UNIVERSITY OF MACAU

ELECTRIC AND COMPUTER ENGINEERING

ECEN1012

Computer Programming and Network Fundamentals

Final Examination

INSTRUCTIONS AND REQUIREMENTS

1. Write down your **Student Number,** and **Name** in this cover page.

2. Mark of each question is presented and total mark of this examination paper is **100.**

3. **NO** any books, notes can be used.

Student No.:   _____

Name: _____

Date: December 13, 2025

Mark：
_____

QUESTION 1 (SELECT THE BEST ANSWER BY FILLING THE ALPHABETIC INDEX IN THE ANSWER BOX.) – (30%)

1.1 The size of MAC address is _____.
   (a) 16 bits
   (b) 32 bits
   (c) 48 bits
   (d) None of the above

> **C**

1.2 Which of the following is the unguided media for signal transmission?
   (a) Optical fiber
   (b) Twisted pair cable
   (c) Radio wave
   (d) none of the above

> **C**

1.3 When we use the 1st harmonic to represent the digital signal and need to send at a rate of 20Mbps, the required bandwidth of a low-pass channel is _____.
   (a) 5MHz
   (b) 10MHz
   (c) 20MHz
   (d) none of the above

> **B**

1.4 With the initialization int i=10, j=2, *p=&i, *q=&j; the value of the express $(10 + (**\& p) / * q)$ is _____.
   (a) 5
   (b) 10
   (c) 15
   (d) none of the above.

> **C**

1.5 Which of the following MAC protocol is contention-free?
   (a) Token passing protocol
   (b) Slotted-ALOHA
   (c) Pure-ALOHA
   (d) CSMA/CD

> **A**

1.6 Which of the following belongs to the transmission impairment?
   (a) attenuation
   (b) propagation delay
   (c) transmission delay
   (d) none of the above

> **A**

1.7 The data type of the expression (10.0)/5 is _____.
   (a) int
   (b) unsigned int
   (c) double
   (d) none of the above

> **C**

1.8 With a slotted Aloha system, we assume that 5 nodes share a common transmission media. At the beginning of each time slot, all nodes do the packet transmission with probability p. To achieve the maximum system efficiency, the value of probability p is _____.
   (a) 0.2
   (b) 0.5
   (c) 1
   (d) none of the above

> **A**

1.9 Which is the output of the following code?

```
void main()
{ int n=9;
  while(n>6)
    { n--; printf("%d",n); }
}
```

    (a) 987
    (b) 876
    (c) 8765
    (d) none of the above

B

1.10 Which of the following is NOT the valid identifier?
    (a) ID4
    (b) 2Sem
    (c) Student
    (d) _name

B

1.11 The checksum of four 8-bit segments 11001100, 10101010, 11110000 and 11000011 is _____.
    (a) 00101100
    (b) 00101101
    (c) 11010011
    (d) none of the above

C

1.12 Suppose a signal travels through a transmission media and its power is reduced to the half of the transmission power. The loss of power is _____.
    (a) -1dB
    (b) -2dB
    (c) -3dB
    (d) -10dB

C

1.13 Assume that 2-bytes are used for storing the int type of data. Which is the maximum value of the positive integer that can be correctly stored?
    (a) $2^4 - 1$
    (b) $2^{15} - 1$
    (c) $2^{16} - 1$
    (d) none of the above

B

1.14 The output of the following code is _____.

```
void main()
{int i = 0;
    while(i++ <= 3)
    printf("%d", i);}
```

    (a) 12
    (b) 123
    (c) 1234
    (d) none of the above

C

1.15 In a CSMA/CD network with the date rate of 100Mbps over a 600m long cable, the signal propagation speed over the cable is $3*10^8$ m/s. The minimum frame size that can be used over this network is _____.
    (a) 200 bits

B

(b) 400 bits
(c) 600 bits
(d) None of the above

Question 2 (10 points). Suppose two active nodes (A and B) are competing for accessing a channel using slotted ALOHA. Assume each node has an infinite number of packets to send. However, node A transmits data at each slot with probability $P_A=0.4$, and node B transmits data at each time slot with the probability $P_B=0.5$. The timeslots are numbered as the 1st , 2nd , 3rd ,4th timeslot, and so on. Please answer the following sub-questions.

