Ain Shams University
Faculty of Science
Department of Mathematics
Computer Science Division
Date: 31/Aug/2022
Total Marks: 90

Group: 1st Year
Course Name: Computer Programming I
Course Code: Comp 104
Time Allowed: 2 hours
No. of Page Sides: 2

Question 1 [20 pts]

1. Write a program to calculate the final price of an item. There are two taxes on each item: the government tax is 4% and the city tax is 2% of the original price. If the item is luxury, with original price over 100,000 Egyptian pounds, then there is an additional 10% luxury tax. The program should read the original price of an item and whether the item is luxury. Then the program computes and prints out the final price of the item.
2. What is the output of the following program, assuming all variables are declared.

```
for (int j=0; ; ) {
    cout << j * 25 <<"-";
    if (j!=7)
        cout << (j+++1) * 25 - 1 << endl;
    else {
        cout << (j+++1) * 25 << endl;
        break;
    }
}
```

3. Let $n = a_k a_{k-1} a_{k-2} \ldots a_1 a_0$ be an integer and $t = a_0 - a_1 + a_2 - \ldots + (-1)^k a_k$. For example, if $n = 8784204$ then $t = 4 - 0 + 2 - 4 + 8 - 7 + 8 = 11$. It is known that n is divisible by 11 if and only if t is divisible by 11. Write a program that prompts the user to enter a positive integer and then uses this criterion to determine whether the number is divisible by 11.

Question 2 [25 pts]

1. Write a program that reads the letter codes 'A' to 'Z' and prints the corresponding telephone digit based on the dial pad on the right. If the user enters any other letter the program prints an "*invalid input*" to the user. The program stops and prints "*Done!*" when the user enters '#'.

Sample Output:

```
Enter a letter: B
The corresponding digit is: 2

Enter a letter: @
invalid input

Enter a letter: #
Done!
```

2. Write a program that reads a student's GPA and whether the student is male or female. The program reads a letter 'f' for female or 'm' for male followed by a GPA. The programs reads these information for 20 students. Then the program counts the number of males and females and their average GPA.
3. Given the following program segment, write a *while* loop that has the same output.

```
for (int i =1 ; i<=5 ; i++) {
    for (int j=1; j<=5; j++)
        cout << "____" << i*j;
    cout << endl;
}
```

Question Three [20 Marks]

a) [10 Marks] Write a C ++ program that reads two arrays X and Y of some integers (of length $n \geq 20$). Then

1) [7 Marks] Compute the sample correlation coefficient defined as:

$$\frac{\sum_{i=0}^{n-1}(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\sum_{i=0}^{n-1}(x_i-\bar{x})^2 \sum_{i=0}^{n-1}(y_i-\bar{y})^2}} \text{ where } \bar{x} = \frac{1}{n}\sum_{i=0}^{n-1} x_i \text{ and } \bar{y} = \frac{1}{n}\sum_{i=0}^{n-1} y_i$$

2) [3 Marks] Show how to insert an integer into the array X at the first position

b) [10 Marks] Trace the following C++ code and conclude the output.

```
int A[2][3]={ 9, 8, 15, 18, 3, 6};
int sum=0;
for (int i=0;i<2;i++){
    for(int j=0;j<3;j++){
        if(i>0 && A[i][j]%2==0)
            sum+= 2*A[i][j]+ A[i-1][j];
        else sum+= 2*A[i][j];
            cout<<"sum="<<sum<<endl;
    }
}
```

Question Four [25 Marks]

a) [10 Marks] Write a complete program using C++ function that reads three numbers a, b and c and then computes the following expression: $E = \frac{f(3+a,b+2a)\cos(a+b)}{f(2a,a+b)h(3ab)}$ where

