國立雲林科技大學
95 學年度碩士班入學招生考試試題

系所：電機系
科目：工程數學

1. Apply Laplace transform to solve the equation,
$y''(t)+2ty'(t)-6y=t;\quad y(0)=0, y'(0)=0$ (10%)

2. Find the inverse Laplace transform for the following function. (10%)
$$\frac{s}{(s+1)^2(s^2+2s+5)}$$

3. Apply Laplace transform to find the solution for the following equations. (10%)
$$x(t)+3\int_0^t[x(\tau)-y(\tau)]d\tau=1$$
$$y(t)+2\int_0^t[2y(\tau)-x(\tau)]d\tau=0$$

4. Find the Fourier transform for the following function. (10%)
$$\frac{3e^{it}}{t^2-2t+5}$$

5. Find the inverse Fourier transform for the following function. (10%)
$$\frac{1}{(1+\omega^2)(4+\omega^2)}$$

6. Find the general solution for the following differential equations.

(i) $y^2+y-x\frac{dy}{dx}=0$ (10%)

(ii) $\frac{d^2y}{dx^2}+2\frac{dy}{dx}-8y=16+(12x-4)e^{2x}$ (15%)

7. Determine the relationship of a, b, c such that the following system of linear equations has (i) an infinite number of solutions, (5%)
(ii) exactly one solution, (5%)
(iii) no solution. (5%)
$$2x-y+z=a$$
$$x+y+2z=b$$
$$3y+3z=c$$

8. Let $w=\begin{bmatrix}1\\2\\3\\-12\end{bmatrix}$, $v_1=\begin{bmatrix}1\\2\\3\\4\end{bmatrix}$, $v_2=\begin{bmatrix}-1\\-2\\-3\\4\end{bmatrix}$ and $v_3=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$. Write the vector w as a linear combination of vectors v_1, v_2 and v_3. (10%)

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系所：電機系、通訊所
科目：線性代數

1. (15%) In the following linear system,

$$\begin{aligned} x_1 + x_2 + x_3 &= 2 \\ 2x_1 + 3x_2 + 2x_3 &= 5 \\ 3x_1 + 4x_2 + \left(k^2 - 6\right) x_3 &= k + 4 \end{aligned}$$

determine all values of k for which the resulting linear system has (a) no solution, (b) a unique solution, (c) infinite many solutions.

2. (15%) Let

$$A = \begin{bmatrix} 4 & 0 & 0 \\ 3 & -2 & 4 \\ 0 & 7 & 1 \end{bmatrix}$$

Find the characteristic polynomial, the eigenvalues and their corresponding eigenvectors of A.

3. (15%) Let W be the subspace of $\mathbf{R}^3$ spanned by

$$T = \left\{ \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix}, \begin{bmatrix} 3 \\ 2 \\ 1 \end{bmatrix}, \begin{bmatrix} 11 \\ 10 \\ 7 \end{bmatrix}, \begin{bmatrix} 7 \\ 6 \\ 4 \end{bmatrix} \right\}.$$

Find a subset of T which is a basis for W. What is the dimension of W?

4. (15%) Let $S = \{\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3\}$ and $T = \{\mathbf{w}_1, \mathbf{w}_2, \mathbf{w}_3\}$ be ordered bases for the vector space $\mathbf{R}^3$, where

$$\mathbf{v}_1 = \begin{bmatrix} -1 \\ 2 \\ 1 \end{bmatrix}, \mathbf{v}_2 = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}, \mathbf{v}_3 = \begin{bmatrix} -2 \\ 2 \\ 1 \end{bmatrix}$$

$$\mathbf{w}_1 = \begin{bmatrix} -1 \\ 1 \\ 0 \end{bmatrix}, \mathbf{w}_2 = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}, \mathbf{w}_3 = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$$

(a) (8%) Compute the transition matrix $P_{S \leftarrow T}$ from the T−basis to the S−basis.

(b) (7%) If $\mathbf{v}$ is a vector in $\mathbf{R}^3$ and the coordinate vector of $\mathbf{v}$ with respect to the T−basis is

$$[\mathbf{v}]_T = \begin{bmatrix} 2 \\ 0 \\ 1 \end{bmatrix},$$

determine the coordinate vector of $\mathbf{v}$ with respect to the S−basis, $[\mathbf{v}]_S$.

5. (15%) Let $T : \mathbf{R}^2 \to \mathbf{R}^3$ be a linear transformation defined by

$$T \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} a - 2b \\ 3a + b \\ a + b \end{bmatrix}$$

(a) (8%) Is T one-to-one?

(b) (7%) Is T onto?

