國立高雄大學 102 學年度碩士班招生考試試題

科目：工程數學
考試時間：100 分鐘

系所：
電機工程學系(光電專業領域)　　是否使用計算機：是
本科原始成績：100 分

(請按題目次序作答，違者以零分計)

1. (20%) (a) Determine the ranks of $A_1=\begin{bmatrix}-2 & 4 & -8\\ 1 & -2 & 4\\ 3 & 6 & 12\end{bmatrix}$ and $A_2=\begin{bmatrix}1 & 3 & 5\\ 2 & -4 & 6\\ 3 & -9 & 15\end{bmatrix}$

(b) With $A_3=\begin{bmatrix}2 & 1 & -2\\ 0 & -2 & -2\\ 3 & 1 & 0\end{bmatrix}$, $A_3\mathbf{X}=\begin{bmatrix}1 & 2 & 0\\ 1 & 0 & 1\\ -2 & 1 & -2\end{bmatrix}$，please find **X**

2 .(15%)　Consider the vector ***v***=(1,-2,1) in R^3. Let ***V*** be the subspace of R^3 consistent of all vectors of the form (a,a,b). Please decompose ***v*** into the sum of a vector that lies in ***V*** and a vector orthogonal to ***V***.

3.(15%)　Let $T:P_2\rightarrow P_1$ be a linear transformation defined as follow on the standard basis $\{x^2,x,1\}$ of P_2. $T(x^2)=3x-2$, $T(x)=-7$, $T(1)=x-3$. Please find $T(x^2-2x+3)$.

4.(10%) solve $y''-8y'+20y=te^t, y(0)=0, y'(0)=0$

5.(10%) solve $y''+4y=\begin{cases}1, & 0\le t<1\\ 0, & t>1\end{cases}, y(0)=0, y'(0)=1$

6.(15%) $2x^2y''-xy'+(x^2+1)y=0$, find the series solution about $x=0$，write down <u>at least three nonzero coefficients</u> <u>for each independent solutions</u>.

7.(15%) Expand the function $f(x)=2-x, 0<x<2$ in a Fourier series.

國立高雄大學 102 學年度研究所碩士班招生考試試題

科目：近代物理
考試時間：100 分鐘

系所：
電機工程學系(光電專業領域)　　是否使用計算機：是
本科原始成績：100 分

一、請舉例說明電子具有波動性(wave like)的實驗，並說明電子動量(momentum)與波長(wave length)的關係。(10%)

二、請說明光電效應(photo-electric effect)的實驗，說明光子能量(photon energy)、功函數(work function)、電子的動能(electron kinetic energy)三者的關係，並說明入射光的頻率與能量的關係。(10%)

三、請說明光輻射與原子作用的幾種形式(10%)

四、請說明原子中電子的能階結構(atomic energy levels)與元素週期表(periodic table of atoms)的關係。(15%)

五、請舉一實驗說明電子的自旋(electron spin)效應。(15%)

六、請說明黑體輻射中輻射光子的能態密度(density of state)與能量平均值(energy average value)的關係。(20%)

七、請舉例說明一量子力學系統位置與動量誤差的測不準(uncertainty)關係 $\Delta P \cdot \Delta x \geq \frac{\hbar}{2}$ (10%)

八、一電子系統中，請寫出平衡狀態之電子能量的機率分佈函數(distribution function) F(E) (10%)

國立高雄大學 102 學年度研究所碩士班招生考試試題

科目：計算機概論
考試時間：100 分鐘

系所：
電機工程學系(計算機專業領域)　是否使用計算機：是
本科原始成績：100 分

1. 名詞解釋，請說明下面專有名詞的意義。
   (4%) (a) Big Data
   (4%) (b) Social Network
   (4%) (c) Instruction Set Architecture
   (4%) (d) Programmable Logic Array
   (4%) (e) Abstract Data Type

2. 數字系統
   (5%) (a) 請計算 2 的補數 1010 與 011001 相加，答案以十進位表示。
   (5%) (b) 請將$(486.DC)_{16}$轉成八進位數字。
   (5%) (c) 請計算 NOT((NOT(xABCD)) OR (NOT(xDCBA)))，並將答案以十六進位表示。
   (5%) (d) 請將$(-9.875)_{10}$以IEEE 754 浮點數格式(圖 1)顯示，並將答案轉成十六進位表示。

$$N = (-1)^S \times 1.\text{fraction} \times 2^{\text{exponent}-127},\ 1 \le \text{exponent} \le 254$$