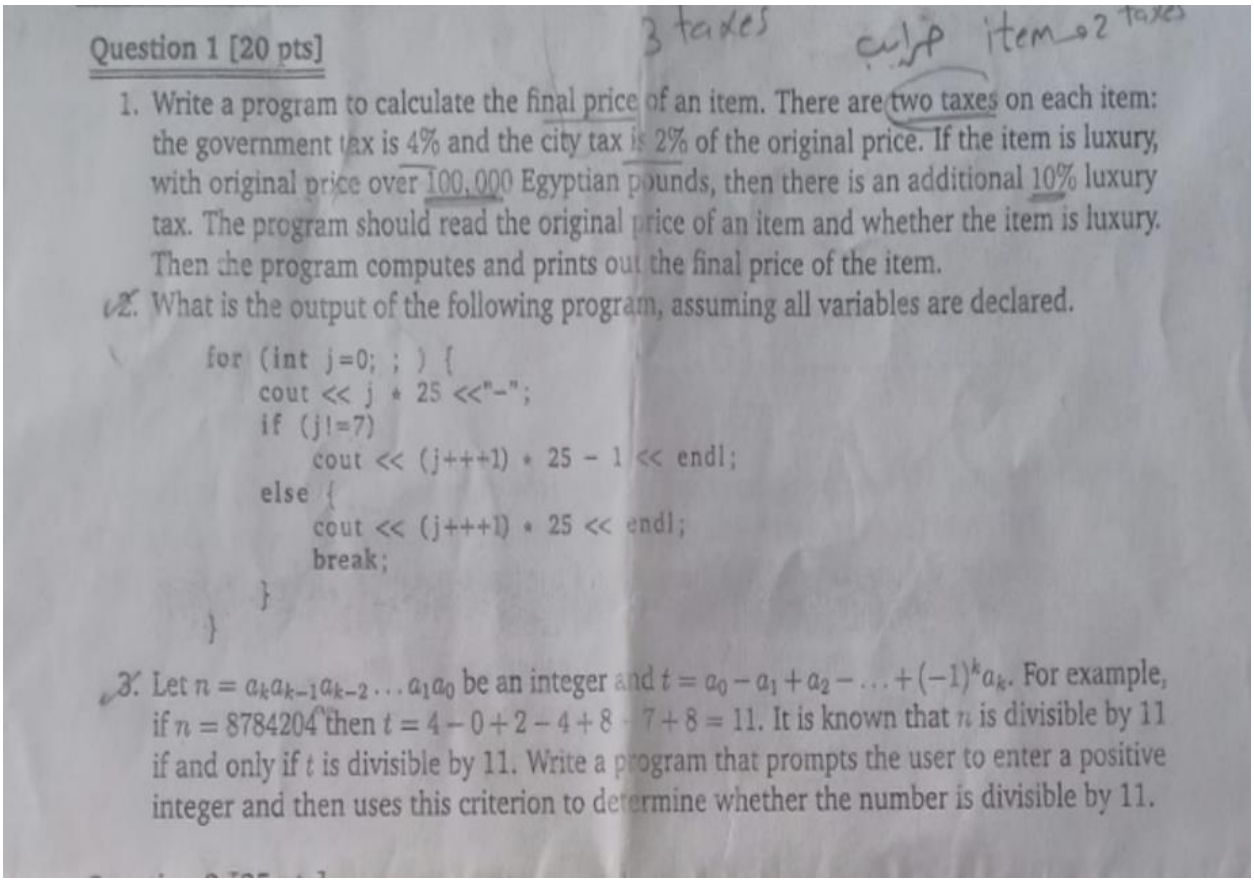
$$f(x,y) = \begin{cases} x^2+y^2 & \text{if } x \geq y \\ xy & \text{if } x < y \end{cases}$$

$$h(x) = \begin{cases} x^2 & \text{if } x \geq 0 \\ -x^2 & \text{if } x < 0 \end{cases}$$

b) [15 Marks] Write the complete function definition in C++ for the following functions:

1. "getAverage" that returns the average of some real numbers located in an array.
2. "getMin" that returns the minimum of real numbers located in an array.
3. "getCount" that returns the number of elements in an array that are smaller than the average of all elements.

Quiestion [1]



Question 1 [20 pts]

1. Write a program to calculate the final price of an item. There are two taxes on each item: the government tax is 4% and the city tax is 2% of the original price. If the item is luxury, with original price over 100,000 Egyptian pounds, then there is an additional 10% luxury tax. The program should read the original price of an item and whether the item is luxury. Then the program computes and prints out the final price of the item.
2. What is the output of the following program, assuming all variables are declared.

```
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    cout << j * 25 <<"-";
    if (j!=7)
        cout << (j++1) * 25 - 1 << endl;
    else {
        cout << (j++1) * 25 << endl;
        break;
    }
}
```

3. Let $n = a_k a_{k-1} a_{k-2} \ldots a_1 a_0$ be an integer and $t = a_0 - a_1 + a_2 - \ldots + (-1)^k a_k$. For example, if $n = 8784204$ then $t = 4 - 0 + 2 - 4 + 8 - 7 + 8 = 11$. It is known that n is divisible by 11 if and only if t is divisible by 11. Write a program that prompts the user to enter a positive integer and then uses this criterion to determine whether the number is divisible by 11.