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系所：電機系、通訊所
科目：線性代數

6. (15%) Is $A = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 0 \end{bmatrix}$ diagonalizable? Explain.

7. (10%) Let $T : R^3 \to R^3$ be the linear transformation defined by

$$T\left(\begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}\right) = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}, T\left(\begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}\right) = \begin{bmatrix} 2 \\ 1 \\ 2 \end{bmatrix}$$
$$T\left(\begin{bmatrix} 0 \\ 1 \\ 2 \end{bmatrix}\right) = \begin{bmatrix} 2 \\ 0 \\ 0 \end{bmatrix}.$$

Find $T\left(\begin{bmatrix} 3 \\ 1 \\ -5 \end{bmatrix}\right)$.

國立雲林科技大學
95學年度碩士班入學招生考試試題
系所：電機系
科目：電路學

1. (20%) Assume that the operational amplifiers in the following circuits are ideal.
   (a) (5%) The circuit in Fig. P1 (a) is a *summing amplifier*. Derive the relationship between the output voltage v_O and the three input voltages, v_a, v_b, and v_c.
   (b) (5%) Determine the output voltage v_O as a function of the input voltage v_S for the circuit shown in Fig. P1 (b).
   (c) (10%) Design a circuit containing operational amplifiers to solve the following set of equations:

$$y' + x = v_{S1}$$
$$2y + x' + 3x = -v_{S2}.$$

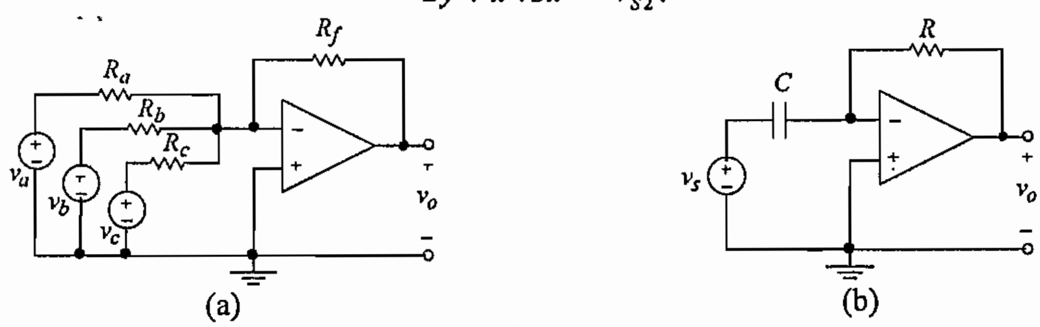

Fig. P1

2. (10%) z -parameters of the two-port network N in Fig. P2 are $\mathbf{z}_{11} = 4\mathrm{s}\,\Omega$, $\mathbf{z}_{12} = \mathbf{z}_{21} = 3\mathrm{s}\,\Omega$, and $\mathbf{z}_{22} = 9\mathrm{s}\,\Omega$ where s denotes the complex frequency.
   (a) (5%) Replace N by its T-equivalent.
   (b) (5%) Use part (a) to find the input current $i_1(t)$ for $v_s(t) = \cos 1000t$ V.

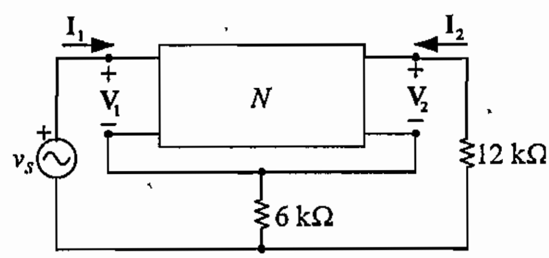

Fig. P2

3. (20%) Consider the configuration in Fig. P3 for measuring power in a three-phase, three-wire system by the two-wattmeter method.
   (a) (10%) Show that the total three-phase power $P_{AB} + P_{BC} + P_{CA}$ is equal to the sum of the two meter readings $W_A + W_C$.
   (b) (10%) Assume that three equal impedances $Z\angle\theta$ are connected. Show that the magnitude of the impedance angle θ is $\tan^{-1}[\sqrt{3} \times (W_C - W_A)/(W_C + W_A)]$.

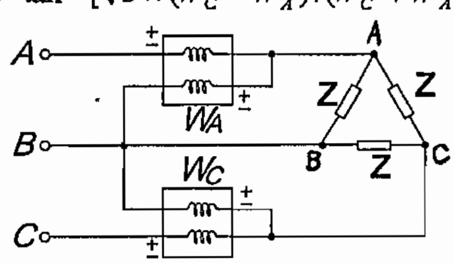

Fig. P3

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系所：電機系
科目：電路學

4. (15%) In the *RL* circuit shown in Fig. P4, the switch is in position *1* long enough to establish steady-state conditions, and at $t = 0$ it is switched to position *2*. Use Laplace transform methods to find the resulting current.

