6}$ A/V^2. $W/L = 1766$.

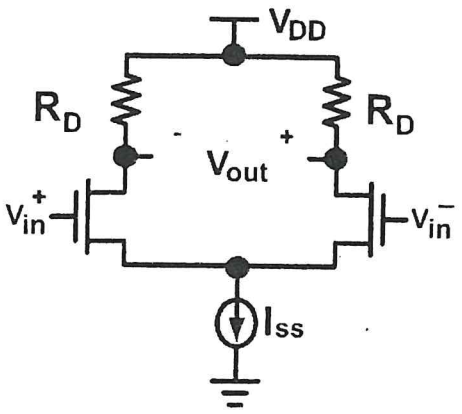


Fig. P4

5. (20 分) The transistor operates in the saturation region. Calculate (a) the small-sign midband gain and (b) 3dB bandwidth in Hz. You may ignore the parasitic capacitances of the transistor. Some device parameter values are: $\lambda = 0$. $g_m = 1.0 \times 10^{-3}$ A/V. $R_D = 10$ kΩ. $C_L = 100 \times 10^{-15}$ F.

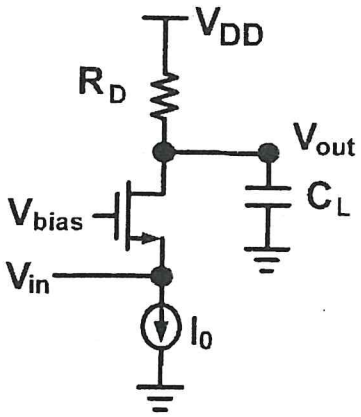
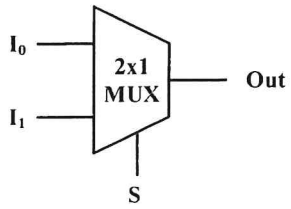


Fig. P5

國立雲林科技大學 109 學年度 系所：電子系
碩士班招生考試試題 科目：計算機概論(1)

1. (10 pts) Convert the following hexadecimal representations of 2's complement binary numbers to decimal number.
   (a) xF0
   (b) x7FF
   (c) x16
   (d) x8000
   (e) x1

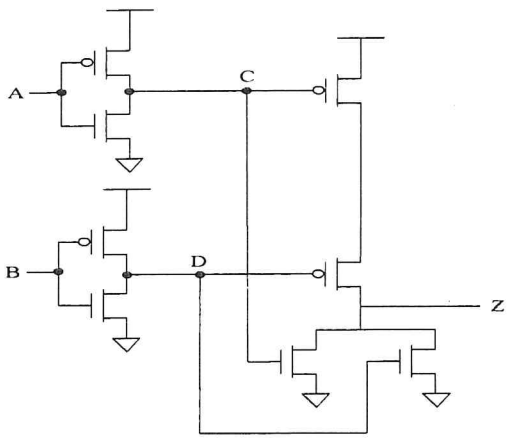
2. (10 pts) A symbol of 2-to-1 mux is listed below. Please draw the gate-level circuit of 2-to-1 mux.



3. (10 pts) Implement the XOR function by means of :
   (a) (5pts) NAND gates only.
   (b) (5pts) NOR gates only.
   Please draw the gate-level circuit.

4. (20 pts) For the transistor-level circuit shown below:
   (a) (10 pts) Fill in the truth table below.
   (b) (10 pts) What is Z in terms of A and B?

A	B	C	D	Z



國立雲林科技大學 109 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)

5. (10 pts) Given an array A of length N with sorted elements of N integers. Given a number X, write a program in C or Java to determine whether X is an element in the array. What is the time complexity O(N) of your program?

6. (10 pts) Consider an array of length N with elements of N integers. Write an algorithm to sort the elements. What is the name of the method of your algorithm? What is the time complexity O(N) of your algorithm?

