



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

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR**

FIRST YEAR 2ND SEMESTER EXAMINATIONS

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

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

DATE: MONDAY 25TH APRIL, 2022 TIME: 12:00 – 2:00 PM

INSTRUCTIONS TO CANDIDATES

THIS IS AN OPEN BOOK EXAMINATION

Answer Question **ONE (1)** 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 04 Printed Pages. Please Turn Over. ▲

QUESTION ONE: COMPULSORY QUESTION [30 MARKS]

A class is declared as

```
1 class Date
2 {
3     private:
4         int days[12] = {31,28,31,30,31,30,31,31,30,31,30,31,30,31};
5         string names[12] = {"Jan", "Feb", "Mar", "Apr", "May", "Jun", "
6         Jul", "Aug", "Sep", "Oct", "Nov", "Dec"};
7         int day;
8         int month;
9         int year;
10    public:
11 };
```

The year should be initialized to a value between 2000 and 2100, 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 definition of a function that return true if the value held in variable **year** represents a leap year, otherwise returns false. [3 Marks]
- (b) Write the definition of set functions such that their calls can be cascaded. [6 Marks]
- (c) Write definition of get function for each of the instance variables. [3 Marks]
- (d) Assume a constructor had been defined in the class Date as

```
1 Date (int y, int month, int day){
2     y = year;
3     month = month;
4 }
```

- (i) Identify and explain **TWO** errors in the constructor definition. [2 Marks]
- (ii) Write C++ lines(s) of code within the constructor that should be used to properly initialize instance variable day. [3 Marks]
- (iii) Explain the error in a line of code written in main function as

```
1 Date d;
```

[2 Marks]

(e) 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 $a\%b$. Write a function that will return the index of the day on which first of January for the year initialized in **year falls** [3 Marks]

(f) 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 2022, your function should display

Question (f) Sample Output

```
Calendar for Apr 2022
Mo Tu We Th Fr Sa Su
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
```

[8 Marks]

QUESTION TWO

[15 MARKS]

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

```
1 int x = 0;
2 for(; x <= 8 ; x--) {
3     if( x % 4 != 1)
4         cout << x;
5     else
6         cout << "\nNo!\n";
7     x += 2;
8 }
9 }
```

(b) Write a function that returns the average of an array passed to it. [3 Marks]

(c) A sequence of numbers is given by

$$r_i = a_{i-1} * b_{i-1} + a_{i-1}$$

for $a_0 = 1$ and $b_0 = 4$, Using a **do...while** loop, write a C++ program that will display the first 10 numbers in this sequence. [4 Marks]

(d) 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 while loop(s), write a C++ program to find and display all these four numbers. [4 Marks]

QUESTION THREE

[15 MARKS]

A **Year** has got 12 months numbered 1 to 12. Each month has a name with month 1 being January and month 12 December. The names of the months are stored in a private array **months** whose structure in memory is shown in Figure 1.



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 a month of the year. Month is initialized to a number between 1 and 12 (1 and 12 inclusive) or initialized to -1 if the month is out of the specified range. [2 Marks]
- (iii) Write the definition of function that returns the number of current month of the year. [2 Marks]
- (iv) Write the definition of the function that returns the name that corresponds to the current month of the year. If current month is 1, this function returns **Jan**. [Don't use decision making constructs] [2 Marks]
- (v) Write definition of a function that returns the name of the next month. [Only use one decision making construct] [1 Marks]
- (vi) Write definition of a function that returns the name of the previous month. [Only use one decision making constructs] [2 Marks]
- (vii) Write definition of a function that adds one to the current month. [2 Marks]
- (viii) Write definition of a function that adds number of months it receives as a parameter to the current month. [Re-use the function defined in (vii) above] [2 Marks]

QUESTION FOUR

[15 MARKS]

- (a) Although in C++ programming, **break** statement is considered as unstructured. Re-write the loop below, using keyword **break**. [3 Marks]

```
1 int data[7] = {61, 12, 34, 50, 40, 67};
2 int i = 0;
3 while(data[i] != 50) {
4     i += 1;
5 }
6 cout << data[i] << " found\n";
```

- (b) Taylor series for **sin(x)** and **cos(x)** are defined as

$$\sin(x) = \sum_{n=0}^{\infty} (-1)^n \frac{x^{2n+1}}{(2n+1)!}$$

$$\cos(x) = \sum_{n=0}^{\infty} (-1)^n \frac{x^{2n}}{(2n)!}$$

where x is the angle in radians and n is the number of repetitions. Given an angle in degrees (**deg**), we can convert it into radians (**rad**) using the formula

$$rad = \frac{deg}{180} \times \pi$$

where π is a constant whose value is approximately 3.14159. Given a partial class definition,

```
1 class Trig
2 {
3     private:
4         double x;
5     public:
6 };
```

- (i) Write definition a function that receives an angle in degrees and return the equivalent angle in radians [1 Mark]
(ii) Write definition of a **non-recursive** function that receives an integer and returns the factorial of that integer [1 Mark]
(iii) Using a **do...while** loop, write definition of a function named **sinx** which receives angle in degrees and calculates and returns the sin of that angle,

only when the error between the estimated sine and the actual sine is less or equal to 10^{-4} . Re-use functions defined in (i) and (ii) above. *Hint: Use the $\sin(x)$ function from $math.h$ library to get actual sine* [4 Marks]

- (iv) Using a **for** loop, write definition of a function named **cosx** which receives angle in degrees and calculates and returns the cosine of that angle. Re-use functions defined in, (i) and (ii) above. Let n vary from 0...10 [3 Marks]
- (v) Write definition of the function declared as **void display()** such that it displays the sine and cosine of angle **x**. For example, if **x** is initialized to 30° , this function display should be equivalent to sample output shown below

Example Output [3 Marks]

```
Angle in degrees = 30
Angle in radians: 0.523599
cos(30) = 0.866025
sin(30) = 0.5
```