L-Università
ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

INTERMEDIATE MATRICULATION LEVEL
2022 SECOND SESSION

SUBJECT:	**Computing**
DATE:	2nd September 2022
TIME:	9:00 a.m. to 12:05 p.m.

Directions to Candidates

Answer **ALL** questions in Section A and the question in Section B.

• Good English and orderly presentation are important.
• All answers are to be written on the booklet provided.
• The use of flowchart templates is permitted but calculators may **not** be used.

SECTION A
Answer ALL questions in this section.

1. a. Briefly explain Round Robin scheduling. (1)
   b. Windows 11 is a pre-emptive multithreading operating system which manages threads. Each program is assigned a single thread of execution so thread scheduling greatly determines system performance. Briefly explain why Windows 11 does not implement Round Robin scheduling and refer to how it overcomes one of the main disadvantages of the Round Robin approach to scheduling. (1)
   c. Explain how a multithreading Operating System (OS) can be caught in a deadlock. (1)
   d. How does polling differ from interrupt-handling? (1)
   e. One important role of the OS is memory management.
      i. Explain the role an OS plays in memory store protection. (1)
      ii. Distinguish between logical and physical address. (2)
      iii. Briefly explain the role of memory allocation. (1)

(Total: 8 marks)

2. A supermarket chain is developing a new loyalty scheme system. Customers will be a given an account on which they will accumulate points when shopping at any of the chain's outlets. The system will allow customers to spend their points in any of the outlets, and award other seasonal loyalty benefits accordingly.

   a. The development of the new system involves a number of stages including:

System Testing
Feasibility Study
System Analysis
System Design

      i. Which stage will follow the initial problem definition? (1)
      ii. Briefly describe **TWO** tasks that would be done during system design. (2)
      iii. Suggest **TWO** ways data can be collected at the system analysis stage. (1)
      iv. Differentiate between black box and white box testing. (2)

   b. After the new system is up and running, system maintenance may be in order. Name **TWO** reasons why the system may need maintenance. (2)

(Total: 8 marks)
Please turn the page.

3. a. During the Covid-19 pandemic, online commerce became more important than ever. Give **ONE** advantage of using e-commerce for the supplier and **ONE** advantage for the consumer. Give a brief explanation in **each** case. (2)

   b. Another effect of the pandemic was the increased use of remote working. Give **ONE** advantage of remote working for the employer and give a brief explanation. (1)

   c. Name and clearly describe the function of **ONE** utility software that can help keep one's personal computer system clean especially when we have a very active online presence. (2)

   d. The Operating System (OS) is key when it comes to device management.
      i. Which of these three aspects of the OS is responsible for this? (1)

Process Management	User-Interface	Storage Management

      ii. Name and briefly describe **TWO** ways the OS might have helped make online learning more feasible for young children. (2)

(Total: 8 marks)

4. A gaming computer is advertised with the specs shown below:

Processor Type	AMD Ryzen 9 5900X
Motherboard	B550-F GAMING
CPU Speed	3.7 GHz (Turbo 4.8 GHz)
Memory	16 GB
Memory Type	DDR4
Memory Speed	DDR4 - 3200
Memory Configuration	2 x 8 GB
Storage	2 TB HDD + 1 TB SSD
Storage Type	Solid State Drive

   a. The clock speed of this CPU is 3.7 GHz. Name another relevant CPU characteristic, besides clock speed, when considering CPU performance. Briefly describe how this impacts performance. (2)

   b. Special internal registers inside the CPU help it carry out its functions. Which of the following is a reasonable size for a register on the above CPU? (1)

64 bits	64 bytes	64 kilobytes

   c. This system has both a HDD and an SSD. Explain **ONE** use of **each** device. (2)

   d. This CPU has a 64-bit address bus. How can this impact system performance? (1)

   e DDR RAM is a type of Dynamic RAM (DRAM). Name **TWO** ways you would expect it to differ from Static Ram (SRAM). (2)

(Total: 8 marks)

5. A school is setting up a network and is considering a star topology.

   a. Explain why a star topology is generally preferred to a bus topology when a network involves a large number of stations. (1)

   b. Suggest **ONE** limitation of a star topology. (1)

   c. Distinguish between a hub and a router's role in data transfer. (2)