圖 1

3. (10%) 計算機的記憶體是用以儲存資料與指令的地方，其可視為一塊連續的二維陣列，分別儲存資料的內容與存放位址。在實際運作上，對於記憶體進行資料的存取時，則會透過 memory's address register (MAR)與 memory's data register (MDR)來完成讀寫的動作。請簡述存取(分別針對讀取與寫入)記憶體資料的過程。

4. (10%) 計算機輸入/輸出(I/O)的運作主要有三類技術，分別為：程式化控制 I/O(Programmed I/O)、中斷驅動 I/O(Interrupt-driven I/O)、與直接記憶體存取(Direct Memory Access, DMA)。請分別描述此三類技術的運作方式。

5. (10%) 假設 $n > 3$，請問底下的虛擬碼程式片段總共執行了幾次"+"運算？

```
for i = 1 to (n–3) do{
  w ← 2w +3 z + 10
    for j = 1 to n do
      z ← y + y + y + 20
    for k = 1 to n^2 do{
      for l = 1 to n do
        y ← 4x + 5l
      for m = 1 to n do
        x ← w + 2y + 3z
    }
}
```

科目：計算機概論
考試時間：100 分鐘

系所：
電機工程學系(計算機專業領域)　是否使用計算機：是
本科原始成績：100 分

6. (12%) 請寫出底下由 C 語言所撰寫的程式，在螢幕上顯示的執行結果為何？

```
#include<stdio.h>
#define MAX_NUM 7

int main(){
  int Array[MAX_NUM] = {44, 98, 77, 65, 33, 11, 26};
  int index = 0;
  int i, j, temp;

  for(j = 1; j < MAX_NUM; j++){
    temp = Array[j];
    i = j - 1;
    while(temp < Array[i]){
      Array[i+1] = Array[i];
      i--;
      if(i == -1)
        break;
     }
     Array[i+1] = temp;

     for(index = 0; index < MAX_NUM; index++)
       printf("%4d", Array[index]);
     printf("\n");
   }
}
```

7. (8%) 下表為四種排序方法的時間複雜度彙整。假設 *n* 表示所需排序的資料總數，請以 Big-O 表示每種方法的時間複雜度，並完成表格內容(a)~(h)。(作答請標示清楚)

	Quick Sort	Merge Sort	Selection Sort	Insertion Sort
Best case	(a)	(b)	(c)	(d)
Worst case	(e)	(f)	(g)	(h)

8. The height of a binary tree is defined as the number of edges in the longest path from the root to a leaf.

   (5%) (a) Find the average-case height of a binary tree with five nodes. You have to consider all possible binary trees with five nodes. Assume that each of these is equally likely to occur.

   (5%) (b) Approximate the best-case height of a binary tree with *n* nodes. (請以 big-Θ表示之)

國立高雄大學 102 學年度研究所碩士班招生考試試題

系所：

科目：計算機結構　　電機工程學系(計算機專業領域)　　是否使用計算機：是

考試時間：100 分鐘

本科原始成績：100 分

以下題目請以中文作答。**請標明題號，並按順序作答。**

1. 名詞解釋
   (1) ASCII (5%)
   (2) MIPS (5%)
   (3) Associative memory (5%)
   (4) Hamming code (5%)
   (5) SMP (5%)
   (6) Virtual Memory (5%)
   (7) Asynchronous I/O (5%)
   (8) FLOPS (5%)
   (9) Amdahl's law (5%)
   (10) Pipelining (5%)
2. 請比較 RISC 計算機與 CISC 計算機的特徵與差異(10%)
3. 請說明並比較不同記憶體技術的特色與差異：DRAM、SRAM、MDRAM、SDRAM、DDR SDRAM (10%)
4. 近年來圖形處理器(Graphic Processing Unit, GPU)除了用來加速圖形的顯示外，也被用來作爲平行計算。請說明如何使用 GPU 來進行平行計算，其與中央處理器(Central Processing Unit, CPU)的關係與程式執行的過程(10%)
5. 有一簡易的 24 位元計算機有 6 個 24 位元暫存器，其 ISA(Instruction Set Architecture)中規範了共 16 個基本指令，指令長度均爲 24 位元，並以 2 補數(2's complement)作爲處理方式。
   (1) 請問該計算機的 address space 與 addressability？(5%)
   (2) 若該計算機暫存器與記憶體之間的資料移動定址模式爲直接定址(direct addressing)。請問程式執行於該計算機時，資料區段存放在記憶體中有何限制？爲什麼？(5%)
6. 通常程式執行時會使用輸出入(I/O)功能，請回答下面問題：
   (1) 請說明計算機如何處理因爲 I/O 所引起的中斷(interrupt) (5%)
   (2) 請說明 DMA(Direct Memory Access) I/O 與一般 I/O 的差異？(5%)

