

國立高雄大學九十六學年度研究所碩士班招生考試試題

系所：電機工程學系光電組

科目：工程數學

電機工程學系微電子組-元件

考試時間：100 分鐘

電機工程學系微電子組-積體電路與系統

是否使用計算機：是

本科原始成績：100 分

微分方程 (50%)

1. (10%) Solve $\frac{dy}{dx} = \frac{\cos(2y) + x}{2x\sin(2y)}$

2. (10%) Solve the given initial-value problem

$$y'' + 4y' + 5y = 0, \quad y(0) = 1, \quad y'(0) = 1$$

3. (10%) Solve the problem with given initial value.

$$x^2y'' - 3xy' + 3y = 0, \quad y(1) = 3, \quad y'(1) = 5$$

4. (10%) Solve the given system of differential equations

$$\frac{dx}{dt} = x - y + e^t$$

$$\frac{dy}{dt} = 2x - y$$

$$x(0) = 2, \quad y(0) = -2$$

5. (10%) $d(t - t_0)$ is a Dirac delta function, Use Laplace

transform of the differential function to solve

$$y'' + 2y' = 4 + 2d(t - 1), \quad y(0) = 0, \quad y'(0) = 2$$

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線性代數〔占 50%,每題十分〕

1. Let $L: P_2 \rightarrow P_2$ be the linear transformation defined by

$$L(y) = x^2 y'' - y' + y.$$

Compute the matrix M that represents the linear transformation L using the ordered basis

$B = \{1, (x-1), (x-1)^2\}$ for the domain and $B' = \{1, (x-2), (x-2)^2\}$ for the target space.

2. Find an orthogonal basis for the solution set to

$$2x + y + 3z - w = 0.$$

3. Find a formula for A^k , where

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

4. Let W be the subspace of R^4 spanned by $A_1 = [1 \ 2 \ 1 \ 1]^t$ and $A_2 = [1 \ 0 \ 1 \ 0]^t$. Compute the projection of B onto W $\text{Proj}_W(B)$ for $B = [1 \ 2 \ 3 \ 4]^t$.

5. Find the distance of the point $X = [4 \ 1 \ 7]^t$ of R^3 from the subspace W consisting of all vectors of the form $[a \ b \ b]^t$.

國立高雄大學九十六學年度研究所碩士班招生考試試題

科目：近代物理

系所：電機工程學系光電組

是否使用計算機：是

考試時間：100 分鐘

本科原始成績：100 分

- 一、請舉例說明電子具有波動性(wave)的實驗，並說明電子動量(momentum)與波長(wave length)的關係。(20%)
- 二、請舉例說明光子具有粒子性的實驗，並說明光子能量(energy)與頻率(frequency)的關係。(20%)
- 三、請說明原子中電子結構(atomic structure)與週期表(periodic table)的關係。(20%)
- 四、請利用能帶理論(band theory)說明材料導電性(conductivity)的差異。(20%)
- 五、請說明自發輻射(spontaneous emission)與激發輻射(stimulated emission)的差異。(20%)

國立高雄大學九十六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組
本科原始成績：100 分

是否使用計算機：是

1. (30%) Please explain the following terminologies
 - A. (3%) Turing machine
 - B. (3%) Instruction set architecture
 - C. (3%) Memory-mapped I/O
 - D. (3%) Binary heap tree
 - E. (3%) NP-completeness
 - F. (3%) DDoS
 - G. (3%) Phishing
 - H. (3%) RAID-1
 - I. (3%) DHCP
 - J. (3%) Dual-Core Processor
2. Service routine problem
 - A. (5%) What is a system service routine?
 - B. (5%) State the detailed scenario of invoking a service routine
3. Reconstruct the corresponding binary tree according to the following results of preorder and inorder traversal
 - A. (5%) Preorder=A B D E H I C F G J K ; Inorder=D B H E I A F C J G K
 - B. (5%) Preorder=A B D E F G K C H I ; Inorder=K G F E D B A C H I
4. Some numbers, 548, 33, 816, 128, 2, 928, 664, are given. Answer the following questions
 - A. (5%) What is the result of applying MSD-radix sort on these numbers?
 - B. (5%) Suppose that a hash table, which has five 2-slot buckets (0,1,2,3,4), is given. The hash function $g(x)=(d_2+d_1+d_0) \bmod 5$, where d_i is digital of 10^i of the input number, is used and overflow is resolved by linear probing on the hash table by examining bucket $(g(x)+2) \bmod 5$. What are the final contents of the hash table if the above numbers are input sequentially?
5. Please represent $-9.25_{(10)}$ (minus 9.25 in decimal) in the following format
 - A. (5%) Base-6 (using number 0,1,2,3,4,5)
 - B. (5%) IEEE Standard 754 Floating Point Number

