



**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR**

FIRST YEAR 2ND SEMESTER EXAMINATIONS

**BACHELOR OF SCIENCE IN
COMPUTER SCIENCE, INFORMATION TECHNOLOGY,
EDUCATION TECHNOLOGY, KNOWLEDGE MANAGEMENT,
MATHEMATICS, PHYSICS, STATISTICS, EDUCATION
SCIENCE, GEOGRAPHICAL INFORMATION SCIENCE**

**COURSE CODE: BCS 120 / BIT 121
COURSE TITLE: OBJECT ORIENTED PROGRAMMING I**

DATE: TUESDAY 11TH April 2023

TIME: 8:00 - 10:00

INSTRUCTIONS TO CANDIDATES

THIS IS AN OPEN BOOK EXAMINATION

Answer Question **ONE** and Any **OTHER 2** questions

Ensure your answers/ideas are clearly expressed

All your answers must be clearly numbered

Write in ink. Rough work can be done (in answer booklet) in pencil and will not be marked. Cross out any rough work.

Calculators, phones, tablets, computers not allowed

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 06 Printed Pages, including cover page. Please Turn Over.

QUESTION ONE: COMPULSORY QUESTION

[30 MARKS]

A class is declared as

```
1 class Birthday{
2     private:
3         int days[12] = {31,28,31,30,31,30,31,31,30,31,30,31};
4         string names[12] = {"Jan", "Feb", "Mar", "Apr", "May", "Jun", "
5         Jul", "Aug", "Sep", "Oct", "Nov", "Dec"};
6         int day;
7         int month;
8         int year;
9     public:
};
```

The year should be initialized to a value between 1000 and 2010, month should be initialized to any value between 1 and 12 and day is initialized to any valid value respective to the month and year. A leap year is a year divisible by 4 and number of days in February is 29.

- (a) Write the definition of set functions for the instance variables such that their calls can be cascaded. [3 Marks]
- (b) Write definition of get function for each of the instance variables. [3 Marks]
- (c) Assume a constructor had been defined in the class Birthday as

```
1 Date (int day, int Month, int year = 1000){
2     this->year = year
3     ;this.month = month;
4     day = day;
5 }
```

- (i) Identify and explain **TWO** errors in the constructor definition. [2 Marks]
- (ii) Explain **TWO** errors in a line of code written in main function as

```
1 Birthday b(13);
```

[2 Marks]

- (d) Write definition of a function **void leap()** such that it changes number of days in February to **29** if the value in **year** represents a leap year. [3 Marks]

- (e) Write definition of function **string toString()** that returns a string representation of the birthday. If year is set to **2009**, month is initialized to **2** and day is assigned a value **14**, the function should return **14 - Feb - 2009** [3 Marks]
- (f) Given a year as a four digit integer, index of the day on which first of January for that year falls is given by

$$first = R(5(R((y - 1), 4)) + 4(R((y - 1), 100)) + 6(R((y - 1), 400)), 7)$$

where $R(a, b)$ is a **mod** function that returns $a\%b$. Using a **while** loop, write definition of function **int firstMonth()** such that it returns the index of first day of the month initialized in the variable **month** for the year initialized in **year**. If **month** is initialized to **4** and **year** initialized to **2023**, the function should return **5** since April 2023 starts on a **Saturday** [4 Marks]

- (g) Using a **do...while** loop within a **for** loop, write the definition of a function declared as **void calendar()**; such that it displays the calendar of the month initialized in variable **month** for the year in **year**. If month is initialized to **4** and year is initialized to **2023**, your function should display

Question (g) Sample Output

Calendar for Apr 2023						
Mo	Tu	We	Th	Fr	Sa	Su
27	28	29	30	31	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
1	2	3	4	5	6	7

[10 Marks]

QUESTION TWO

[15 MARKS]

- (a) Standard deviation of data in a dataset is given by

$$s = \sqrt{\frac{\sum_{i=1}^N (x_i - \mu)^2}{N}}$$

where **N** is the number of data items in the set, **x** is individual data item in the set and μ is the mean of data items in the set given by

$$\mu = \frac{\sum_{i=1}^N x_i}{N}$$

(i) Using a **for** loop, write definition of a function that receives the dataset and size of the dataset as parameters, calculates and return mean of data items in the dataset. [3 Marks]

(ii) Using a **do...while** loop, write definition of a function that receives the dataset and size of the dataset as parameters, calculates and return the standard deviation of the dataset. Re-use the function defined in (i) above [4 Marks]