Quiestion [1]1

ملخص السؤال بيقول ان فيه ضريبه للحكومه ب4% و للمدينه ب2% و 10% ضريبه رفاهيه.

الحل الأول ورقى الشركه عاوزه تاخد مبلغ معين من المنتج (الى هيدخلو اليوزر فى البرنامج)والباقى ضرايب

هنفرض ان الرقم الى هيدخلو اليوزر 100000 دا السعر الى هيوصل للشركه عن طريق المنتج يبقى الحل كدا

100000=Num – Num * 16%

100000=(84/100)*Num

Num = (100/84)*100000

If we switch between (100000 and Price)

Num = Price*(100/84)

```
#include<iostream>
using namespace std;
int main()
{
	float price, num, govtax, citytax, luxurytax;
	cout << "enter the price that you want to earn \n";
	cin >> price;
	num = price * (100.00 / 84);
	govtax = num * 0.04;
	citytax = num * 0.02;
	luxurytax = num * 0.10;
	cout << "the price which the item will be sold by =  " << num << endl;
	cout << "the goverment tax(4%) =   " << govtax << endl;
	cout << "the citytax(2%) =   " << citytax << endl;
	cout << "the luxurytax(10%) =   " << luxurytax << endl;
	//100000 للتأكيد على ان الناتج الأخير ب
	cout << "the price which wonna be took is =   " << num - (luxurytax + citytax + govtax) << endl;
	return 0;
	system("pause");
}
```