國立高雄大學九十六學年度研究所碩士班招生考試試題

科目：計算機概論
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系所：電機工程學系計算機組
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是否使用計算機：是

6. Let $A = \{2, 3, 6, 9, 18\}$, and define a relation \mathfrak{R} on A by $x\mathfrak{R}y$ if $x \mid y$ (x can divide y).
 - A. (5%) Draw the Hasse diagram for the poset (A, \mathfrak{R}) .
 - B. (5%) Topologically sort the Hasse diagram in (a).
7. (10%) For a prescribed universe and any open statements $p(x)$, $q(x)$ on the variable x , prove or disprove the validity of the statement, $[\forall x p(x) \Rightarrow \forall x q(x)] \Leftrightarrow \forall x [p(x) \Rightarrow q(x)]$.
8. (10%) Find a deterministic finite state machine that recognizes the set of all strings on $S=\{a, b\}$

國立高雄大學九十六學年度研究所碩士班招生考試試題

科目：計算機系統
考試時間：100 分鐘

系所：電機工程學系計算機組
本科原始成績：100 分

是否使用計算機：是

I. 配合題：從 a 至 t 選最適合的詞，不得重複 (每題 2 分，共 10 題，計 20 分)

- | | | | |
|------------------|------------------|----------------------|----------------------|
| a. assembler | f. datapath | k. micro-kernel | p. superscalar |
| b. CISC | g. demand paging | l. monolithic-kernel | q. temporal locality |
| c. compiler | h. interrupt | m. polling | r. TLB |
| d. control | i. linker | n. spatial locality | s. write-back |
| e. copy-on-write | j. loader | o. split cache | t. write-through |

1. A cache that keeps track of recently used address mappings to avoid an access to the page table
2. A program that is usually associated in a kernel
3. A program that translates a symbolic version of instructions into the binary version
4. An advanced pipelining technique that enables the processor to execute more than one instruction per clock cycle
5. Initially load pages only as they are needed
6. Removing all nonessential components from the kernel and implementing them as system and user-level programs
7. The component of the processor that performs arithmetic operations
8. The host repeatedly reads the busy bit until that bit becomes clear
9. The principle that if a data location is referenced, data locations with nearby addresses will tend to be referenced soon
10. Write data into the disk as soon as they are placed in any cache

II. 是非題：對答 T，錯答 F (每題 2 分，共 10 題，計 20 分)

1. More powerful instructions do not mean higher performance.
2. Floating-point addition is associative; that is $x+(y+z)=(x+y)+z$.
3. The delay in determining the proper instruction to fetch is called a control hazard.
4. A rated 43,800-hour MTTF of disks means that the lifetime of a disk is around five years.
5. Spinlocks are not appropriate for single-processor systems yet are often used in multiprocessor systems.
6. By thread pools serving a request with an existing thread is usually slightly faster than creating a new thread.
7. The FIFO page-replacement algorithm incurs Belady's anomaly.
8. For PCs using the same Intel-compatible instruction set and executing the same number of instructions for a program, the fastest PC will be the one with the highest clock rate.
9. Sharing a reentrant module is easier when segmentation is used than when pure paging is used.
10. In the growing phase of two-phase locking protocol, a transaction may obtain locks but may not release any lock.

III. 單選題 (每題 2 分，共 10 題，計 20 分)

1. A buffer within a functional unit that holds the operands and the operation is called (A) reorder buffer (B) branch buffer (C) reservation station (D) delay slot
2. A cache structure in which a block can be placed in any location in the cache is called (A) fully associate cache (B) set-associate cache (C) directly-mapped cache (D) multi-level cache
3. Which of the following stage will access the memory? (A) instruction fetch (B) instruction decode and register file read (C) Execute and address calculation (D) write back
4. Which of the following stage will NOT access the register? (A) instruction fetch (B) instruction decode and register file read (C) Execute and address calculation (D) write back
5. Which kind of the following memory requires recycling? (A) ROM (B) SRAM (C) DRAM (D) flash memory