國立高雄大學 102 學年度研究所碩士班招生考試試題

系所：電機工程學系（微電子專業領域）

科目：工程數學

考試時間：100 分鐘

是否使用計算機：是

本科原始成績：100 分

1. (10%) Solve (a) $y'' + 3y' + 2y = 4x + 8$ (b) $y'' + 3y' + 2y = 2e^{-x}$

2. (10%) Solve the given initial-value problem $x\frac{dy}{dx} - y = x^2 \cos x\,,\ y(\frac{\pi}{2}) = 0$

3. (10%) Solve the integral equation $y + 2\int_0^t y(\tau)\,d\tau = 10\,[u(t-1) - u(t-2)]$

   [* $u(t-a)$ is a unit step function]

4. (10%) Determine the current $i(t)$ in a single-loop LRC circuit when L=1 H, R=2 Ω, C=1 F, $i(0) = 0$ and impressed voltage is 110-110u(t-1)

5. (10%) Solve $\begin{cases} \frac{dx}{dt} = 12x - 9y \\ \frac{dy}{dt} = 4x \end{cases}$

6. (10%) Find the eigenvalues and the corresponding eigenvectors of $A=\begin{bmatrix}2 & -7 & 0\\ 5 & 10 & 4\\ 0 & 5 & 2\end{bmatrix}$

7. (10%) $A=\begin{bmatrix}1 & 1 & 1\\ 2 & 3 & 1\\ 1 & -1 & -2\end{bmatrix}$ (a) Find inverse matrix A^{-1} (b) Determinant of A^{-1}

8. (10%) Use the vector (1,1,1), (2,3,1) and (1,-1,-2) to form a basis for a three-dimensional subspace V of $\mathbf{R}^3$. Construct an orthonormal basis for V.

9. (10%) Determine (a) the kernel and (b) the range of transformation defined by the following matrix

$$M=\begin{bmatrix}1 & 2 & 8\\ 0 & 1 & 3\\ 2 & 2 & 10\end{bmatrix}$$

10. (10%) Compute $\begin{bmatrix}1 & 3\\ 3 & 9\end{bmatrix}^7$

國立高雄大學 102 學年度研究所碩士班招生考試試題

科目：微電子學
考試時間：100 分鐘

系所：
電機工程學系(微電子專業領域)
本科原始成績：100 分

是否使用計算機：是

1. (10%) For the circuit shown in Fig.1, derive an expression for $V_i(s)/V_s(s)$, and show that it is of the low-pass STC type. Find the 3-dB frequency for the case R_s=20KΩ, R_i=80 KΩ, and C_i=5pF.

2. (10%) For the circuit in Fig.2, find the currents through all branches and the voltages at all nodes.

Fig. 1

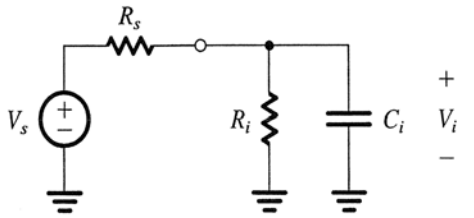
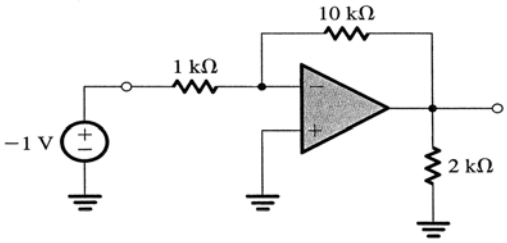
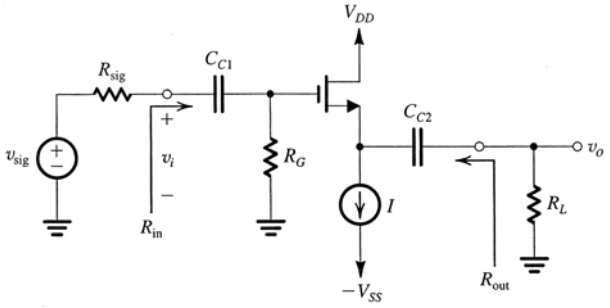