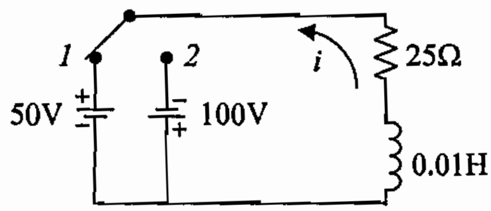

Fig. P4

5. (15%) (*a*) Find L_2 in the high-pass circuit shown in Fig. P5, if $|\mathbf{H}_v(\omega)| = 0.5$ at a frequency of 50 MHz. (*b*) At what frequency is $|\mathbf{H}_v(\omega)| = 0.9$?

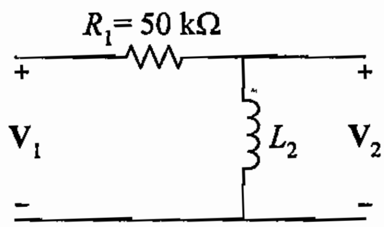

Fig. P5

6. (10%) (*a*) Write the expression for $i(t)$ which decays exponentially from 5 at $t = 0$ to 2 at $t = \infty$ with a time constant of 200 ms.

(10%) (*b*) Express $v(t)$, graphed in Fig. P6, using the step function.

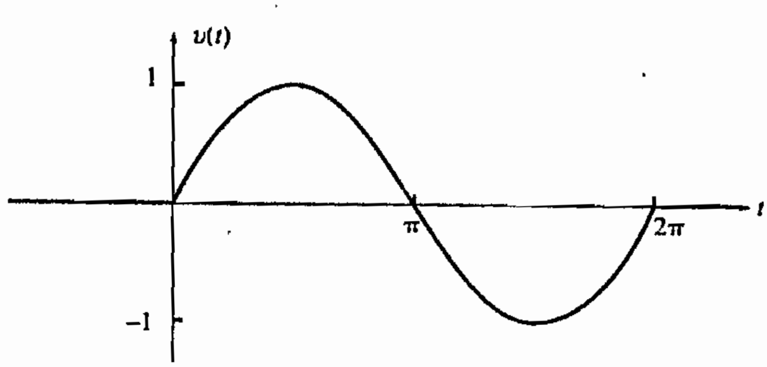

Fig. P6

國立雲林科技大學
95學年度碩士班入學招生考試試題

系所：電機系
科目：自動控制

1. Find the solution of the difference equation (10%)

$$y(k)+y(k-1)-2y(k-2)=u(k-1)+3u(k-2)$$

due to zero initial conditions (that is, $y(-1)=y(-2)=0$) and the unit-step input sequence (that is, $u(k)=1, \quad k\geq 0$).

2. Consider a unity feedback control system shown in Figure 1 for $G(s)=\dfrac{2k}{s(s+1)}$.

We adjust k so that the natural frequency $\omega_n=\dfrac{1}{\sqrt{2}}$. Find the maximum overshoot and the peak time for the unit step input ? (15%)

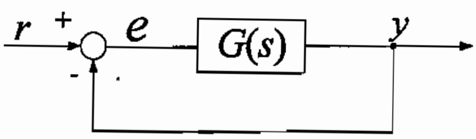

Figure 1

3. Consider a unity feedback control system shown in Figure 1. The steady state velocity error $e_v(t)$ due to a ramp function $r(t)=atu_s(t)$, for $a>0$ and $u_s(t)$: the unit step, is defined as $e_v(t)=\lim_{t\to\infty}\left|\dfrac{r(t)-y(t)}{a}\right|$. Find the ranges of β_i, $i=0,1,2,$ so that the closed loop transfer function $G_0(s)=\dfrac{Y(s)}{R(s)}=\dfrac{\beta_2 s^2+\beta_1 s+\beta_0}{s^3+3s^2+2s+4}$ has velocity error $e_v(t)$ small than 10%.

(15%)

4. A system is represented in state space as (10%)

$$\dot{\mathbf{x}}(t)=\begin{bmatrix}-1 & -k & -2 & -3\\ 1 & 0 & 0 & 0\\ 0 & 1 & 0 & 0\\ 0 & 0 & 1 & 0\end{bmatrix}\mathbf{x}(t)+\begin{bmatrix}1\\0\\0\\0\end{bmatrix}u(t)$$

$$y(t)=\begin{bmatrix}0 & 1 & k & 2\end{bmatrix}\mathbf{x}(t)$$

Find the range of k such that the system is stable.