國立高雄大學九十六學年度研究所碩士班招生考試試題

科目：計算機系統

系所：電機工程學系計算機組

是否使用計算機：是

考試時間：100 分鐘

本科原始成績：100 分

6. Which of the following feature is commonly found in real-time OS? (A) preemptive, priority-based scheduling (B) preemptive kernel (C) minimized latency (D) all of above
7. Which of the following information defined in C is NOT allocated in stack at runtime? (A) local variables (B) global variables (C) arguments for a function call (D) return address from a function call
8. With four page frames, what is the minimum number of page faults for an optimal page-replacement strategy for the reference string: 1,2,3,4,5,3,4,1,6,7,8,7,8,9,7,8,9,5,4,5,4,2? (A) 9 (B) 10 (C) 11 (D) 12
9. Which of the following security threat is resulting from program bug? (A) buffer overflow (B) trap door (C) Trojan horse (D) virus
10. Which of the following scheduling algorithms could result in starvation? (A) first-come, first-served (B) shortest job first (C) round robin (D) none of above

IV. 問答題 (每題 10 分，共四題，計 40 分)

1. Suppose you wish to run a program P with 7.5×10^9 instructions on a 5 GHz machine with a CPI of 0.8. (a). What is the expected CPU time? (b) When you run P, it takes 3 seconds of wall clock time to complete. What is the percentage of the CPU time P received?
2. Assume there are three small caches, each consisting of four one-word blocks. One cache is fully associative, a second is two-way set associative, and the third is direct mapped. Find the number of misses for each cache organization given the following sequence of block addresses: 0, 8, 0, 6, 8.
3. Assume that process P1 has a period of $p_1=50$ and a CPU burst of $t_1=25$. For P2, the corresponding values are $p_2=80$ and $t_2=35$. (a) Show that rate-monotonic scheduling will miss deadlines if assigning P1 a higher priority. (b) Show that earliest-deadline-first scheduling can meet deadlines.
4. Suppose you have developed a new file server with an enhanced communication protocol. For existing clients running conventional OS such as Windows XP and Linux, identify the ways to adapt the clients to obtain the new file service and explain the strengths and weaknesses of each way.

國立高雄大學九十六學年度研究所碩士班招生考試試題

系所：

科目：微電子學

電機工程學系微電子組-元件

是否使用計算機：是

考試時間：100 分鐘

電機工程學系微電子組-積體電路與系統

本科原始成績：100 分

1. For the NMOS amplifier in Fig.1. Derive expressions for the voltage gains v_s/v_i and v_d/v_i . (20%)
2. Consider the amplifier shown in Fig.2. For what value of β does the circuit begin to saturate? If we can conclude that large β is dangerous in this circuit. Now, consider the effect of reduced β , say, to $\beta=25$. What values of r_e , g_m , and r_π ? What is the overall voltage gain? (20%)
3. The feedback amplifier in Fig.3 has $I = 1$ mA and $V_{GS} = 0.8$ V. The MOSFET has $V_t = 0.6$ V and $V_A = 30$ V. For $R_S = 10$ k Ω , $R_1 = 1$ M Ω , and $R_2 = 4.7$ M Ω , find the voltage gain v_o/v_s , the input resistance R_{in} , and the output resistance R_{out} . (20%)
4. What is the maximum resistor ratio required by a 8-bit D/A converter utilizing a binary-weighted resistor network? (20%)
5. A power transistor for which $T_{Jmax} = 180^\circ$ C can dissipate 50 W at a case temperature of 50° C. If it is connected to a heat sink using an insulating washer for which the thermal resistance is 0.6° C/W, what heat-sink temperature is necessary to ensure safe operation at 30 W? For an ambient temperature of 39° C, what heat-sink thermal resistance is required? If, for a particular extruded-aluminum-finned heat sink, the thermal resistance in still air is 4.5° C/W per centi-meter of length, how long a heat sink is needed? (20%)