Fig. 2



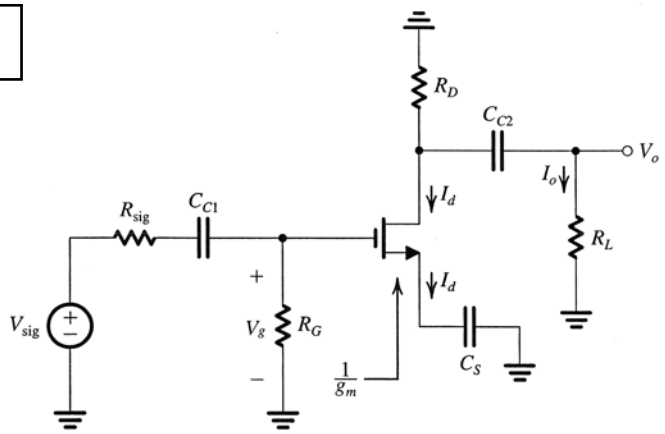
3. (10%) Consider a source follower such as that in Fig.3. Note that g_m = 1 mA/V and r_o=150 kΩ. Let R_{sig} = 1 MΩ and R_L=15 kΩ. Find R_{in}, A_{vo}, A_v, and R_{out} with r_o taken into account.

Fig. 3



4. (10%) As shown in Fig.4, the CS amplifier has C_{C1}=C_s=C_{C2}=1μF, R_G=10 MΩ, R_{sig}=100kΩ, g_m=2mA/V, R_D=R_L=10kΩ. Find A_M, f_{p1}, f_{p2}. f_{p3}, and f_L. (r_o is neglected)

Fig. 4



國立高雄大學 102 學年度研究所碩士班招生考試試題

科目：微電子學
考試時間：100 分鐘

系所：
電機工程學系(微電子專業領域)
本科原始成績：100 分

是否使用計算機：是

5. (20%) A MOS differential pair operated at a bias current of 0.8mA employs transistors with $W/L=100$ and $\mu_n C_{ox}$=0.2mA/V^2, using R_D=5kΩ, and R_{SS}=25 kΩ, as shown in Fig.5.
   (a) Find the differential gain, the common-mode gain, and the common-mode rejection ratio (in dB) if the output is taken single-endedly and the circuit is perfectly matched.
   (b) Repeat (a) when the output is taken differentially.
   (c) Repeat (a) when the output is taken differentially but the drain resistances have a 1% mismatch.

Fig. 5

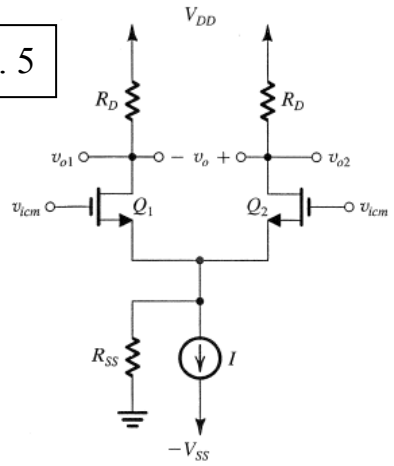
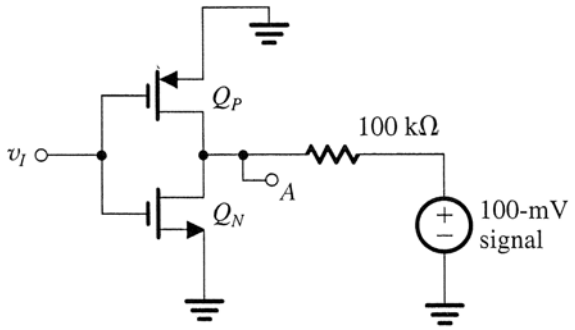


Fig. 6



6. (10%) A CMOS inverter for which $k_n=10k_p$=100μA/V^2 and V_t=0.5V is connected as shown in Fig.6 to a sinusoidal signal source having a Thevenin equivalent voltage of 0.1V peak amplitude and resistance of 100 kΩ. (a)What signal voltage appears at node A with v_I=+1.5V? (b)What signal voltage appears at node A with v_I= -1.5V?

