國立雲林科技大學 107 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. Find the solution of the equation $3x(xy-2)dx+(x^3+2y)dy=0$. (10 分)

2. Find the solution of the equation $y''-2y'-3y=3t^2+4t-5$ with $y(0)=9$ and $y'(0)=-4$. (15 分)

3. Find the solution of the system $\begin{cases} x_1' = 5x_1 - 3x_2 + 8 \\ x_2' = x_1 + x_2 + 32t \end{cases}$ with $\begin{cases} x_1(0) = 2 \\ x_2(0) = 0 \end{cases}$. (15 分)

4. Find the solution of the equation $y''-3y'+2y=4e^{2t}$ with $y(0)=-3$ and $y'(0)=5$. (10 分)

   (a) Prove that the Laplace transform of $4e^{2t}$ is $\frac{4}{s-2}$.

   (b) Solving the differential equation by using Laplace transform.

5. Perform the indicated operation, give that (10 分)

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

   (a) (A+B)C (b) If 2X−6(2A−B)=0 , Find X.

6. Find the eigenvalues and eigenvectors of A. (10 分)

$$A=\begin{bmatrix}2 & 0 & 1\\ 0 & 1 & 0\\ 2 & 0 & 3\end{bmatrix}$$

7. (a) A real square matrix A=[a_{jk}]. Define the following terms: (using by A^T, A, A^{-1})
   (1) Symmetric matrix (2) Skew-Symmetric matrix (3) Orthogonal matrix (6 分)

   (b) Determine the nature (Symmetric or Skew-Symmetric or Orthogonal) of the following matrices. (8 分)

$$A=\begin{bmatrix}1 & 2\\ 2 & 3\end{bmatrix}、B=\begin{bmatrix}\frac{\sqrt{3}}{2} & \frac{-1}{2}\\ \frac{1}{2} & \frac{\sqrt{3}}{2}\end{bmatrix}、C=\begin{bmatrix}0 & 9 & -12\\ -9 & 0 & 20\\ 12 & -20 & 0\end{bmatrix}、D=\begin{bmatrix}1/7 & 3/7 & 2/7\\ 3/7 & 2/7 & 5/7\\ 2/7 & 5/7 & 3/7\end{bmatrix}$$

8. If $\vec{A}=2\vec{i}+\vec{j}-\vec{k}$, $\vec{B}=\vec{i}-3\vec{j}-5\vec{k}$ Find (a) $\vec{A}\cdot\vec{B}$ (b) $\vec{A}\times\vec{B}$ (c) the cosθ between $\vec{A}$ and $\vec{B}$ (d) the projection of $\vec{A}$ on $\vec{B}$. (16 分)

國立雲林科技大學 107 學年度
碩士班招生考試試題

系所：電子系
科目：半導體元件

1. Explain the following terms
   (a) Heterojunction (5%)
   (b) Fixed Oxide charge (5%)
   (c) Schottky barrier potential of a metal/p-type junction (5%)
   (d) Threshold voltage (5%)

2. For a pin junction, the charge distribution is shown in Fig.1. Draw the field and voltage distributions and find the applied voltage. (15%)
   ($n_i=10^{10}/cm^3$, kT=0.025eV, ln10=2.3)

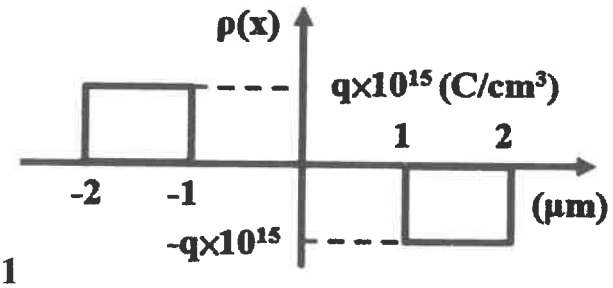


Fig.1

3. Describe the reasons the dominate current is electron or hole current of (a) p^+n and (b) p^+N junctions, where + and N mean high doping concentration and wider band gap, respectively. (15%)

4. Explain or define the following terms:
   (a) N-type dopants for Silicon (5%)
   (b) Depletion region of p-n junction (5%)
   (c) Hole carriers in a semiconductor (5%)
   (d) Electron mobility (5%)