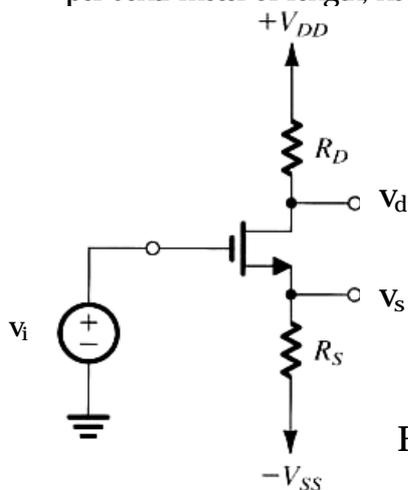


Fig. 1

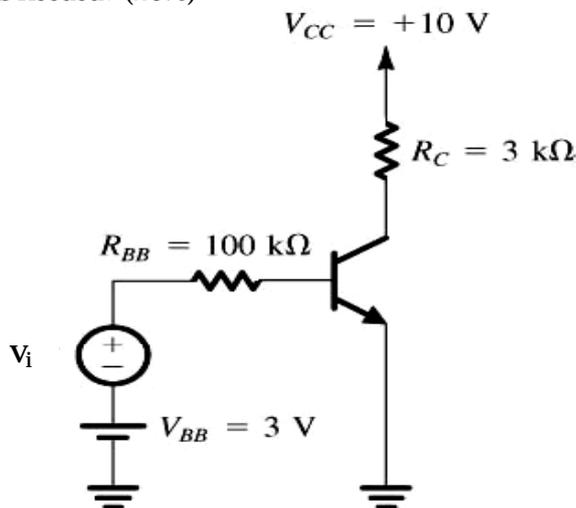


Fig. 2

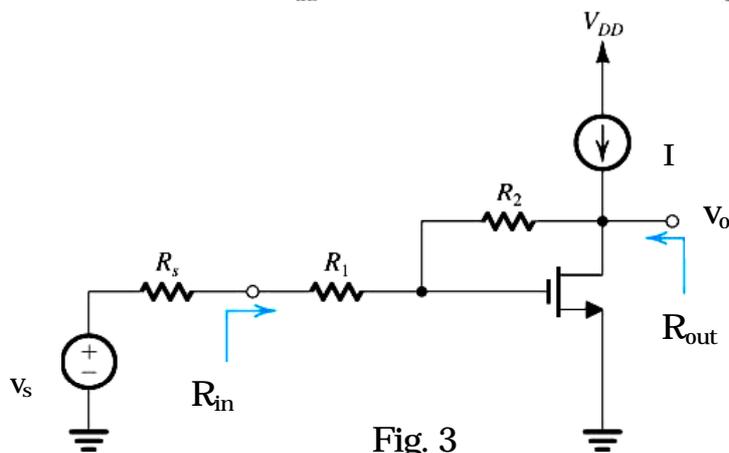


Fig. 3

國立高雄大學九十六學年度研究所碩士班招生考試試題

科目：計算機組織
考試時間：100 分鐘

系所：
電機工程學系微電子組-積體電路與系統
本科原始成績：100 分

是否使用計算機：是

1. The solution to the quadratic equation $x^2 - 11x + 22 = 0$ is $x = 3$ and $x = 6$. What is the base of the numbers? (10%)
2. Convert the hexadecimal number 68BE to binary and then from binary convert it to octal. (10%)
3. (a) Design a half-subtractor circuit with inputs x and y and outputs D and B . The circuit subtracts the bits $x - y$ and places the difference in D and the borrow in B . (5%)
(b) Design a full-subtractor circuit with three inputs x , y , z and two outputs D and B . The circuit subtracts $x - y - z$, where z is the input borrow, B is the output borrow, and D is the difference. (5%)
4. (a) How many 32K x 8 RAM chips are needed to provide a memory capacity of 256K bytes? (3%)
(b) How many lines of the address must be used to access 256K bytes? How many of these lines are connected to the address inputs of all chips? (4%)
(c) How many lines must be decoded for the chip select inputs? Specify the size of the decoder. (3%)
5. Obtain the 15-bit Hamming code word for the 11-bit data word 11001001010. (10%)
6. Show the IEEE 754 binary representation for the floating-point number 10_{ten} in single and double precision. (10%)
7. Please construct a division hardware using a 32-bit ALU and 64-bit right/left-shift register. You should show the hardware and the algorithm flow chart. (10%)
8. How many total bits are required for a direct-mapped cache with 64KB of data and one-word blocks, assuming a 32-bit address? (10%)
9. Consider a cache with 64 blocks and a block size of 16 bytes. What block number does byte address 1200 map to? (10%)
10. What is the average time to read or write a 512-byte sector for a typical disk rotating at 5400 RPM? The advertised average seek time is 12 ms, the transfer rate is 5 MB/sec, and the controller overhead is 2 ms. Assume that the disk is idle so that there is no waiting time. (10%)