7. (10%) Sketch a CMOS realization for the function $Y=\overline{A+B(C+D)}$

8. (10%) Two circuits are shown in Fig.7 (a) and (b). For each, express Y as a function of A and B.

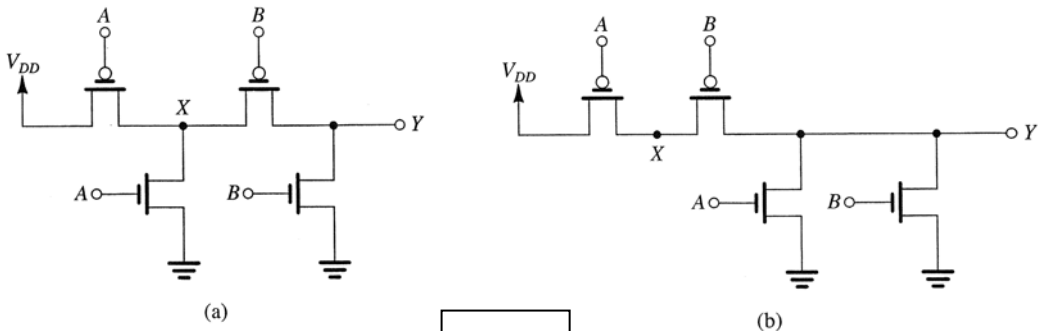


Fig. 7

9. (10%) Sketch the logic gate symbolic representation of an SR latch using NAND gates. Give the truth table and describe the operation. Also sketch a CMOS circuit implementation.

國立高雄大學 102 學年度研究所碩士班招生考試試題

科目：工程數學
考試時間：100 分鐘

系所：
電機工程學系(通訊專業領域)　　是否使用計算機：是
本科原始成績：100 分

● 共十題，每題十分。請依題號順序作答，否則酌予扣分。

1. Consider the vector space R^n over R with the usual operations. Let

$$e_1=\begin{bmatrix}1\\0\\0\\\vdots\\0\end{bmatrix},\ e_2=\begin{bmatrix}0\\1\\0\\\vdots\\0\end{bmatrix},\ \cdots,\ e_n=\begin{bmatrix}0\\0\\0\\\vdots\\1\end{bmatrix}$$

and

$$\varepsilon_1=\begin{bmatrix}1\\0\\0\\\vdots\\0\end{bmatrix},\ \varepsilon_2=\begin{bmatrix}1\\1\\0\\\vdots\\0\end{bmatrix},\ \cdots,\ \varepsilon_n=\begin{bmatrix}1\\1\\1\\\vdots\\1\end{bmatrix}$$

form two bases of R^n.

(a) Find a matrix A such that $A[\varepsilon_1,\varepsilon_2,\cdots,\varepsilon_n]=[e_1,e_2,\cdots,e_n]$.

(b) If $v\in R^n$ has the coordinate $(1,2,\cdots,n)$ on the basis $\{e_1,e_2,\cdots,e_n\}$, what is the coordinate of v under $\{\varepsilon_1,\varepsilon_2,\cdots,\varepsilon_n\}$?

2. Construct a 3×3 real symmetric matrix A such that the eigenvalues of A are 1, 1, and -1, and $\alpha=[1,1,1]^t$ and $\beta=[2,2,1]^t$ are eigenvectors corresponding to the eigenvalue 1.

3. Define mapping T and U on the vector space R^n by

$$T(x_1,x_2,\cdots,x_n)=(0,x_1,x_2,\cdots,x_{n-1})$$

and

$$U(x_1,x_2,\cdots,x_n)=(x_n,x_1,x_2,\cdots,x_{n-1}).$$

(a) Find $UT(x_1,x_2,\cdots,x_n)$.

(b) Find $T^n(x_1,x_2,\cdots,x_n)$.

(c) Find matrix representation of T.

(d) Find matrix representation of U.

(e) Find dimension of $Ker(T)$.