In 1984 the International Organization for Standardization (ISO) proposed OSI as a way to create a framework that technology companies around the world could use as the basis of their networking technologies.

   d. Briefly describe the OSI model? (1)

   e. Identify which OSI layer:
      i. is involved when the user reads messages or transfers files. (1)
      ii. handles problems that occur as a result of bit transmission errors and ensures that the pace of the data flow doesn't overwhelm the sending and receiving devices. (1)

   f. Explain why in an age where a lot of financial transactions happen over networks, the IP model may be preferred to the OSI model. (1)

(Total: 8 marks)

6. A hospital's pharmacy has a database that keeps track of all the medicines in stock and their suppliers. The database includes a table of StockItems and another for Suppliers.

   a. Suggest a reason why a flat database would not be a good idea in this case. (1)

   b. The structure of the table StockItems is shown below.

Field Name	Field Type
Product ID	Autonumber
Product name	Text
Brand	Text
Supplier ID	Number
Items in stock	Number
Re-order limit	Number

      i. Suggest with a reason which field would be the primary key. (1)
      ii. Suggest a record structure with **FOUR** fields for the Supplier Table. Identify the primary key for this new table and give a reason why you chose this field. (3)

  c. There is a relationship between the Supplier and StockItems tables.
      i. In the context of a relational database, what is a foreign key? Give an example of a suitable foreign key in the StockItems table. (2)
      ii. How does this foreign key help in reducing redundancy? (1)

(Total: 8 marks)

7. a. LEDs are used to express binary values in a binary clock. With this type of clock, each column of LEDs displays a binary-coded decimal (BCD) numeral. BCD does not work in the same way as a binary to decimal conversion. Show how this is true by representing the number **72** in both forms (Binary and BCD). (2)

  b. HTML colour codes are not represented in decimal values but in hexadecimal. These HTML colour codes start with a hash symbol followed by 3 pairs of hexadecimal numbers. The first two numerals show how much red, the second pair show how much green and the final pair show how much blue. How many units of red, green and blue would the HTML colour code **#0101DF** have? (2)

  c. i. What is the maximum positive number that can be represented when using an 8-bit two's complement? (1)
      ii. What is the lowest negative number that can be represented when using a 6-bit register? (1)

  d. Fixed point representation is widely used in digital signal processing (DSP) and game applications. This is because performance might be more important than precision. Assuming that the binary point is between the fourth and fifth bit positions, obtain the equivalent decimal value of the number **0101.0110**$_2$ (2)

(Total: 8 marks)

8 A 3-bit unsigned number **N** consists of the bits **A, B, C**. A logic circuit is to be used to compare **N** with the value 5.
  a. Draw a truth table for the logic circuit that gives output logic value '1' when **N≤5** and output logic value '0' when **N>5**. (2)
  b. Draw the Karnaugh map for the above truth table. (2)
  c. Using the Karnaugh map, obtain a minimised Boolean function for the circuit in terms of bits A, B, C and draw the resulting circuit using logic gates. (4)

(Total: 8 marks)

9. a. Consider the following assembly language program.

```
              MOV AX,0            ; move 0 into AX
              MOV BX,05           ; move 05 into BX
    LOOP:     ADD AX,BX           ; add AX and BX storing in AX
              DEC BX              ; decrement BX
              JE DONE             ; jump to DONE when contents
                                    of BX will be equal to zero
              JG LOOP             ; jump to LOOP if contents of
                                    BX are greater than zero
    DONE:     MOV BX, 05          ; move 05 into BX
```

   i. How many instructions are executed when this program is run to completion?   (1)
   ii. What are the contents of AX, in hexadecimal after execution of the program? (show your workings)   (3)

   b. Name **ONE** addressing mode used in the assembly program. For this addressing mode, write down an example from the above program.   (1)

   c. Before a program can be executed, it must be translated from **source code** to **object code**, and the executable program must be loaded into main memory.
   i. Define the terms in bold.   (2)
   ii. What is the purpose of the *linker* in the assembly process?   (1)

(Total: 8 marks)

10. a. An IP address is a unique address that identifies a device on the Internet or a local network. It is often expressed in **dotted decimal notation**.
   i. Explain the term in bold and explain its purpose.   (2)
   ii. The following is the IPv4 binary notation for an IP address.