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系所：電機系
科目：自動控制

5. Express the following problems. (15%)
   (a) Define gain margin and phase margin. (5%)
   (b) What information is contained in the specification $K_v = 1000$? (5%)
   (c) what is the linear time-invariant system ? (5%)

6. Given the characteristic equation

$$D(s) = (s+1)(s+2)(s+3) + K,$$

find the breakaway point in the root locus and the corresponding gain, K. (10%)

7. Given the unity feedback system shown in Figure 1 with $G(s) = \dfrac{K}{s(s+3)(s+5)}$,

solve the following problem: (15%)
   (a) Sketch the Nyquist diagram. (10%)
   (b) Find the range of gain, K for stability. (5%)

8. Find the state transitional matrix for the following state equation: (10%)

$$\dot{\mathbf{x}}(t) = \begin{bmatrix} 1 & -5 \\ 1 & -1 \end{bmatrix} \mathbf{x}(t)$$

國立雲林科技大學
95 學年度碩士班入學招生考試試題

系所：電機系
科目：計算機概論（丙）

1. 試計算下列算式：
   (a) $(1100.1)_2 \div (10.1)_2 = (?)_2$ (5%)
   (b) $(11100)_2 \div (1010)_2 = (?)_2$，取到小數點後 10 位。(5%)

2. (a) $(0.01001100110011\ldots)_2 = (\ ?\ )_{10}$ (5%)
   (b) $(101010111100.1)_2 = (\ ?\ )_{16}$ (5%)

3. (a) 試說明什麼是 ASCII code，其最常見的用途為何? (5%)
   (b) 試說明什麼是 Unicode，用途為何? (5%)

4. 試說明虛擬記憶體 (virtual memory) 的工作原理。(10%)

5. (a) Intel Pentium 4 的核心時脈 (core clock) 頻率為 3.8 GHz，但我們一般指其使用頻率為 200 MHz，試說明它們個別所指為何? (5%)
   (b) 何謂 USB (Universal Serial Bus)，其最常見的用途為何? (5%)

6. 試回答下列有關計算機網路之問題。
   (a) 乙太網路中之CSMA/CD之所要求之最小訊框長度為何？為什麼？（4%）
   (b) 何謂二元指數後退演算法(binary exponential backoff algorithm)？（4%）
   (c) 試說明並比較connectionless communication和connection-oriented communication？（4%）

7. 在作業系統中，
   (a) 試寫出四種不同的CPU排班演算法(scheduling algorithm)。(6%)
   (b) 試說明為什麼最短工作先處理(Shortest Job First)會有最短的平均等待時間。(4%)

8. 在作業系統中，
   (a) 何謂 process？（4%）
   (b) 試畫出它的狀態圖(state diagram)並說明之。(6%)

9. (a) 試說明並比較C語言中的函數(function)和巨集(macro)。(4%)
   (b) 試說明並比較直譯器(interpreter)和編譯器(compiler)。(4%)

10. (a) 試問圖(一)之 C 語言程式執行後，它將印出的 a 和 s 值各為何？(5%)
    (b) 試問圖(二)之 C 語言程式執行後，它將印出的 a 和 b 值各為何？(5%)

國立雲林科技大學
95學年度碩士班入學招生考試試題

系所：電機系
科目：計算機概論 (丙)

```
#include <stdio.h>
int main(void)
{
 int a=5, i=1; int k, j, s;
 do { a=a+2; printf("a = %d\n", a);} while(~i--);

 for(k=2; k<6; k++, k++)
 { s=1;for(j=k; j<6; j++) s+=j;printf("s = %d\n", s); }
 return 0;
}
```

圖(一)

```
#include <stdio.h>
int main(void)
{
 int a=7, b=6, x=1, y=0;

 switch(x)
 {
     case 1: switch(y) { case 0: a++ ; break ; case 1: b++ ; break ; }
     case 2: a++ ; b++ ; break ;
 }
 printf("a = %d, b = %d\n", ++a ,b++ );
 return 0;
}
```

圖(二)

國立雲林科技大學
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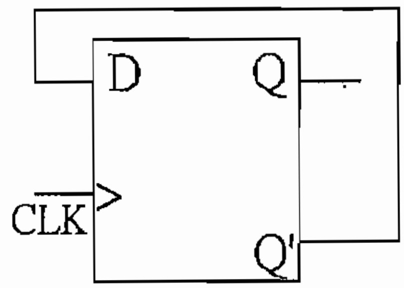
系所：電機系
科目：計算機概論（丁）