(b) What would be the output of the code except below [4 Marks]

```
1  int x = 0;
2  while(x <= 8) {
3      if( x % 4 != 1)
4          cout << x << "\t";
5      else
6          cout << "No!" << endl;
7      x += 2 - 1;
8  }
9 }
```

(c) A positive integer is called a perfect number if it is equal to the sum of all of its positive divisors, excluding itself. For example, **6** is the first perfect number because $6 = 3 + 2 + 1$. The next is $28 = 14 + 7 + 4 + 2 + 1$. There are four perfect numbers less than **10,000**. Using a **for** loop within a **do...while** loop, write a C++ program to find and display all these four numbers and their factors. Your output should match sample output below. [4 Marks]

Question (c) Sample Output

```
1 + 2 + 3 = 6
1 + 2 + 4 + 7 + 14 = 28
```

QUESTION THREE

[15 MARKS]

(a) A **Week** has got 7 days numbered 1 to 7. Each day has a name with day 1 being Monday and day 7 Sunday. The names of the days are stored in a private array **days** whose structure in memory is shown in Figure 1.

names →

Mon	Tue	Wed	Thu	Fri	Sat	Sun
-----	-----	-----	-----	-----	-----	-----

Figure 1: Structure of an array in memory

- (i) Write a line of code that initializes the array **names** with names shown in Figure 1. [2 Marks]
- (ii) Write the definition of a function that will initialize day of the week. Day is initialized to a number between 1 and 7 (1 and 7 inclusive) or initialized to 1 if the day is out of the specified range. [2 Marks]
- (iii) Write the definition of the function that returns the name that corresponds to the current day of the week. If current day is 1, this function returns **Mon**. [Don't use decision making constructs] [2 Marks]
- (iv) Write definition of a function **int when(int)** such that it returns name of day, **x** days after current day. [Only use one decision making construct] [2 Marks]
- (b) In programming, **break** statement is considered as unstructured. Re-write the loop below, without using keyword **break**. [2 Marks]

```

1  int data[7] = {61, 12, 34, 50, 40, 67};
2  int i = 5;
3  while(i > -1) {
4      if(89 == data[i]){
5          cout << data[i] << " found\n";
6          break;
7      }
8      i -= 1;
9  }
```

- (c) A rectangle is a 2D shape. All 2D shapes have name. A rectangle has length and width in addition to attributes of 2D shapes. A rectangle has area and perimeter derived from its length and width.
- (i) Write the class definition for **Shape2D** to model 2D shape [2 Marks]
- (ii) Write the class definition for **Rectangle** to model a rectangle. [3 Marks]

QUESTION FOUR

[15 MARKS]

Maclaurin series for natural logarithm of a number is given by

$$\ln(1 - x) = - \sum_{n=1}^{\infty} \frac{x^n}{n}$$

$$\ln(1 + x) = \sum_{n=1}^{\infty} (-1)^{n+1} \frac{x^n}{n}$$

for all $|x| < 1$. Given a partial class definition as

```
1 class Log{
2     private:
3         double x;
4     publi:
5 };
```

- (i) Write the definition of function **void setX(double)** such that it properly initialize **x** where $0.0 < x < 1.0$. [3 Marks]
- (ii) Write defintion of get function for instance variable **x**. [2 Mark]
- (iii) Using a **while** loop, write definition of a function **double log_m_x()** such that it returns natural logarithm of **1-x** [3 Marks]
- (iv) Using a **do...while** loop, write definition of a function **double log_p_x()** such that it returns natural logarithm of **1+x** [3 Marks]
- (v) Write definition of the main function. In the function:-
 - Create an object of the class **Log**
 - Prompt user to enter value for **x** and call appropriate function of class **Log** to initialize instance variable **x**, only if $x < 1.0$ then call appropriate member functions of **Log** class, display **ln(1 + x)** and **ln(1 - x)**
 - If $x \geq 1$, display error message **"Input should be greater than 0 and less than 1"** and exit.

For instance, If the user enters **0.5** as value of **x**, the main function display an output equivalent to **Sample Output 1** shown below

```
Sample Output 1
Enter value of x : 0.5
ln( 1 + 0.5 ) = 0.405465
ln( 1 - 0.5 ) = -0.693147
```

but if user enters a value greater than 1 (say user enters 1.5), output should be equivalent to **Sample Output 2** shown below

```
Sample Output 2
Enter value of x : 1.5
Input should be greater than 0 and less than 1
```

[4 Marks]