10000010 00001011 00001001 11101100

   Which of the following four addresses in dotted decimal notation would be the correct one for it?   (1)
   a. 129.9.9.239
   b. 130.11.6.239
   c. 130.11.9.236
   d. 130.11.11.236

   b. In order for computers to connect to the Internet and web sites, they need to be organised. The Internet achieves this through a system of IP addressing and Domain Name System (DNS) servers. Define and explain how DNS achieves the above by including a description of how the DNS works?   (3)

Question continues on next page.

c. i. To avoid data transmission errors, a system makes use of odd parity checking. Complete the following two bytes of data so that both have **odd** parity. (1)

	1	1	1	1	0	0	0

	0	0	0	0	1	1	1

ii. Another system makes use of **even parity**. For each of the following two bytes indicate whether have been transmitted correctly or incorrectly using even parity. (1)

a. 11001000

b. 01101001

(Total: 8 marks)

Section B

1 a. Consider the following Classes:

```
1    public class Staff {
2         String designation = null;
3         String schoolName = null;
4         public Staff(){
5              designation = "Teacher";
6              schoolName = "New School";
7         }
8         public String getDesignation(){
9              return designation;
10        }
11        public String getSchoolName() {
12             return schoolName;
13        }
14   public class Teacher extends Staff {
15         public void display(String subject) {
16              System.out.println("Subject: " + subject);
17         }
18         public void display(String subject, int num){
19              System.out.println("Subject: " + subject + " " +
     "Number of Students: " + num);
20         }
21      }
22   }
23   public class Runner {
24      public static void main(String[] args){
25             Teacher t = new Teacher();
26             System.out.println(t.getDesignation());
27             t.display("Computing");
```

```
28                    t.display("Computing", 10);
29          }
30     }
```

i. What does the `static` keyword in line 24 of class Runner mean? (1)
ii. What is method overloading? Indicate where this occurs in the above classes. (2)
iii. What is the meaning of the keyword `this` in Java? (1)
iv. What is being done in line 25? (1)
v. Name **ONE** OOP principle that is being used in the above code and indicate the specific part of the code where this principle is being applied. (2)

b. i. Describe **TWO** access modifiers that may be applied to Java fields and methods. (2)
   ii. Why are they useful? (1)

c. Consider the following code:

```
1    public class Main {
2        static void algorithm(int array[]) {
3            int size = array.length;
4
5            for (int i = 0; i < size - 1; i++) {
6                for (int j = 0; j < size - i - 1; j++) {
7                    if (array[j] > array[j + 1]) {
8                        int temp = array[j];
9                        array[j] = array[j + 1];
10                       array[j + 1] = temp;
11                   }
12               }
13           }
14       }
15       public static void main(String args[]) {
16           int[] arr = { -2, 45, 0, 11, -9 };
17           algorithm(arr);
18       }
19   }
```

i. State the contents of `arr` after the method `algorithm(arr)` is executed in line 17. (1)
ii. What type of sorting algorithm is being used? (1)
iii. Is the parameter in the above method `algorithm` being passed by value or passed by reference? (1)
iv. What would happen if the above for loop in line 6 would be changed to the following? (1)

```
for (int j = 0; j < size - i ; j++)
```

Question continues on next page.

a. Below is a snippet of incomplete java code which assigns a random number between 0 and 50 to an array *MyArray* of type integer.

```
for(int i =0; i< MyArray.length; i++) {
   MyArray[i] =    //insert code to assign a random number
                        between 0 and 50
   }
```

Insert the proper statement where prompted in the above code.   (2)

e. i. A computer uses a stack with data items entering the stack via the input stream and leaving the stack via the output stream. The only operations available are **PUSH** and **POP**.

Given the input stream **ABCDE**, show, through the use of the above two operations, if the output stream **ACEDB** is possible. (show your workings through the use of the following table. The first step has been done for you).   (2)

Step	Operation	Stack Status	Popped
1	Push A	A	

ii. If the elements "A", "B", "C" and "D" are placed in a queue and are deleted one at a time, in what order will they be removed?   (1)

iii. One service that a queue may provide is storing various entities, such as data, to be processed later on. Name **ONE** service that a stack may provide in a computer.   (1)

(Total: 20 marks)