1. 布林代數(Boolean Algebra)證明題
   (a) (5%) 請證明(A'+B)'+(A'+B')'=A？
   (b) (5%) 請說明T型正反器(T Flip-Flop)的真值表(Truth Table)？並且，證明D型正反器(D Flip-Flop)的輸出埠Q'，連線至輸入埠D，會變成T=1的T型正反器(T Flip-Flop)？如圖一所示。



圖一

2. 已知布林函數X⊙Y＝XY+X'Y'，請使用以下不同的邏輯閘電路來實現此布林函數。
   (a) (5%) 只可以使用AND, NOT, OR邏輯閘？
   (b) (5%) 只可以使用NAND邏輯閘？

3. 請使用CMOS邏輯元件來實現Y=(AB+CD)'邏輯函數的實際電路。
   (a) (5%) Y=(AB+CD)'邏輯函數的NMOS電路架構部分
   (b) (5%) Y=(AB+CD)'邏輯函數的PMOS電路架構部分

4. 一般計算機的記憶體(Memory)架構與匯流排(Bus)架構，可以分成范紐曼(Von Neumann)架構與哈佛(Harvard)架構，二大類。請問：
   (a) (4%) 何謂范紐曼(Von Neumann)架構？何謂哈佛(Harvard)架構？
   (b) (4%) 范紐曼(Von Neumann)架構與哈佛(Harvard)架構，各自的優缺點為何？
   (c) (2%) 在自動控制或資訊家電領域中被廣泛採用的8051微處理器與ARM9嵌入式處理器，是採用上述何種的記憶體與匯流排架構？

國立雲林科技大學
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系所：電機系
科目：計算機概論（丁）

5. 一般計算機的組合語言指令集(Assembly Instruction Set)，可以分成精簡指令集(RISC)與複雜指令集(CISC)，二大類。請問：
   (a) (4%) 何謂精簡指令集(RISC)？何謂複雜指令集(CISC)？
   (b) (4%) 精簡指令集(RISC)與複雜指令集(CISC)，各自的優缺點為何？
   (c) (2%) 在自動控制或資訊家電領域中被廣泛採用的 8051 微處理器與 ARM9 嵌入式處理器，是採用上述何種的組合語言指令集？

6. 計算機系統可視為由底層的硬體、作業系統(Operating System)、系統程式(system program)等組成。請問：
   (a) (5%) 系統程式的目的為何？
   (b) (5%) 系統呼叫(system call)的目的為何？

7. 考慮作業系統中的虛擬記憶體管理(Virtual Memory Management)機制。假設系統僅有三個頁框(frame)記憶體。我們追蹤一個特定的處理程序(process)開始執行之後所進行的記憶體存取動作，發現其所存取的邏輯記憶體頁面(page)編號分別為：7、0、1、2、0、3、0、4、2、3(計共十次)。倘若開始時，記憶體的三個頁框是空的，試問：
   (a) (5%) 先進先出(First-In-First-Out)的頁面替換(page replacement)演算法所產生的尋頁缺失(page faults)次數為何？
   (b) (5%) LRU (Least-Recently-Used)的頁面替換演算法所產生的尋頁缺失次數為何？

8. 考慮快速排序(quick sort)問題。
   (a) (5%) 若取第一筆記錄的鍵值作為控制鍵（control key 或 pivot key），依遞增方式排列下列原始資料：

      7，3，17，8，6，11，8，5

      若 Pass 1 為 <u>6，3，5</u>，7，<u>8，11，8，17</u>(底線標示排序的個別部分檔案)，則 Pass 2 為何？
   (b) (5%) 哪些方式可加快快速排序的執行時間？

9. 試設計適當的遞迴函數(recursive function)完成下列動作。(以 pseudo-code 或 C 程式語言描述均可，但只須寫出函數本體即足夠)
   (a) (5%) 假設已給定 m 與 n 兩正整數，其中 $m \geq n \geq 1$。設計一函數 $gcd(m, n)$，以遞迴方式求 m 與 n 的最大公因數。
   (b) (5%) 設 b 為給定的某一整數而 n 為大於等於 1 的整數，設計一函數計算 $power(b, n) = b^n$ 之值。

10. 考慮圖二所示之 C 語言程式。令每個整數型態資料均佔用 4 位元組 (bytes) 記憶體空間。

```
#include <stdio.h>
void main()
{
      int i, j, A[5][5] = {0};
      int *ptr = &A[2][0];

      for (i = 0; i < 5; i++)
            for (j = i; j < 5; j++) A[i][j] = i+j+2;
      printf("%d, %d\n",*ptr+4, *(ptr+4));
}
```

