國立雲林科技大學
99 學年度碩士班暨碩士在職專班招生考試試題

系所：資工系、電子系
科目：線性代數

本試題共七題，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. (20%) Consider the matrix
$$A=\begin{bmatrix}2 & -2 & 0\\ -3 & 1 & 0\\ 0 & 0 & 3\end{bmatrix}.$$
(a) (5%) Find its characteristic polynomial.
(b) (5%) Find its eigenvalues.
(c) (10%) Find the corresponding normalized eigenvectors.

2. (10%) Determine the rank of
$$A=\begin{bmatrix}1 & 0 & 8\\ 0 & 1 & -9\\ 1 & 2 & -10\\ -3 & 4 & -60\\ 7 & 8 & -16\\ -6 & 4 & -84\end{bmatrix}.$$

3. (10%) Prove that $(AB)^T = B^T A^T$, where A and B are matrices, and T represents the transpose operation.

4. (10%) Prove that a square matrix A is invertible if and only if $\det(A) \neq 0$.

5. (15%) Find a basis for the column space of the following matrix A.
$$A=\begin{bmatrix}1 & 1 & 0\\ 2 & 3 & -2\\ -1 & -4 & 6\end{bmatrix}$$

6. (20%) Consider the linear transformation $T(x,y)=(3x+4y,5x+7y)$ of $\mathbf{R}^2 \to \mathbf{R}^2$. Prove that T is invertible and find the inverse of T.

7. (15%) Show that the following matrix A is not diagonalizable.
$$A=\begin{bmatrix}5 & -3\\ 3 & -1\end{bmatrix}$$

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1. (10%) Given the structure type and variable definitions

```
struct ShoeSize
{
  char width;
  int number; };
struct ShoeType
{
  char style;
  ShoeSize size;
  double price; };
ShoeType shoe1, shoe2;
```

What type do these variables have?

(a) shoe1.style
(b) shoe2.size
(c) shoe1.size.width
(d) shoe2.price
(e) shoe1.size.number

2. (10%) Suppose your program contains the following class definition (along with definitions of the member functions):

```
class YourClass
{
 public:
    YourClass (int newInfo, char moreNewInfo);
    YourClass( );
    void doStuff( );
 private:
    int information;
    char moreinformation;
};
```

Which of the following are legal?

(a) YourClass anObject(42, 'A');
(b) YourClass anotherObject;
(c) YourClass yetAnotherObject( );
(d) anObject = YourClass(99, 'B');
(e) anObject = YourClass( );
(f) anObject = YourClass;

3. (10%) Answer the following questions regarding an array called `table`:

(a) (3%) Declare the array to be an integer array and to have 3 rows and 3colums.

(b) (4%) Use a for repetition statement to initialize each element of the array to the sum of its subscripts. Assume that the integer variables `i` and `j` are declared as control variables.

(c) (3%) Write a program segment to print the values of each element of array table in

tabular format with 3 rows and 3 columns.

4. (5%) What is the output of the following program?

```
#include < iostream >
using namespace std;
void f(int n);
int t=0;
int main (void)
{
 f(9);
 cout << t <<endl; }
void f(int n)
{
 if (n>1)
 {
    t++;
    if (n%2==0)
       f(n/2);
    else
       f(3*n+1); }
}
```

5. (5%) What is the output of the following program?

```
#include <iostream>
using namespace std;
int p=10;
main ( )
{
     int sub1(void);
     void sub2(int);
     void sub3(int*);
     int a = 5, b=8 ,i;
     for (i =1;i<=3;i ++)
     {
        sub2(a);
        sub3(&b);
        cout<< "it " << i << "th pass =" << sub1()<< a << b <<p
<<endl;     }
}
int sub1(void)
{
   static int x=0;
   x++;
   return(x); }
void sub2 (int y)
{ y--; p-=y;}
void sub3 (int *z)
{  *z+=1; }
```

6. (5%) Write a definition for a void-function that has two `int` value parameters and outputs to the screen the product of these arguments. Write a `main` function that asks the user for these two numbers, reads them in, calls your function, then terminates.

7. (5%) Consider the following function and code segment.

```
void One( int first, int & second )
{
   first = 17;
   second = first + 1; }
int main()
{
   int j = 4;
   int k = 3;
   One(j, k); }
```

After the call to `One(j, k);` what are the values of `j` and `k`?