5. Describe the advantages of direct bandgap for semiconductors. (15%)

6. Describe briefly the formation of the build-in potential in a p-n junction diode. (15%)

國立雲林科技大學 107 學年度
碩士班招生考試試題

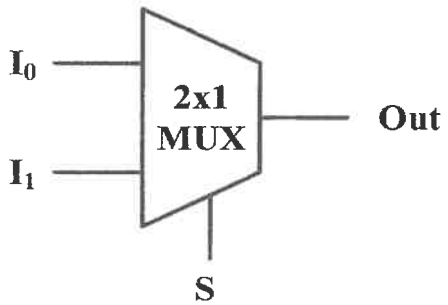
系所：電子系
科目：計算機概論(1)

1. Convert the following 2's complement binary numbers to decimal. (20%)
(a) 1010
(b) 0110
(c) 01011010
(d) 11111110
(e) 0011100111010011

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

3. Implement a 4-to-1 mux using only 2-to-1 muxes making sure to properly connect 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. (10%)

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



5. Given an array of 100 elements. Write an algorithm or C program with comments to do bubble sort. Draw a flowchart. How many comparisons and how many swaps the algorithm will take at worst? What is the time complexity of this algorithm? Which sorting algorithm is faster than bubble sort? (13%)

6. Describe a Turing machine. What are the similarities between a Turing machine and a personal computer? What are the differences? (13%)

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系所：電子系
科目：計算機概論(1)

7. Write an algorithm to find all the prime numbers less than or equal to n. Use comments to explain your program and draw a flowchart to illustrate the algorithm. Show that your algorithm work for n=25 (12%)

8. Write down the Euclidean algorithm to find the greatest common divisor between two positive integers a and b. You cannot use any division or mod function but you can use subtraction. Write down a recursive version of the Euclidean algorithm. This recursive version can use the mod function. Show that both algorithms work with two examples for each algorithm? (12%)

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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. From the Voltage Transfer Characteristic (VTC), we can find four parameters of the VTC (V_{OH}, V_{OL}, V_{IL}, and V_{IH}). Determine the noise margins:
   (a) (5 分) NM_H and
   (b) (5 分) NM_L

2. For the instrumentation amplifier of Fig. P2:
   (a) (10 分) find the voltage v_1 and v_2.
   (b) (10 分) find the voltage v_3 and v_4.
   (c) (5 分) find the voltage v_O.

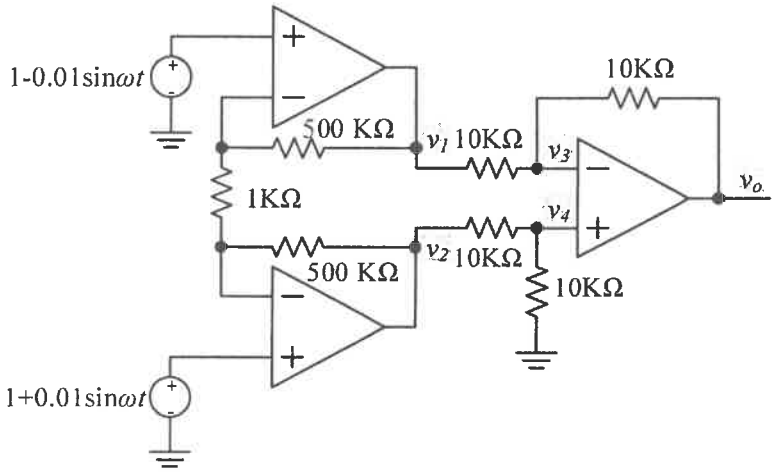

Fig. P2

3. Assume the forward voltage of the diode which shown in Fig. 3(a)(b)and(c) is 0.1V with no leakage current.
   (a) (5 分) Find the values of I_1 and V_1 in the circuits shown in Fig. P3(a).
   (b) (5 分) Find the values of I_2 and V_2 in the circuits shown in Fig. P3(b).
   (c) (5 分) Find the values of I_3 and V_3 in the circuits shown in Fig. P3(c).

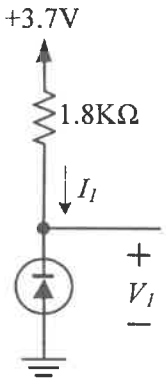

Fig. P3(a)

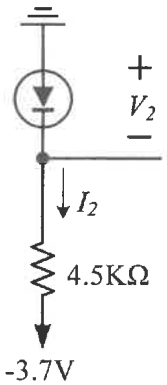

Fig. P3(b)

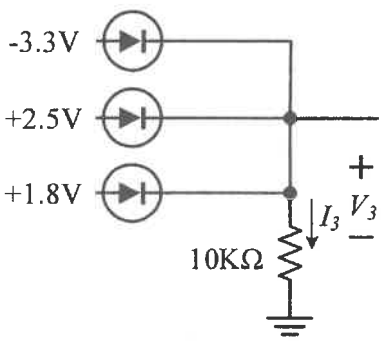

Fig. P3(c)

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4. (20 分) The operational amplifiers are ideal. Please (a) calculate the voltage gains of the circuits shown in Fig. P4(a), where R1=10kΩ and R2=100Ω. (b) Write down Vout in terms of V_A, V_B, R_A, R_B, and R_C, as shown in Fig. P4(b).