7. (10 pts) Consider to write a program in assembly language to run on a computer system with an operating system. There are three sequential steps of how an assembly language is transformed to run on the development board. The first step is done with an assembler. The second step is done with a linker. The third step is done with a loader.
Describe what is done at each step.

8. (10 pts) Consider a MIPS processor. There are five stages in an execution cycle. Describe each stage in detail. If you know another RISC (reduced instruction set computing) processor, then you can answer this question with the processor you know instead of MIPS.

9. (10 pts) 有一部 Arduino 驅動的玩具車，車子前面兩個輪子可以移動讓車子左轉、右轉與往前直行，車子只有這三種移動方式。車子前面有兩個光感測器去感測地板上的亮度，地板白的時候回傳 1 的訊號、地板黑的時候回傳 0 的訊號。地板上有一條粗黑線，玩具車被放在黑線上時，兩個光感測器相隔的寬度剛好是在黑線兩旁的白背景上。請你設計一個有限狀態機，目標是要車子沿著黑線往前移動。請畫圖說明各個狀態代表的意義，以及該狀態下車子要做哪個動作。例如，車子在黑線上的正中央，兩個光感回傳的訊號是 11，這時候車子應該往前直行。

國立雲林科技大學 **109** 學年度 碩士班招生考試試題

系所：電子系

科目：半導體元件

$n_i(\text{Si}) = 10^{10}\ \text{cm}^{-3}$, $q = 1.6 \times 10^{-19}$ C, $kT = 0.025$ eV, $\ln 10 \approx 2.3$, $e^{10} \approx 2.2 \times 10^4$

1. Explain the following terms: (a) Single-crystal (b) Polycrystalline (c) Amorphous (10%)
2. Assume there are five semiconductors: Si, GaAs, Ge, GaP, and $Al_xGa_{1-x}As$. (a) What are elemental semiconductors? (b) What are compound semiconductors? (10%)
3. Explain the following terms: (a) Energy band (b) Bandgap (10%)
4. (a) What is an intrinsic semiconductor? (b) If a group V element, such as phosphorous (P), is added to pure silicon, will it become an *n*-type or *p*-type semiconductor? Why? (10%)
5. Briefly explain the following two transport mechanisms shown in semiconductor: (a) Drift (b) Diffusion (10%)
6. Explain
   (a) High injection for *pn* diode (5%)
   (b) Avalanche breakdown (5%)
   (c) Linearly grade pn junction (5%)
   (d) Strong inversion of MOS structure (5%)
7. Calculate the electron and hole current densities of a silicon *pn* diode, with $N_a = 10^{16}\ \text{cm}^{-3}$ and $N_d = 10^{18}\ \text{cm}^{-3}$ by applied forward bias of 0.5V. The μ_n, μ_p, L_n and L_p are 1000 cm^2/V/s, 100 cm^2/V/s, 80 μm and 5 μm, respectively. (15%)
8. The charge distribution of a MOS structure is given as in Fig.1. Draw the field and voltage distributions and band diagram. Where $Q_m + Q_{ss} = qN_a x$. (15%)