背面尚有試題

科目：工程數學
考試時間：100 分鐘

系所：
電機工程學系(通訊專業領域)　　是否使用計算機：是
本科原始成績：100 分

4. Let

$$V=\left\{x=\begin{bmatrix}x_1\\x_2\\x_3\\x_4\end{bmatrix}\in R^4 \mid x_1=x_3+x_4, x_2=x_3-x_4\right\}.$$

(a) Show that V is a subspace of R^4.
(b) Find a basis for V and for $V^{\perp}$.

5. For $P_3[x]$ over R, define the inner product as

$$\langle f,g\rangle=\int_{-1}^{1} f(x)g(x)dx$$

where $P_3[x]=\text{Span}\{1,x,x^2,x^3\}$.
(a) Find an orthonormal basis for the subspace $\text{Span}\{x,x^2\}$.
(b) Extend the basis in (a) to an orthonormal basis for $P_3[x]$ with respect to the inner product.

6. If X and Y are independent random variables both uniformly distributed on $(0,1)$, then calculate the probability density of $X+Y$.

7. If X and Y are independent Poisson random variables with respective means λ_1 and λ_2, calculate the conditional expected value of X given that $X+Y=n$.

8. Suppose the joint density of X and Y is given by

$$f(x,y)=\begin{cases}4y(x-y)e^{-(x+y)}, & 0<x<\infty,\ 0\le y\le x\\ 0, & \text{otherwise}\end{cases}$$

Compute $E[X\mid Y=y]$.

科目：工程數學
考試時間：100 分鐘

系所：
電機工程學系(通訊專業領域)　　是否使用計算機：是
本科原始成績：100 分

9. Consider a circle of radius R, and suppose that a point within the circle is randomly chosen in such a manner that all regions within the circle of equal area are equally likely to contain the point. (In other words, the point is uniformly distributed within the circle.) If we let the center of the circle denote the origin and define X and Y to be the coordinates of the point chosen, then, since (X,Y) is equally likely to be near each point in the circle, it follows that the joint density function of X and Y is given by

$$f(x,y)=\begin{cases} c, & \text{if } x^2+y^2 \le R^2 \\ 0, & \text{if } x^2+y^2 > R^2 \end{cases}$$

for some value of c.

(a) Determine c.

(b) Find the marginal density function of X.

(c) Find the marginal density function of Y.

(d) Compute the probability that D, the distance from the origin of the point selected, is less than or equal to a.

(e) Find $E[D]$.

10. Suppose you arrive at a post office having two clerks at a moment when both are busy but there is no one else waiting in line. You will enter service when either clerk becomes free. If service times for clerk i are exponential with rate λ_i, $i=1,2$, find $E[T]$, where T is the amount of time that you spend in the post office.

國立高雄大學 102 學年度研究所碩士班招生考試試題

科目：通訊系統
考試時間：100 分鐘

系所：
電機工程學系(通訊專業領域)　　是否使用計算機：是
本科原始成績：100 分

1. **Hilbert Transform (30pts)**

The Hilbert transform of a signal x(t) is $\hat{x}(t) = \Im^{-1}[-j\,\mathrm{sgn}(f)X(f)]$ where $\mathrm{sgn}(f) = \begin{cases} 1, f > 0 \\ 0, f = 0 \\ -1, f < 0 \end{cases}$

Assume that the Fourier transform of x(t) is real and has the shape as shown in Figure 1. Determine and plot the spectrum of each of the following signals:

$$a)\ x_1(t) = \frac{2}{3}x(t) + \frac{1}{3}j\hat{x}(t);\ b)x_2(t) = \left[\frac{4}{3}x(t) + \frac{4}{3}j\hat{x}(t)\right]e^{j2\pi f_0 t};\ f_0 >> W$$

$$c)x_3(t) = \left[\frac{2}{3}x(t) + \frac{4}{3}j\hat{x}(t)\right]e^{j2\pi Wt};\ d)x_4(t) = \left[\frac{2}{3}x(t) - \frac{2}{3}j\hat{x}(t)\right]e^{j\pi Wt}$$