8. (6%) Number system conversion
   (a) Binary to octal number : $(101100011010 11.111100000110)_2 = (\ ?\ )_8$
   (b) Hexadecimal to binary number : $(306.D)_{16} = (\ ?\ )_2$

9. (6%) Complements
   (a) Please find the 1's complement of $(1011000)_2 = (\ ?\ )$
   (b) Please find the 10's complement of $(246700)_{10} = (\ ?\ )$

10. (12%) Postulates and Theorems of Boolean Algebra
   (a) DeMorgan $(x+y)' = ?$
   (b) DeMorgan $(xy)' = ?$
   (c) Absorption $x+xy = ?$
   (d) Absorption $x(x+y) = ?$

11. (5%) Sum of mintern to product of maxterm
   $F(A, B, C) = \Sigma(1, 4, 5, 6, 7) = \Pi(?)$

12. (5%) Simplify the Boolean function $F=A'C+A'B+AB'C+BC$ as sum of products expression?

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13. (8%) Simplify the Boolean function

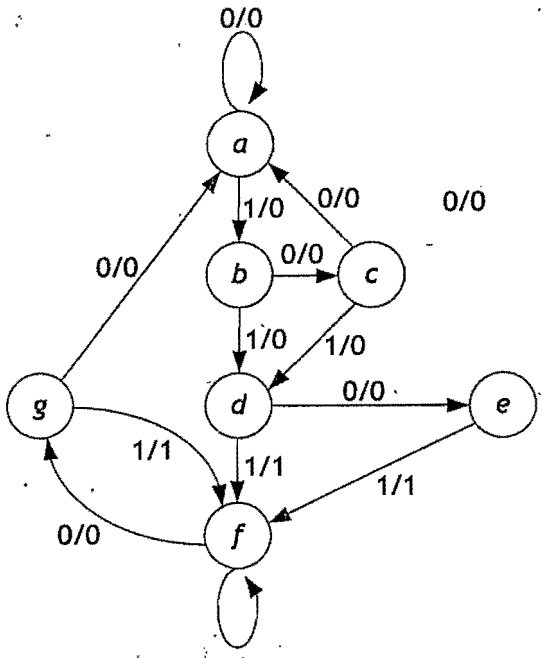
$F(w,x,y,z) = \Sigma(1,3,7,11,15)$

which has don't care conditions (terms)

$d(w,x,y,z) = \Sigma(0,2,5)$

as sum of products expression?

14. (8%) Please reduce the state diagram



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科目：離散數學

1. For the directed graph specified below **(15%)**

G=(N,A), N(G)={a , b , c , d },

A(G)={<a , b > , <a , c > , <b , d > , <c , d > , <b , a > , <d , c >}

(a) Complete the directed graph. (3%)

(b) Find the adjacency matrix of the graph. (4%)

(c) Find the adjacency list of the graph. (4%)

(d) Depict the **advantages** and **disadvantages** of using **the adjacency matrix** and **the adjacency list**, respectively. (4%)

2. Please determine the coefficient of x^{15} in $g(x)=(x^2+x^3+x^4+...)^4$. **(15%)**

3. Given a connected simple graph, *G*, consists of *n* vertices. **(10%)**

(a) What is the minimum number of edges of *G*. (2%)

(b) What is the number of edges of the minimum spanning tree *T* of *G*. (2%)

(c) Two algorithms of Kruskal and Prim can be used to determine the minimum spanning tree. Please detail the differences between the Kruskal's and Prim's algorithms. (6%)

4. Determine a_n, where $a_1=1, a_n-\frac{n}{n-1}a_{n-1}=n^3, n\geq 2$. **(10%)**

5. If an alphabet consists of the symbols 0, 1, and 2, then 01, 11, 21, 12, and 20 are five of the nine strings of length 2. Let ***n*** be any positive integer and $x = x_1x_2...x_n$ be one of the strings of length ***n*** based on the above alphabet. We define the weight of *x*, denoted wt(*x*), by $wt(x) = x_1+x_2+...+x_n$. For example, wt(12) = 3 and wt(22) = 4. Based on the alphabet given above, if $n = 10$, how many of the strings have even weight? **(10%)**