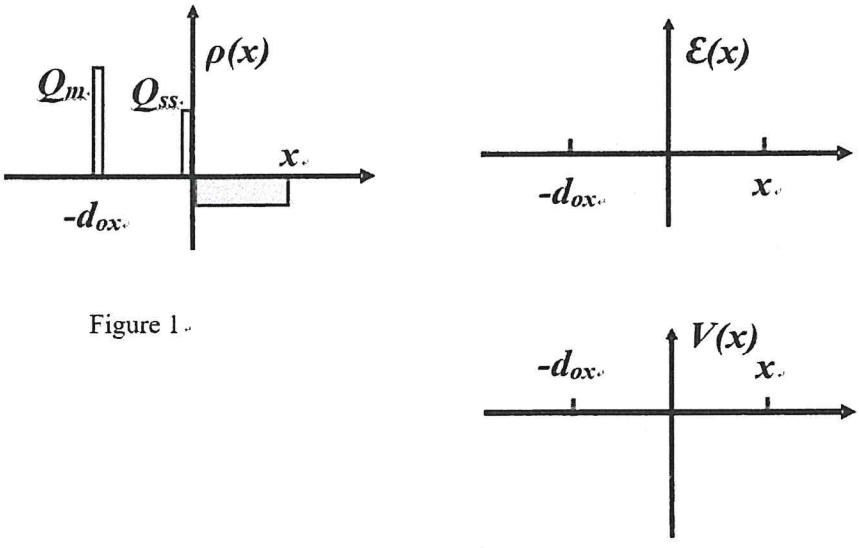


Figure 1

國立雲林科技大學 109 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. 某電磁波在液體中 (折射率為 n) 傳播，已知其頻率為 10.0 MHz，波速為 1.0 × 10^8 m/sec。測量此電磁波的電場 **E** 的振幅，在進入液面的初始條件 $E(z = 0, t = 0) = 2.0$ V/m；沿著 z 方向傳播 5 公尺後 ($z = 5.0$ m)，其振幅減為 1.0 V/m。(提示：ln 0.5 = -0.693)

(a) 求此液體的折射率 n 。(5%)

(b) 寫出電場 E 的一般表示式。(10%)

2. 有 2 個介質，以 $y = 0$ 為界。$y < 0$ 時，$\varepsilon_{r1} = 4.0$ 且電場 $\mathbf{E}_1 = 3\mathbf{a}_x + 6\mathbf{a}_y + 4\mathbf{a}_z$；$y > 0$ 時，$\varepsilon_{r2} = 5.0$。

(a) 若在界面 $y = 0$ 沒有任何自由電荷，求 $\mathbf{E}_2$。(10%)

(b) 若在界面 $y = 0$ 有面電荷密度 $\rho_s = 0.25$ nC/m^2，求 $\mathbf{E}_2$。(10%)

3. 有一個平板電容，電極版的面積是 4 m^2，且兩個電極的間距是 0.01 m，填充的介電質其相對介電常數 $\varepsilon_r = 10.0$ 且電導率 $\sigma = 10^{-8}$ S/m。若在兩個電極間施加 6 V 的電壓。

(a) 求此平板電容的電容值。(5%)

(b) 儲存在此平板電容的靜電位能是多少焦耳(J)？(5%)

(c) 此平板電容的消耗功率是幾瓦(W)？(5%)

國立雲林科技大學 109 學年度 碩士班招生考試試題

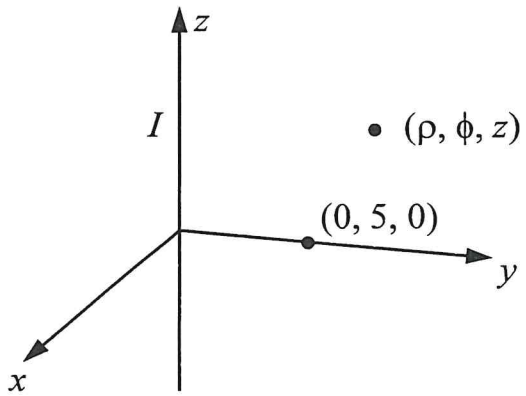
系所：電子系

科目：電磁學

4. 假設 z 軸上有一無限長的導線，導線上的電流 $\mathbf{I} = 10^{-3}\,\mathbf{a}_z$ (A)。

(a) 說明直角坐標上的點(0, 5, 0)其磁場方向； (10%)

(b) 求圓柱座標上任一點(ρ, ϕ, z) $(\rho \neq 0)$ 的磁場大小和方向。 (20%)



5. 下圖中有兩個向量場。

(a) 分別說明(1)、(2)兩個向量場的散度(divergence)為大於零、等於零、還是小於零？ (10%)

(b) 分別說明(1)、(2)兩個向量場的旋度(curl)是否為零？如果不為零，請說明其方向。 (10%)