國立高雄大學九十六學年度研究所碩士班招生考試試題

科目：電磁學

系所：電機工程學系微電子組-元件

是否使用計算機：是

考試時間：100 分鐘

本科原始成績：100 分

1. Write down (1)Stokes's theorem, (2)Gauss's law, (3)Poisson's equation, (4)Biot-Savart law (5)Faraday's law (of electromagnetic induction). (20%) (寫出公式及各符號意義即可，例如 $V=IR$, V:電壓, I:電流, R:電阻)
2. For a vector function $A=a_r r^2+a_z 3Z$, verify the divergence theorem for the circular cylindrical region enclosed by $r=4$, $Z=0$, and $Z=5$. (10%)
3. A polystyrene sheet ($\epsilon_r=2.6$) is introduced perpendicularly in a uniform electric field $E_0=a_x E_0$ in free space. Determine (a)electric field intensity inside the polystyrene E_i , and (b)polarization vector inside the polystyrene P_i . (10%)
4. Two lossy homogeneous dielectric media with dielectric constants $\epsilon_{r1}=2$, $\epsilon_{r2}=3$, and conductivities $\sigma_1=10(\text{ms})$, $\sigma_2=5(\text{ms})$ are in contact at the $Z=0$ plane. In the $Z>0$ region (medium 1) a uniform electric field $E_1=a_x 30 - a_z 60$ (V/m) exists. Find (a) E_2 in medium 2, (b) current density J_1 , (c) the surface charge density at the interface. (15%)
5. Two infinitely long, thin, parallel conducting wires carrying current I_1 and I_2 in the different direction. The wires are separated by a distances d . (a) determine the force per unit length between the two wires (10%), (b) is the force between the two wires attraction or repulsion? (5%)
6. A circular loop of only one turn of conducting wire lies in the xy -plane with its center at the origin of a magnetic field specified by $B=a_z B_0 \sin(\pi r/2b) \cos \omega t$, where b is the radius of the loop and ω is the angular frequency. Find (a)flux linking Φ . (5%), (b)emf induced in the loop. (10%)
7. A 90 MHz electromagnetic wave exists in an air-dielectric coaxial cable having an inner conductor with radius a and an outer conductor with inner radius b . Assuming perfect conductors, and the phosor form of the electric field intensity to be $E=a_r(E_0/r)\exp(-jkz)$ (V/m), $a<r<b$. (a)find k , (b)find H from the $\nabla \times E$ equation, and (c)find the surface current density on the inner conductor. (15%)

國立高雄大學九十六學年度研究所碩士班招生考試試題

科目：工程數學

系所：電機工程學系通訊組

是否使用計算機：是

考試時間：100 分鐘

本科原始成績：100 分

線性代數〔占 50%，每題十分〕

1. Let $L: P_2 \rightarrow P_2$ be the linear transformation defined by

$$L(y) = x^2 y'' - y' + y.$$

Compute the matrix M that represents the linear transformation L using the ordered basis

$B = \{1, (x-1), (x-1)^2\}$ for the domain and $B' = \{1, (x-2), (x-2)^2\}$ for the target space.

2. Find an orthogonal basis for the solution set to

$$2x + y + 3z - w = 0.$$

3. Find a formula for A^k , where

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

4. Let W be the subspace of \mathbb{R}^4 spanned by $A_1 = [1 \ 2 \ 1 \ 1]^t$ and $A_2 = [1 \ 0 \ 1 \ 0]^t$. Compute the projection of B onto W $\text{Proj}_W(B)$ for $B = [1 \ 2 \ 3 \ 4]^t$.

5. Find the distance of the point $X = [4 \ 1 \ 7]^t$ of \mathbb{R}^3 from the subspace W consisting of all vectors of the form $[a \ b \ b]^t$.