(2.1) Derive the probability that node A succeeds to transmit its first packet in the 3rd timeslot. (2 points)
(2.2) Derive the probability that the first successful packet transmission occurs in the 4th timeslot. (2 points)
(2.3) Derive the efficiency of this two-node system. (2 points)
(2.4) Derive the node A's transmission efficiency, that is the probability that node A successfully transmits a packet. (2 points)
(2.5) Keep the value of $P_A=0.4$. Please derive the value of P_B such that the transmission efficiency of node B is twice as large as A's transmission efficiency. (2 points)

Answer:
(1) Let h is the probability that A succeeds in an arbitrary timeslot, then we have
h=P_A(1-P_B) = 0.4*0.5=0.2;
Then, the probability that A succeeds to transmit its first packet in the 3rd timeslot is given as
[(1-h)^2]*h=(0.8^2)*0.2=0.128=12.8%
where [(1-h)^2] represents the probability that A fails its transmission at the 1st and 2nd time slots, and h represents A successfully transmits its packet at the 3rd timeslot.

(2) p(some node succeeds in a slot) $= p\_A(1 - p\_B) + p\_B(1 - P\_A)$ $= 0.4 * 0.5 + 0.5 * 0.6 = 0.2 + 0.3 =$ 0.5
p(no node succeeds in a slot) $= 1 - 0.5 = 0.5$
Hence,   the probability that the first success occurs in slot 4 is given as
= p(no node succeeds in first 3 slots) p(some node succeeds in slot 4)
$= (0.5)^3 * 0.5 = 0.0625$

(3) Efficiency = p(some nodes succeeds in a slot) $= p\_A(1 - p\_B) + p\_B(1 - P\_A)$ $= 0.4 * 0.5 + 0.5 * 0.6 = 0.2 + 0.3 = 0.5$

(4) p(node A succeeds in a slot) $= p\_A(1 - p\_B)$ $= 0.4 * 0.5 = 0.2$

(5) P_B(1-P_A)= 2*P_A(1-P_B) , That is, P_B=4/7;

Question 3 (5 points). Consider a 5-bit generator G=10011, and suppose the data to be transmitted is D=10100111, the sender will choose r additional bits, denoted as R, and append them to D to construct a CRC code.

- (a) Calculate the value of R (note that you not only need to give the final result, but also need to show the calculation process). (3 points)
- (b) Give the constructed 12-bit CRC code. (2 points)

Answer:

(a) R=1101

					1	0	1	1	1	0	1	1
10011	1	0	1	0	0	1	1	1	0	0	0	0
	1	0	0	1	1							
		0	1	1	1	1						
		0	0	0	0	0						
			1	1	1	1	1					
			1	0	0	1	1					
				1	1	0	0	1				
				1	0	0	1	1				
					1	0	1	0	0			
					1	0	0	1	1			
						0	1	1	1	0		
						0	0	0	0	0		
							1	1	1	0	0	
							1	0	0	1	1	
								1	1	1	1	0
								1	0	0	1	1
									1	1	0	1

(b) 101001111101

Question 4 (5 points). Please fill in the value of these expressions.

Expression	Value
3 && 4 || 5 + 5	1
! ! 3 * ! 4	0
10+25%2*6	16
!2*!3 + 1	1
! 5 <= 2	1

Hints: please refer to the following table for the precedence of different operators.

Operator					Associativity	Precedence
( )	++ (postfix)	-- (postfix)			left to right	Highest
+ (unary)	- (unary)	++ (prefix)	-- (prefix)	!	right to left	
*	/	%			left to right	
+	-				left to right	
<	<=	>	>=		left to right	
==	!=				left to right	
&&					left to right	
||					left to right	
?:					right to left	
=	+=	-=	*=	/= etc.	right to left	
, (comma operator)					left to right	Lowest

Question 5 (5 points). Read the following program and write the output.

Code:

```c
#include
int main(void)
{ int Number=0;
  do
   {
     switch (Number)
        {
          default:
                printf("Magusa\n");
          case 0:
                printf("Girne\n");
                break;
          case 3:
                printf("Lefkosa\n");
                break;
          case 2:
                ++Number;
          case -1:
                printf("Iskele\n");
                break;
          case 1:
                printf("Karpaz\n");
        }
      ++Number;
     }
     while(Number <5);
     return (0);
}
```

Output:

G	i	r	n	e	
K	a	r	p	a	z
I	s	k	e	lh	e
M	a	g	u	s	a
G	i	r	n	e	

Question 6 (5 points). Read the following program and write the output.