圖二

(a) (5%) 圖二程式的 printf()輸出為何？

考慮如圖三所示之另一獨立程式(圖三程式的編譯、運作與圖二完全無關)。

```
#include <stdio.h>
void main()
{
      int B[5][5] = {0};
      int *ptr = &B[2][0];

      for (int i = 0; i < 5; i++)
            for (int j = 0; j < i; j++) B[i][j] = i+j+2;

      printf("%d, %d, %d\n",i,j,*ptr);
}
```

圖三

(b) (5%) 圖三所示之程式是否可執行？若可，則程式的輸出為何？若否，則原因為何？

國立雲林科技大學
95 學年度碩士班入學招生考試試題

系所：電機系
科目：電力系統

1. (20%) A single-phase source has a terminal voltage $V = 120\angle 0^{\circ}$ volts and a current $I = 25\angle 30^{\circ}$A, which leaves the positive terminal of the source. Determine the real and reactive power, and state whether the source is delivering or absorbing each.

2. (20%) A balanced three-phase 208-V source supplies a balanced three-phase load. If the line current I_A is measured to be 10 A and is in phase with the line-to-line voltage V_{BC}, find the per-phase load impedance if the load is (a) Y-connected, (b) Δ–connected.

3. (20%) A single-phase 100-kVA, 2400/240-volt, 60-Hz distribution transformer is used as a step-down transformer. The load, which is connected to the 240-volt secondary winding, absorbs 80 kVA at 0.8 power factor lagging and is at 230 volts. Assuming an ideal transformer, calculate the following: (a) primary voltage, (b) load impedance, (c) load impedance referred to the primary, and (d) the real and reactive power supplied to the primary winding.

4. (20%) As shown in Figure 1, a 25-MVA, 13.8-kV, 60-Hz synchronous generator with $X_d'' = 0.15$ per unit is connected through a transformer to a bus that supplies four identical motors. The rating of the three-phase transformer is 25 MVA, 13.8/6.9 kV, with a leakage reactance of 0.1 per unit. Each motor has a subtransient reactance $X_d'' = 0.2$ per unit on a base of 5 MVA and 6.9 kV. A three-phase fault occurs at point **P**, when the bus voltage at the motors is 6.9 kV. Determine: (a) the subtransient fault current, (b) the subtransient current through breaker A.

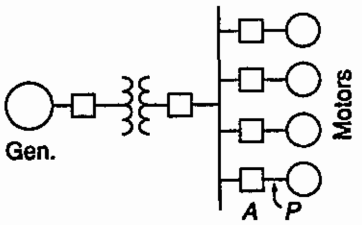

Figure 1

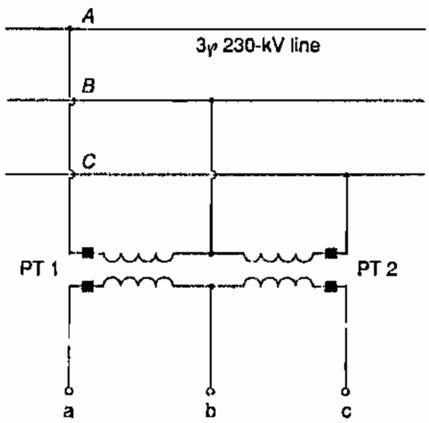

Figure 2

5. (20%) Given the open-delta PT connection shown in Figure 2, both PTs having a voltage rating of 240 kV : 120 V, the voltages are specified as $V_{AB} = 230\angle 0^{\circ}$, $V_{BC} = 230\angle -120^{\circ}$, and $V_{CA} = 230\angle 120^{\circ}$ kV. Determine V_{ab}, V_{bc}, and V_{ca} for the following cases: (a) The dots are shown in Figure 2. (b) The dot near c is moved to b in Figure 2.

國立雲林科技大學
95 學年度碩士班入學招生考試試題

系所：電機系
科目：資料結構

1. 已知 A 為一個二維陣列，若 A[1][2]之記憶體位置為 22，且 A[3][4]與 A[4][3]之記憶體位置分別為 36 與 41，則 A[41][5]之記憶體位置為何？(10%)

2. 現有一數列需進行排序，其鍵值為{23, 97, 1, 8, 86, 3, 97, 7}，試列出用插入排序法(Insertion sort)，以「鍵值不遞減」之順序排序時，所產生之每一回合的結果。(10%)

3. 假設利用插入排序法將 1000 筆資料作排序，需耗時 0.5 秒鐘，試估計在相同的機器上，同樣欲以插入排序法將 15000 筆資料作排序時，需耗時多久？(10%)