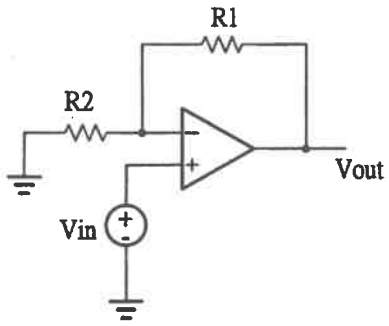

Fig. P4(a)

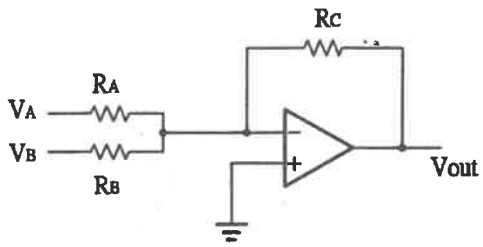

Fig. P4(b)

5. (30 分) All MOS transistors are biased in the saturation region. Neglect the body-effect of the NMOS transistors. Calculate (a) open-loop gain, (b) loop gain, and (c) closed-loop gain of the feedback amplifier shown in Fig. P5. $\lambda_N = \lambda_P = 0.1V^{-1}$. $g_{mN} = 10\times10^{-3}A/V$. $g_{mP} = 2.5\times10^{-3}A/V$. $I_{SS} = 2mA$. R1=100kΩ. R2=100kΩ.

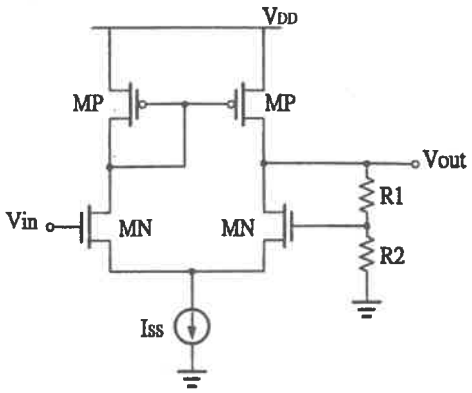

Fig. P5

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

1. 請分別用微分與積分形式寫出基本電磁學的 4 個馬克斯威爾方程式，並解釋每個方程式的物理涵義。(12%)

2. 有一電位 $V = 3x^2yz$ (V)，x, y, z 代表笛卡兒座標。請寫出電場 **E** 的方程式，並計算在座標 (3 m, 2m, 1m) 處的電場。(10%)

3. 在原點有一個 20.0-nC 的點電荷。
   (a) 在真空的環境下，請計算離原點 1.0 m 處，電場 **E** 與電通量密度 **D**。
   (b) 若此電荷是埋沒在很大體積的純水環境($\varepsilon_r = 81$)中，請計算離原點 1.0 m 處，電場 **E** 與電通量密度 **D**。
   (使用球座標) (20%)

4. 有一平板電容，在結構上兩個平行電極板間的介電質是可以移除的。若此平板電容在平行電極板間沒有任何介電質時，電容值是 8 nF；填充某介電質材料後，電容值變為 32 nF。求此介電材料的介電常數(dielectric constant/relative permittivity)是多少？(8%)

5. 一電磁波的頻率為 10^8 Hz，波長為 2 m，
   (a) 求此電磁波的傳遞速度。
   (b) 若此電磁波的函數為 $A_0 \cos(\omega t - \beta z)$，求 ω 和 β 的值。
   (20%)

6. 請說明：
   (a) 磁場的單位。
   (b) 磁通量密度的單位。
   (c) 磁場和磁通量密度的關係。
   (12%)

7. 若 z 軸上有一無限長之導線，通有電流 I (往 $+z$ 方向)，
   (a) 請說明 y 軸上的 $(0, r, 0)$ 位置其磁場方向。
   (b) 請說明 $(0, r, 0)$ 位置其磁場大小與 r 的關係。
   (18%)