Code:
```c
#include <stdio.h>
int n=100;
void func1()
     {
       int n=40;
       printf("%d\n", n);
     }
void func2()
     {
     printf("%d\n", n);
     }

int main(void)
     {
       int m=20, n=30;
       func1();
       func2();
       {
         int n=50;
         printf("%d\n", n);
       }
       printf("%d\n%d\n", m++, ++n);
       getch();
       return(0);
     }
```

Output:

4	0	
1	0	0
5	0	
2	0	
3	1	

Question 7 (4 points). Read the following program and write the output.

```c
#include <stdio.h>

void mysterious(int *a, int *b, int *c)
    { *a = *c;
    *b = *b + *a;
    *c = *a - *b;
```

```
        }

int main (void )
    { int w = 5;
    int x = 1;
    int y = 3;
    int z = 2;
    mysterious(&x, &y, &w);
    printf("%d\n %d\n %d\n %d\n", w, x, y, z);
    mysterious(&w, &w, &z);
    printf("%d\n %d\n %d\n %d\n", w, x, y, z);
    getch();
    return(0);
    }
```

Output:

-	3
5	
8	
2	
4	
5	
8	
0	

Question 8 (8 points). Write C statements according to the following descriptions. If necessary, do necessary declarations and initialization.

(8. 1) Declare a one-dimensional int array with the identifier arr of length 10 and initialize all elements to 1.

Code:

```
int arr[10];
int i;
for(i=0; i<10; i++)
arr[i]=1;
```

(8.2) Assign 10 to 40 to the first and fifth element of the array arr in part (a) respectively and display these two elements on the screen.

Code:

```
arr[0] = 10;
arr[4] = 40;
printf("first value %d fifth value %d\n", arr[0], arr[4]);
```

(8.3) Enter new values for the array defined in (a) from the keyboard and print the array elements in one row on the screen.

Code:

```
int i;
for(i=0; i<10; i++)
        {scanf("%d", &arr[i]);
         printf("%d ", arr[i]);
         }
```

(8.4) Find the summation of array arr elements defined in part (c) and print the result on the screen.

Code:

```
   int sum = 0;
   for(i=0; i<10;i++)
sum+=sum[i];
printf("summation %d \n", sum);
```

Question 9 (8 points). Please complete the following C program to calculate the power of a number using **recursion**, where the power and the number are input from keyboard using scanf(). For example, when the input for base and power are 4 and 3, respectively, the output of the program is given as follows:

Enter the value of base: 5
Enter the value of power: 3
The value of 5 to the power of 3 is: 125

```
#include <stdio.h>
long int getPower(int b, int p)

int main()
{
    int base, power;
    long int result;

    printf("Enter the value of base: ");
    scanf("%d", &base);

    Please complete this part of code

    printf("Input the value of power: ");
    scanf("%d",&power);
    result=getPower(base,power);
    printf("The value of %d to the power of %d is: %ld\n",base,power,result);
    system("pause");
    return 0;
}

long int getPower(int b, int p)
{
```

Please complete this part of code

```
   long int result = 1;
  if(p == 0) return result;
   result=b*(getPower(b,p-1));


}
```

Question 10 (8 points). A prime number is a number greater than 1 whose only factors are 1 and itself. The smallest prime number is 2. Please write a program to find first n prime numbers, where n is the input from the keyboard.

For example, when the input n is 5, the output should be the follows.

First 5 prime numbers are: 2   3   5   7   11

```
#include<stdio.h>

int main()
{

    int n,i = 3, count, c;

    scanf("%d", &n);

    if(n >= 1)
    {
        printf("First %d prime numbers are : %d ", n, 2);

    }

    // iteration for n prime numbers
    // i is the number to be checked in each iteration starting from 3
    for(count = 2; count <= n; i++)
    {
        // iteration to check c is prime or not
        for(c = 2; c < i; c++)
        {
            if(i%c == 0)
                break;
        }

        if(c == i)   // c is prime
        {
            printf("%d ", i);
            count++;      // increment the count of prime numbers
        }

    }

    return 0;
}
```

Question 11 (10 points). Write a C program to find the largest and smallest elements in an array using pointers, where the array has 5 elements and the elements of the array are input from the keyboard using the function scanf().

```c
#include <stdio.h>

void findMinMax(int *arr, int size, int *max, int *min) {
    *max = *min = *arr;
    for (int i = 1; i < size; i++) {
        if (*(arr + i) > *max) {
            *max = *(arr + i);
        }
        if (*(arr + i) < *min) {
            *min = *(arr + i);
        }
    }
}

int main() {
    int arr[5],i, size=5;
    int max, min;
    for(i=0; i<size; i++)
        scanf("%d", &arr[i]);

    findMinMax(arr, size, &max, &min);

    printf("Largest element: %d\n", max);
    printf("Smallest element: %d\n", min);

    return 0;
}
```

Draft/Extended Page:

Please indicate clearly the question number which your answer refers to, otherwise it may not be scored.