4. (a)試簡述 hashing 與一般 searching 技巧有何不同？(5%)
   (b)在選用搜尋法時，假設你有序列搜尋(linear search)，二元搜尋(binary search)，與赫序法(hashing)可供選擇，你如何評估選用這些不同的搜尋法？(5%)

5. 那一些排序法是採用分而治之(divide and conquer)的策略？那一些排序法是屬於不穩定的排序法？(10%)

6. 給定一個遞迴(recursive)函數：
   $F(n)=0, if\ n=0$，$F(n)=1, if\ n=1$，$F(n)=F(n-1)+F(n-2), if\ n>1$，$n$ 為整數，
   (a) 試以遞迴的方式寫出一個C語言程式來解它。(5%)
   (b) 試以非遞迴的方式寫出一個C語言程式來解它。(5%)

7. 試以文字和圖形來敘述Dijkstra's algorithm (最短路徑演算法)之主要步驟並分析它的時間複雜度。(10%)

8. (a) 何謂花費最少擴張樹 (minimum cost spanning tree)？(2%)
   (b) 試寫出(以文字和圖形來敘述)兩個可用來建立花費最少擴張樹之演算法的主要步驟並分析它們的時間複雜度和優缺點。(13%)

9. 給定一個中置(infix)算數式：(A+B-C)×D/E-F×(G-H)×I/(J×K)，
   (a) 試寫出它的前置(prefix)算數式。(3%)
   (b) 試寫出它的後置(postfix)算數式。(3%)

10. 試解釋下列名詞：(a) 二元樹 (binary tree)，(b) 連通圖 (connected graph)，(c) 完全圖 (complete graph)。(9%)

國立雲林科技大學
95 學年度碩士班入學招生考試試題

系所：電機系
科目：電子學

1. For the circuit shown in Figure 1, assume transistor parameters of β =100 and $V_A=\infty$. (a) Determine the dc collector current in each transistor. (b) Find the small-signal voltage $A_v=v_o/v_s$. (c) Determine the input and output resistances R_{ib} and R_o. (20%)

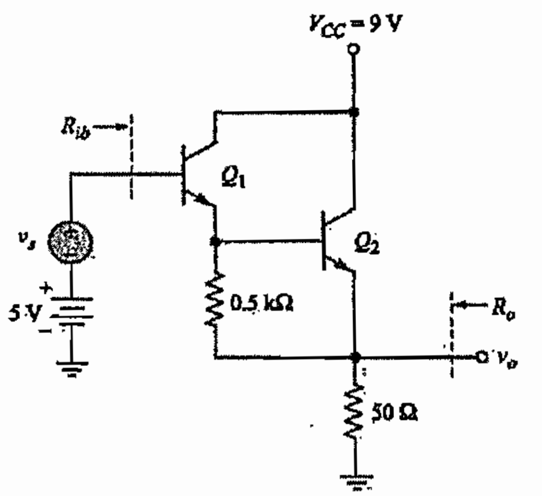

Figure 1

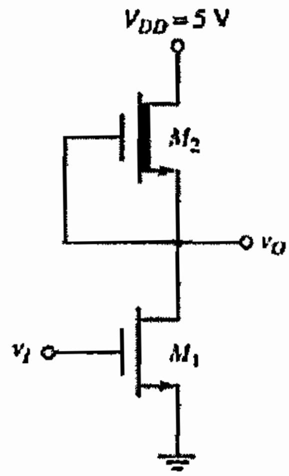

Figure 2

2. Consider the circuit in Figure 2. The transistor parameters are for M_1, $V_{TN}=0.8V$ and $k'_n=40\mu A/V^2$, and for M_2, $V_{TN}=-2V$, $k'_n=40\mu A/V^2$, and W/L=1. Determine the W/L ratio for M_1 such that $v_O=0.15V$ when $v_I=5V$. (10%)

3. A source-follower circuit with a saturated load is shown in Figure 3. The transistor parameters are $V_{TND}=1$ V, $K_{nD}=1$ mA/V^2 for M_D, and $V_{TNL}=1$ V, $K_{nL}=0.1$ mA/V^2 for M_L. Assume $\lambda=0$ for both transistors. Let $V_{DD}=9$ V. (a) Determine V_{GG} such that the quiescent value of v_{DSL} is 4 V. (b) Determine the small-signal open-circuit ($R_L=\infty$) voltage gain about this Q-point. (c) Calculate the small-signal voltage gain for $R_L=4$ kΩ. (20%)