6. Consider the following program segment, where *i*, *j*, and *k* are integer variables.

```
for i := 1 to 20 do
    for j := 1 to i do
        for k := 1 to j do
            print (i * j + k)
```

How many times is the **print** statement executed in this program segment? **(10%)**

7. Please prove the Euclid theorem: There are infinitely many primes. **(10%)**

8. Let $m \in Z^+$ with ***m*** odd. Prove that there exists a positive integer ***n*** such that ***m*** divides $2^n + 1$. **(10%)**

9. Consider a Turing machine that has the following two instructions:

(1, 1, 0, 2, R),

(2, 1, 1, 1, R).

Determine its output when it is run on the following tape. (Remember that a Turing machine starts in state 1, reading the leftmost nonblank cell.) **(10%)**

•	•	b	1	1	1	b	•	•

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題目1至題目10爲多選題，每題5分，每題需全部答對才給分。

1. Which are correct for computer-system architecture?
   (A) Multiprocessor systems are known as loosely coupled systems.
   (B) Multiprocessor systems have three main advantages; i.e., increased throughput, economy of scale, and increased reliability.
   (C) For an asymmetric multiprocessing system, a master processor controls the system, and the other processors either look to the master for instruction or have predefined tasks.
   (D) Clustered systems differ from multiprocessor systems, in that they are composed of two or more individual systems coupled together.

2. Which are correct for virtual machines?
   (A) The layer approach is taken to its logical conclusion in the concept of a virtual machine.
   (B) A major difficulty with the virtual-machine approach involves main memory systems.
   (C) VMware runs as an application on a host operating system such as Windows or Linux and allows this host system to concurrently run several different guest operating systems as independent virtual machines.
   (D) Java also provides a specification for a Java virtual machine.

3. Which are correct for process scheduling?
   (A) The objective of multiprogramming is to have some process running at all times, to maximize CPU utilization.
   (B) The job scheduler selects processes from a pool and loads them into memory for execution.
   (C) The CPU scheduler controls the degree of multigramming.
   (D) The CPU scheduler may need to be invoked only when a process leaves the system.

4. Which are correct for multithreaded programming?
   (A) Green threads-a thread library available for Solaris uses the many-to-one model.
   (B) The many-to-many model multiplexes many user-level threads to a larger number of kernel threads.
   (C) User threads are supported above the kernel and are managed without kernel support.
   (D) The many-to-one model allows the developer to create as many user threads as she wishes, and it is with greater concurrency.

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5. Which are correct for CPU scheduling criteria?
   (A) CPU utilization
   (B) turnaround time
   (C) waiting time
   (D) response time

6. Which are correct for semaphores?
   (A) Semaphores are used to deal with criticl-section problems, but not synchronization problems.
   (B) Usually, we use counting semaphores to solve the critical-section problem.
   (C) Using spinlocks is not a good approach in a multiprocessor system.
   (D) A semaphore is accessed only through two standard atomic operations: wait() and signal().

7. Which are correct for deadlocks?
   (A) A resource-allocation graph with a cycle must have a deadlock.
   (B) The circular-wait condition and the hold-and-wait condition are independent of each other.
   (C) For the deadlock-avoidance scheme, if a process requests an available resource, we must consider whether the system state is safe or not after allocating the resource to the process.
   (D) One way to ensure that the circular-wait condition never holds is to impose a total ordering of all resource types and to require that each process requests resources in an increasing order of enumeration.

8. Which are correct for memory management?
   (A) The binding of instructions and data to memory addresses can be done at compile time, load time, and execution time.
   (B) Dynamic loading does not require special support from the operating system.
   (C) The first-fit and best-fit strategies for memory allocation usually suffer from external fragmentation.
   (D) In the inverted page table scheme, each process has its own page table.

9. Which are correct for virtual-memory management?
   (A) The optimal page-replacement algorithm has the lowest page-fault rate of all algorithms.
   (B) The working-set model is based on the assumption of spatial locality.
   (C) When dynamic paging is used, we sometimes need to allow some of the pages to be locked in memory, specially under the context-switch situation.
   (D) The FIFO page-replacement algorithm would suffer from Belady's anomaly.