國立高雄大學九十六學年度研究所碩士班招生考試試題

科目：工程數學

系所：電機工程學系通訊組

是否使用計算機：是

考試時間：100 分鐘

本科原始成績：100 分

機率 (占 50%)

1. Let X be the random variable, having Poisson distribution with the probability mass function

$$p(x=k) = \frac{e^{-a} \cdot a^k}{k!}, a > 0. \text{ Suppose that } p(x=2) = \ln 3 \cdot p(x=1), \text{ find the probability when } k=0. \text{ (10\%)}$$

2. Let S be a random variable with the pdf $f_S(s) = A \cdot \exp\left(\frac{\pi}{8}s^2 - \frac{\pi}{4}s - 3.5\ln 2 - \frac{\pi}{8}\right)$. Find the value A ? (4%) And find its mean and standard deviation? (3% each)

3. Let n be a natural number belonging to the range $1 \leq n \leq 10000$. Let A, B, C be the sets such that $A = \left\{ \frac{n}{3} \text{ is a natural number} \right\}$, $B = \left\{ \frac{n}{5} \text{ is a natural number} \right\}$, and $C = \left\{ \frac{n}{8} \text{ is a natural number} \right\}$. Find the probability of $p(A \cup B \cup C)$? (10%)

4. The life of a base-station is exponentially distributed, with the mean life of six years. If five base-stations, operated independently, are being built at the same time. What is the probability that at least three will still stand after twelve years? (10%)

5. Determine the pdf of $Y = Z^2$, $f_Y(y)$, where $f_Z(z) = \begin{cases} \frac{2z}{a} \cdot \exp\left(-\frac{z^2}{a}\right), & z > 0; \\ 0, & \text{otherwise.} \end{cases}$ (10%)

國立高雄大學九十六學年度研究所碩士班招生考試試題

科目：通訊系統

系所：電機工程學系通訊組

是否使用計算機：是

考試時間：100 分鐘

本科原始成績：100 分

1、Briefly describe the following terminologies : (10%)

- (a) Hilbert Transform
- (b) OFDM
- (c) Matched Filter
- (d) Carson's Rule
- (e) PCM

2、The random process $Z(t)$ is defined by $Z(t) = X \cos(2\pi f_0 t) + Y \sin(2\pi f_0 t)$, where X and Y are zero-mean independent Gaussian random variables with variance σ^2 .

- (a) Find $m_z(t)$ (5%)
- (b) Find $R_z(t_1, t_2)$. Is $Z(t)$ W.S.S? (5%)
- (c) Find the PSD of $Z(t)$. (5%)

3、A baseband signal $x(t)$ with bandwidth W is sampled with sampling interval of T_s and a pulsed signal is formed as $x_p(t) = \sum_{n=-\infty}^{\infty} x(nT_s) p(t - nT_s)$, where $p(t)$ is an arbitrary pulse.

- (a) Find the Fourier transform of $x_p(t)$. (5%)
- (b) Find the conditions for perfect reconstruction of $x(t)$ from $x_p(t)$. (5%)
- (c) Determine the required reconstruction filter. (5%)

4、A binary communication system transmits signals $s_i(t)$ ($i=1,2$). The receiver test statistic is $r = s_i + n$, where the signal component s_i is either $s_1 = 1$ or $s_2 = -1$ and the noise component n has a probability density function of

$$p(n) = \begin{cases} (2 - |n|) / 4 & \text{if } |n| \leq 2 \\ 0 & \text{otherwise} \end{cases}$$

- (a) If $s_1(t)$ and $s_2(t)$ are transmitted with an equal probability, determine the probability of error when the optimum decision is made. (8%)
- (b) If $s_1(t)$ is transmitted with a probability of 0.8, determine the value of the optimum decision threshold. (7%)

5、(a) Find the impulse response of a duobinary signaling scheme which has a frequency response of a half-cycle cosine shape. (10%)

- (b) Describe the necessity of precoding for such a duobinary signaling scheme. (5%)

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科目：通訊系統

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本科原始成績：100 分

6. Compare the performance of DMT and CAP with respect to the following channel impairments : (15%)

(a) Impulse noise.

(b) Narrowband interference.

Assume that (1) the DMT has a large number of subchannels, and (2) the CAP system is uncoded and its receiver uses a pair of adaptive filters for implementation.

7. Suppose that MSK is used to transmit information over an AWGN with a two-sided power spectral density of 10^{-8} W/Hz. The transmitted signal is $4 \cos(2\pi f_0 t + \phi_n)$, where ϕ_n is the modulated phase or corresponding frequency shift.

(a) Draw the modulator. (5%)

(b) Draw the structure of optimal receiver. (5%)

(c) Determine the maximum data rate that can be sent with bit-error-rate $P_e = 10^{-6}$. (5%)