Quiestion [1]2

The Output is

0-24

25-49

50-49

75-99

100-124

125-149

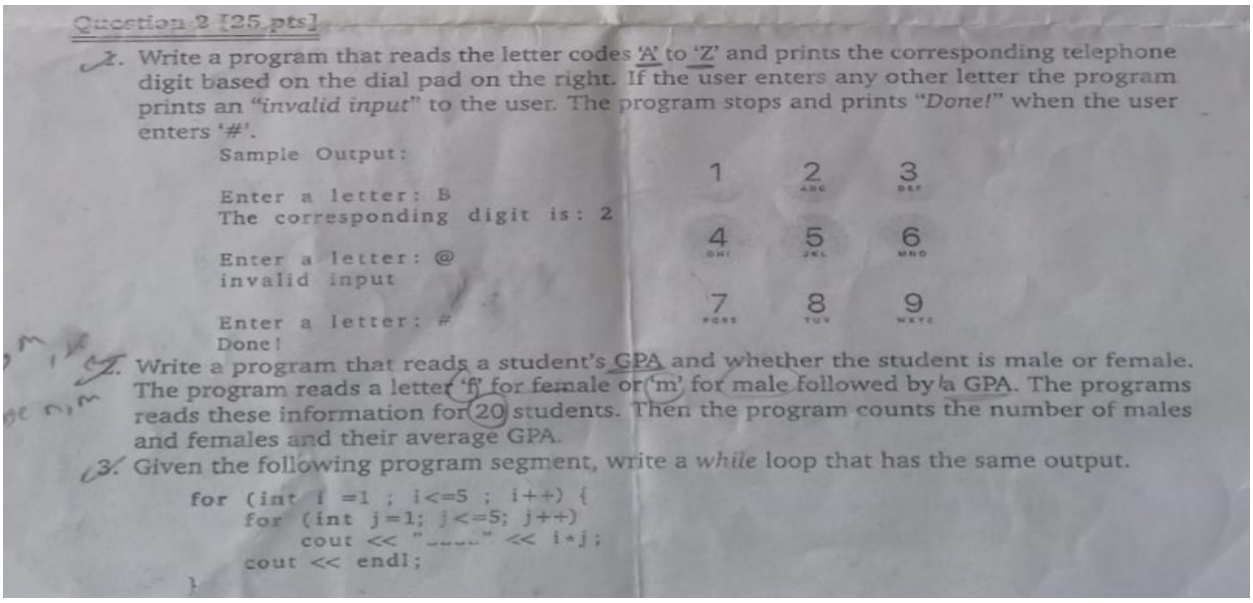
150-174

175-200

Quiestion [1]3

```
#include<iostream>
using namespace std;
int main()
{
	int n, t=0, counter = 1, z, fact = 1;
	do {
		cout << "enter positive number  \n";
		cin >> n;

	} while (n < 0);
	z = n;
	for (int i = 1;; i++) {
		z /= 10;
		counter++;
		if (z == 0) break;
	}
	for (int i = 0; i < counter; i++)
	{
		t += fact * (n % 10);
		n /= 10;
		fact *= -1;
	}
	cout << "t  =   " << t << endl;
	if (t % 11 == 0)cout << "is divisable by 11 \n";
}
```



Question 2 [25 pts]

1. Write a program that reads the letter codes 'A' to 'Z' and prints the corresponding telephone digit based on the dial pad on the right. If the user enters any other letter the program prints an "*invalid input*" to the user. The program stops and prints "*Done!*" when the user enters '#'.

Sample Output:

```
Enter a letter: B
The corresponding digit is: 2

Enter a letter: @
invalid input

Enter a letter: #
Done!
```

1 2 ABC 3 DEF
4 GHI 5 JKL 6 MNO
7 PQRS 8 TUV 9 WXYZ

2. Write a program that reads a student's GPA and whether the student is male or female. The program reads a letter 'f' for female or 'm' for male followed by a GPA. The programs reads these information for 20 students. Then the program counts the number of males and females and their average GPA.

3. Given the following program segment, write a *while* loop that has the same output.

```
for (int i =1 ; i<=5 ; i++) {
    for (int j=1; j<=5; j++)
        cout << "_____" << i*j;
    cout << endl;
}
```

Quiestion [2]1

```
#include <iostream>

using namespace std;

int main()

{

        char a;

        cin >> a;

        switch (a) {

        case 'A':case 'B':case 'C': cout << 2; break;

        case 'D':case 'E':case 'F': cout << 3; break;

        case 'G':case 'H':case 'I': cout << 4; break;

        case 'J':case 'K':case 'L': cout << 5; break;

        case 'M':case 'N':case 'O': cout << 6; break;

        case 'P':case 'Q':case 'R':case'S': cout << 7; break;

        case 'T':case 'U':case 'V': cout << 8; break;

        case 'W':case 'X':case 'Y':case'Z': cout << 9; break;
```

```
        case '#': cout << "done!"; break;

        default: cout << "invalid input";


        }

        return 0;

}
```

Quiestion [2]2

```
enter gender then enter GPA
m
20
enter gender then enter GPA
m
40
enter gender then enter GPA
f
100
enter gender then enter GPA
f
200
number of male is     =  2
avg of male gpa is    =  30
number of female is   =  2
avg of female gpa is  =  150
```

```
#include<iostream>
using namespace std;
int main()
{
        int counterm = 0, summ = 0, a[4], counterf = 0, sumf = 0;
        char b[4];
        for (int i = 0; i < 4; i++) {
                cout << "enter gender then enter GPA\n";
                cin >> b[i] >> a[i];
                if (b[i] == 'm')
                {
                        summ += a[i];
                        counterm++;
                }
                else if (b[i] == 'f')
                {
                        sumf += a[i];
                        counterf++;
                }
        }
        cout << "number of male is    =  " << counterm << endl;
        cout << "avg of male gpa is   =  " << summ / counterm << endl;
        cout << "number of female is  =  " << counterf << endl;
        cout << "avg of female gpa is =  " << sumf / counterf << endl;
}
```

Quiestion [2]3

```
#include<iostream>
using namespace std;
int main()
{
	int i = 1;
	while (i<=5)
	{
		int j = 1;
		while (j <= 5)
		{
			cout << "    " << i * j;
			j++;
		}
		cout << endl;
		i++;
	}
}
```

Quiestion [3]

Question Three [20 Marks]

a) [10 Marks] Write a C ++ program that reads two arrays X and Y of some integers (of length $n \geq 20$). Then