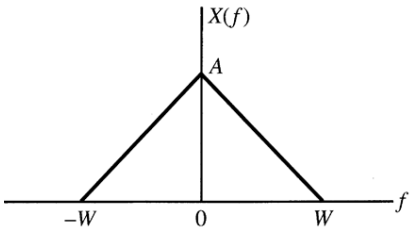


Figure 1

2. **Amplitude Modulation (30pts)**

Consider the system shown in Figure 2. Assume that the average value of m(t) is zero and the maximum value of absolute m(t) is M. Assuming the square law device is defined by

$$y(t) = 4x(t) + 2x^2(t)$$

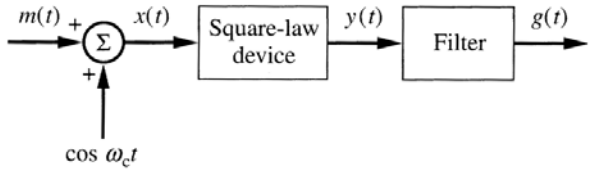


Figure 2

a) Write the equation for y(t) in terms of m(t)

b) Describe the filter that yields an AM signal for g(t).
Give the necessary filter type and frequencies of interest.

c) What value of M yields a modulation index of 0.2?

d) Name an advantage of this method of modulation

3. **Frequency Modulation (20pts)**

A narrowband FM signal has a carrier frequency of 110 kHz and a deviation ratio of 0.05. The modulation bandwidth is 10 kHz. The signal is used to generate a wideband FM signal with a deviation ratio of 20 and a carrier frequency of 100 MHz. The scheme utilized to accomplish

this is shown in Figure 3.

a) Determine the required value of frequency multiplication, n.

b) Also, fully define the mixer by giving two permissible frequencies for the local oscillator,

c) and define the required bandpass filter (center frequency and bandwidth).

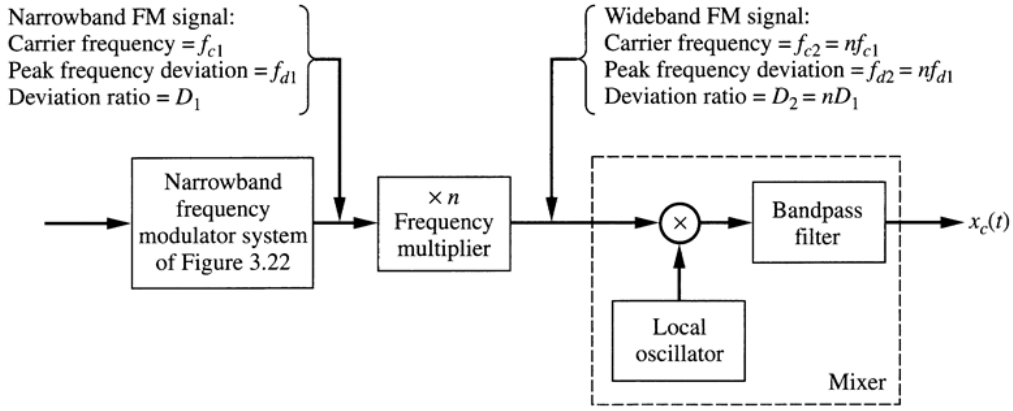


Figure 3

4. **Phase Lock Loop-PLL (20pts)**

The imperfect second-order PLL is defined as a PLL with the loop filter $F(s) = \dfrac{s+a}{s+\lambda a}$

in which λ is the offset of the pole from the origin relative to the zero location. In practical implementation λ is small but often cannot be neglected. Use the linear model of the PLL and derive the transfer function for $\Theta(s)/\Phi(s)$. Derive the expressions for ω_n and ζ in terms of K_t, a, λ

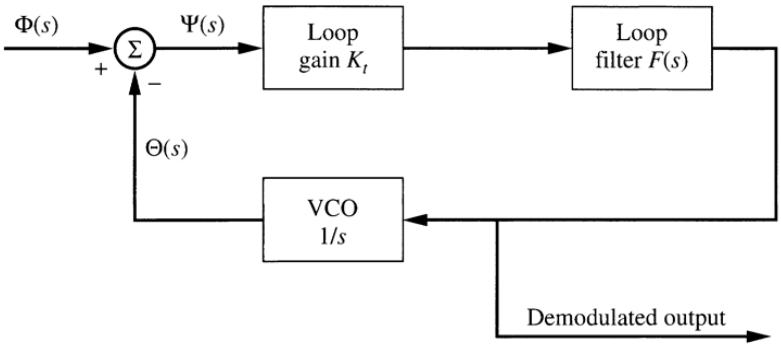


Figure 4