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10. Which are correct for file systems?
(A) In a general graph directory, the reference count is 0 when it is no longer possible to refer to a directory or file.
(B) When a process closes a file, the per-process table entry is removed, and the system-wide entry's open count is decremented.
(C) Three major methods of allocating disk space are in wide use: contiguous, linked, and indexed.
(D) Although indexed allocation supports direct access, it suffers from external fragmentation.

11. Some systems provide file sharing by maintaining a single copy of a file; other systems maintain several copies, one for each of the users sharing the file. Discuss the relative merits of each approach. (15%)

12. Consider the following segment table: (10%)

Segment no.	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

What are the physical addresses for the following logical addresses?
a. (0, 430) b. (3, 400) c. (2, 500)

13. Five jobs A through E, arrive with the sequence at a computer center at almost the same time. They have estimated running time of 4, 8, 10, 2 and 6 minutes. Their priority are 1, 2, 3, 4 and 5, respectively, with 5 being the highest priority. For each of the following scheduling algorithms, determine the average waiting time. Ignore the process switching overhead. (15%)
(a)Round robin (with time slice 1 min.)
(b)Priority scheduling
(c)Shortest job first.

14. How do I/O-bound and CPU-bound programs differ? (10%)

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1. (a) Please describe what kinds of principle of locality is applied by the memory cache system? (6 points)

(b) In the cache system, what is the write-back policy? What is the write-through policy? (6 points)

(c) How many total bits are required for a direct-mapped cache with 64 KB of data and one-word blocks, assuming a 32-bit address? (6 points)

2. In synchronous processor-memory I/O bus system, the synchronous bus clock cycle time is 50 ns, each bus transmission takes 1 clock cycle, and data bus is 32-bits wide. Find the bandwidth when performing one-word reads from a 200-ns memory. (10 points)

3. Table 1 depicts the time of each component used in the associated instruction. What would the speed up obtained from pipelining a single-cycle implementation? (10 points)

Table1

Instruction class	Instruction fetch	Register Read	ALU Operation	Data Access	Register Write	Total time
Load word (lw)	2 ns	1ns	4 ns	2 ns	1ns	10 ns
Store word (sw)	2 ns	1ns	4 ns	2 ns		9 ns
R-format (add, sub, and , or, slt)	2 ns	1ns	4 ns		1ns	8 ns
Branch (beq)	2 ns	1ns	4 ns			7 ns

Table 2

Instruction	Average CPI	gcc	spice
Arithmetic	1.0 clock cycles	48%	50%
Data Transfer	1.4 clock cycles	33%	41%
Conditional branch	1.7 clock cycles	17%	8%
Jump	1.2 clock cycles	2%	1%

4. Table 2 shows the measurements of average CPI for instructions and percentage of instructions executed by category for two programs, gcc and spice. Please compute the effective CPI for the program gcc and spice. (12 points)

5. (a) How many types of pipeline hazards? Write down all types of pipeline hazards. (4 points)
(b) What kind of hazard occurs in the following instructions? And explain how to resolve it? (6 points)

```
lw   $t0,  0 ($t1)
lw   $t2,  4 ($t1)
sw   $t2,  0 ($t1)
sw   $t0,  4 ($t1)
```

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6. Consider a loop branch that branches nine times in a row, then is not taken once. What is the prediction accuracy for this branch, assuming the prediction bit for this branch remains in the prediction buffer. (10 points)

7. (a) Compute 3_{ten} X $(-3_{ten}) = 0011_{two}$ X 1101_{two} by using Booth's algorithm. (4 points) (b) In the single precision representation of the IEEE 754 floating point standard, there are one sign bit, an 8-bit exponent field and a 23-bit significand. What is the bias? (4 points) Show the IEEE 754 binary representation of the number -0.75 in single precision. (6 points)

8. (a) What is "superpipelining" ? (3 points) (b) What is "superscalar"? (3 points) (c) How would this loop be scheduled on a superscalar pipeline for MIPS? (10%)

```
Loop:  lw     $t0,   0($s1)          #$t0 = array element
       addu   $t0,   $t0, $s2        #add scalar in $s2
       sw     $t0,   0($s1)          #store result
       addi   $s1,   $s1,  -4        #decrement pointer
       bne    $s1,   $zero, Loop     #branch  $s1 != 0
```