1) [7 Marks] Compute the sample correlation coefficient defined as:

$$\frac{\sum_{i=0}^{n-1}(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\sum_{i=0}^{n-1}(x_i-\bar{x})^2 \sum_{i=0}^{n-1}(y_i-\bar{y})^2}} \text{ where } \bar{x}=\frac{1}{n}\sum_{i=0}^{n-1}x_i \text{ and } \bar{y}=\frac{1}{n}\sum_{i=0}^{n-1}y_i$$

2) [3 Marks] Show how to insert an integer into the array X at the first position

b) [10 Marks] Trace the following C++ code and conclude the output.

```
int A[2][3]={ 9, 8, 15, 18, 3, 6};
int sum=0;
for (int i=0;i<2;i++){
    for(int j=0;j<3;j++){
        if(i>0 && A[i][j]%2==0)
            sum+= 2*A[i][j]+ A[i-1][j];
        else sum+= 2*A[i][j];
            cout<<"sum="<<sum<<endl;
    }
}
```

Quiestion [3]A

```
#include<iostream>
#include<math.h>
using namespace std;
int main()
{
	int x[1000], y[1000], sumx = 0, sumy = 0, n, i, avgx, avgy, sumxpow = 0, sumypow = 0 ;
	float z;
	do {
		cout << "enter value of n betweek 20,1000 \n";
		cin >> n;
	} while (n < 20 || n>1000);
	cout << "enter value of Array x Then Array y \n";
	for (i = 0; i < n; i++)
	{
		cin >> x[i] >> y[i];
		sumx += x[i];
		sumy += y[i];
	}
	avgx = sumx / n;
	avgy = sumy / n;

	sumx = 0;
	sumy = 0;
	for (i = 0; i < n; i++)
	{
		sumx += x[i] - avgx;
		sumy += y[i] - avgy;

		sumxpow += pow(x[i] - avgx, 2);
		sumypow += pow(y[i] - avgy, 2);
	}
	z = (1.00 * sumx * sumy) / sqrt(sumxpow * sumypow);
	cout << "the output ===   " << z << endl;
}
```

Quiestion [3]B

```
#include<iostream>
#include<math.h>
using namespace std;
int main()
{
	int a[2][3] = { 9,8,15,18,3,6 }, sum = 0;
	for (int i = 0; i < 2; i++)
	{
		for (int j = 0; j < 3; j++)
		{
			if (i > 0 && a[i][j] % 2 == 0)
				sum += 2 * a[i][j] - a[i - 1][j];
			else
				sum += 2 * a[i][j];
			cout << "sum =" << sum << endl;
		}
	}
}
```