4. For the FET circuit in Figure 4, the transistor parameters are: $K_n=1mA/V^2$, $V_{TN}=2V$, $\lambda=0$, $C_{gs}=5pF$, and $C_{gd}=1pF$. (a) Draw the simplified high-frequency equivalent circuit. (b) Calculate the equivalent Miller capacitance. (c) Determine the upper 3 dB frequency for the small-signal voltage gain and find the midband voltage gain. (20%)

國立雲林科技大學
95學年度碩士班入學招生考試試題
系所：電機系
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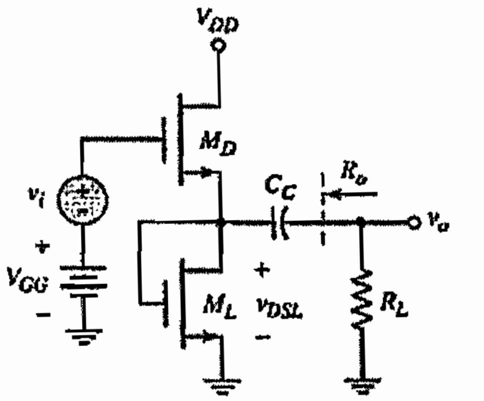


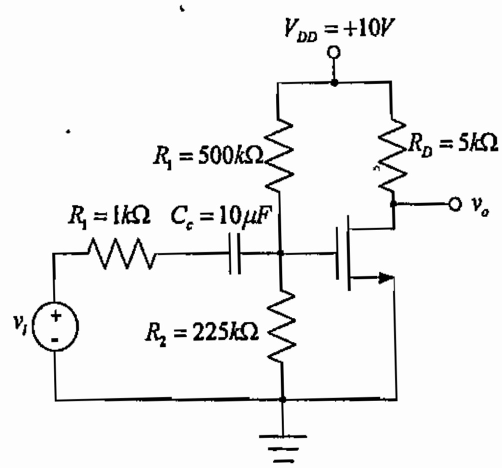
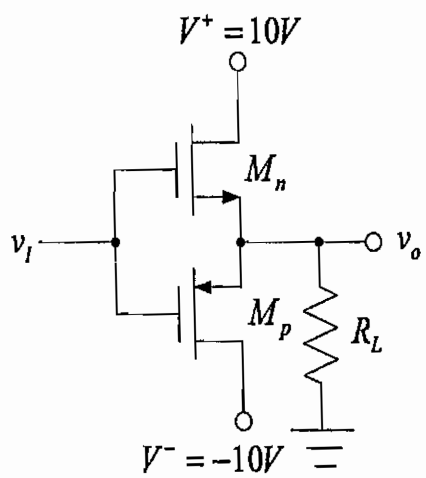


Figure 3 Figure 4

5. Consider the class-B output stage with complementary MOSFETs shown in Figure 5. The transistor parameters are $V_{TN} = V_{TP} = 0$ and $K_n = K_p = 0.4mA/V^2$. Let $R_L = 5k\Omega$. (a) Find the maximum output voltage such that M_n remains biased in the saturation region. (b) Determine the conversion efficiency for a symmetrical sine-wave output signal with the peak value found in part (a). (10%)

6. Consider a differential amplifier with the configuration in Figure 6. Assume transistor parameters of $\beta = 200$, $V_T = 26mV$, $V_{BE,Q3} = 0.7V$, $V_A = 125V$ for Q_3 and Q_4, and $V_A = \infty$ for Q_1 and Q_2. Design the circuit such that the common-mode input voltage is in the range $-5V \le v_{cm} \le +5V$, the common-mode rejection ratio is $CMRR_{dB}$=95dB, and the maximum differential-mode voltage gain is achieved. Assume $I_Q = 0.5mA$ and $I_1 = 1mA$. (20%)



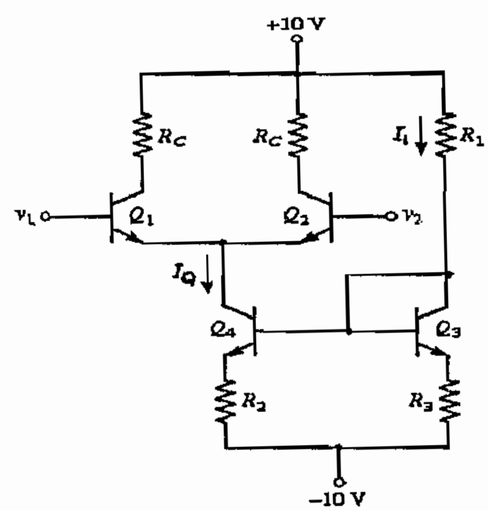


Figure 5 Figure 6