Output

sum =18

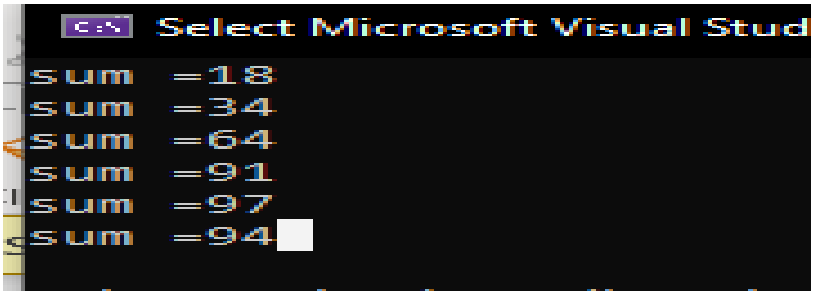
sum =34

sum =64

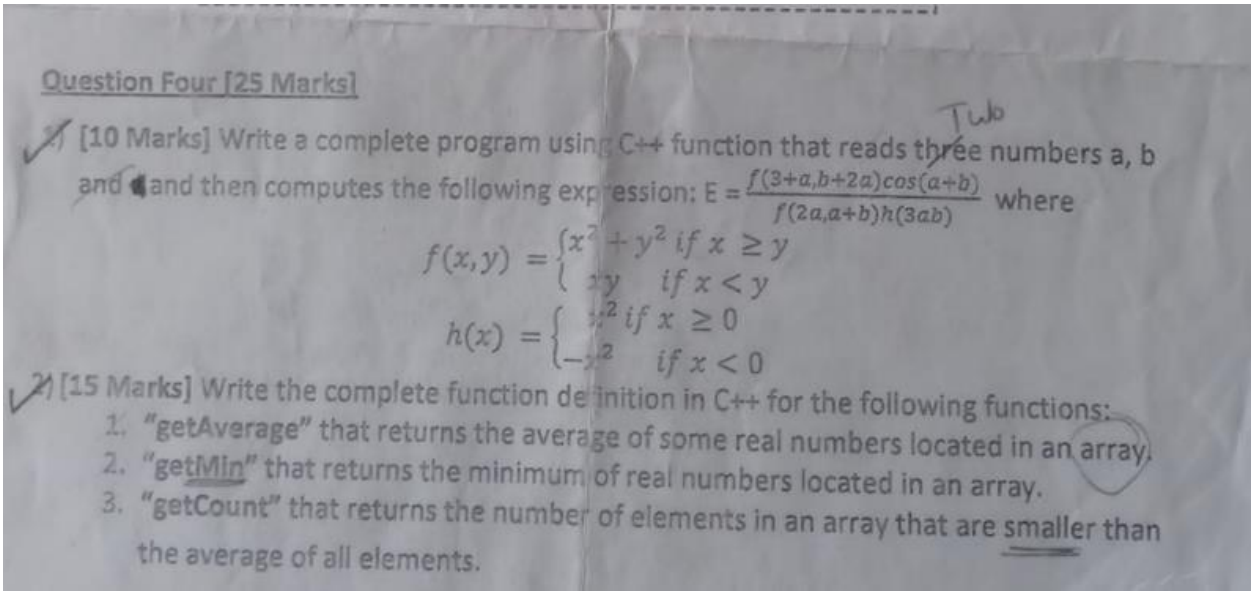
sum =91

sum =97

sum =94



Quiestion [4]



Question Four [25 Marks]

1) [10 Marks] Write a complete program using C++ function that reads three numbers a, b and c and then computes the following expression: $E = \frac{f(3+a,b+2a)\cos(a+b)}{f(2a,a+b)h(3ab)}$ where

$$f(x,y) = \begin{cases} x^2 + y^2 & if\ x \geq y \\ xy & if\ x < y \end{cases}$$

$$h(x) = \begin{cases} x^2 & if\ x \geq 0 \\ -x^2 & if\ x < 0 \end{cases}$$

2) [15 Marks] Write the complete function definition in C++ for the following functions:

1. "getAverage" that returns the average of some real numbers located in an array.
2. "getMin" that returns the minimum of real numbers located in an array.
3. "getCount" that returns the number of elements in an array that are smaller than the average of all elements.

Quiestion [4]1

```
#include<iostream>
#include<math.h>
using namespace std;

int f(int x, int y) {
	if (x >= y) return pow(x, 2) + pow(y, 2);
	else   return x * y;
}
int h(int x) {
	if (x >= 0) return pow(x, 2);
	else return -1 * pow(x, 2);
}
int main()
{
	int a, b, c;
	float E;
	cout << "enter values of a then b then c \n";
	cin >> a >> b >> c;
	E = (f(3 + a, b + 2 * a) * cos(a + b)) / (f(2 * a, a + b) * h(3 * a * b));
```

```
}

Cout<<”E=”<<E<<endl;
```

Quiestion [4]2

```
#include<iostream>
#include<math.h>
using namespace std;

float getaverage(int a[], int n) {
	float avg, sum = 0.0;
	for (int i = 0; i < n; i++) {
		sum += a[i];
	}
	avg = (sum) / n;
	return avg;
}
int getmin(int a[], int n) {
	int min = a[0];
	for (int i = 1; i < n; i++) {
		if (min > a[i])
			min = a[i];
	}
	return min;

}
int getcount(int a[], int n , int avg) {
	float  count = 0.0;
	for (int i = 0; i < n; i++) {
		if (a[i] > avg) break;
		count++;
	}
	return count;
}
int main()
{
	int a[10] = { 1,2,3,4,5,6,7,8,9,10 };
	cout << "average =" << getaverage(a, 10) << endl;
	cout << "min =" << getmin(a, 10) << endl;
	cout << "count =" << getcount(a, 10 , getaverage(a, 10)) << endl;

}
```