MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

UNIVERSITY OF MALTA, MSIDA

MATRICULATION EXAMINATION
INTERMEDIATE LEVEL
MAY 2017

SUBJECT:	COMPUTING
DATE:	16th May 2017
TIME:	9:00 a.m. to 12:05 p.m.

Directions to Candidates

Answer **ALL** questions in Section A and **ONE** question from 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. The control unit of a vehicle alarm system has a set of sensors D, S and L which operate as follows:
   - The door sensor D outputs TRUE when the door of a locked vehicle is opened;
   - The shock sensor S outputs TRUE when it detects an impact from the outside of a locked vehicle;
   - The third sensor L outputs TRUE when the car is locked.

   The alarm output A issues a warning when the car is locked and when either D or S is TRUE.

   a. Draw the truth table for the system above. (2)

   b. Extract an initial Boolean expression from the truth table and simplify it using the laws of Boolean algebra. (3)

   c. Draw a simplified logic circuit for the system above. (1)

   (Total: 6 marks)

2. The Operating System in mobile phones allows users to open more than one application at the same time.
   a. Explain the role of the Operating System in the management of these applications. (1)

   Various notifications from different applications and even an incoming phone call are events that halt the current process.

   b. How is this situation handled? Give the term and explain the process in detail. (3)

   c. Mention another method apart from that mentioned in part (b) which can handle this situation. Why is the method mentioned in part (b) preferred? (2)

   (Total: 6 marks)

3. Consider the following Java method:

```java
private int daysInMonth (int month)
{
  if((month == 4)||(month == 6)||(month == 9)||(month == 11))
  {
      return 30;
  }
  else if (month == 2)
  {
      return 28;
  }
  else
  {
      return 31;
  }
}
```

    a. Explain why the word *private* is used instead of *public*. (1)

    b. Describe the result of the following method call:
       `int days = daysInMonth(2);` (1)

    c. Describe a situation in which a logic error could occur as a result of calling this method. (1)

    d. Write down an additional piece of code which can handle the logic error mentioned in part (c). (2)

    e. Suggest the purpose of using methods when coding. (1)

(Total: 6 marks)

4.   a. What is the maximum address that can be directly addressed in a microprocessor having an 8-bit address bus? (2)

    b. What happens if the size of the address bus is increased? (1)

    c. Explain what happens if a particular microprocessor had to be replaced by another microprocessor which has:
      i.   a wider data bus; (1)
      ii.   a higher clock rate. (1)

    d. What is the role of the control bus in a microprocessor? (1)

(Total: 6 marks)

5. a. Describe the role of the CIR and MAR in the fetch, decode and execute cycle. (2)

    b. Consider the following assembly language instructions:

```
MOV  AX, #1    Move #1 to AX
MOV  CX, #3    Move #3 to CX
MOV  DX, #4    Move #4 to DX

SUB  DX, CX    Subtract CX from DX
SUB  DX, AX    Subtract AX from DX

CMP  DX, 0     Compare DX with 0
JE   X         Jump if DX is equal to 0

ADD  AX, CX    Add CX to AX
X:
ADD  AX, DX    Add DX to AX
```

    i.   List **ONE** instruction that is using immediate addressing. (1)
    ii.   From the above instructions, give an example of an opcode and an operand. (1)
    iii. What is stored in registers AX and DX after the above instructions are executed. (2)

    (Total: 6 marks)

6. The Internet has made e-Commerce and teleworking possible and this has greatly impacted the business world. In fact it has been estimated that e-Commerce generates around $ 1.2 million (€1.1 million) worldwide every 30 seconds.

    a. What is e-Commerce? (1)

    b. Name and briefly describe **ONE** advantage of e-Commerce for small businesses. (1)

    c. Explain how e-Commerce giants like *Amazon* can negatively impact small local shops. (1)

    d. Name **ONE** advantage of e-Commerce for the consumer. (1)

    e. Explain how individual employees benefit from teleworking. (1)

    f. Name **TWO** ways how e-Commerce and/or teleworking help reduce one's negative environmental impacts. (1)

    (Total: 6 marks)

7. Initially, the computing world did not have a single world-standard character encoding system.

    a. How did the Internet make a universal encoding system a necessity? (1)

    b. ASCII is a 7-bit character-encoding standard. How many characters can it represent? (1)

    c. What makes Unicode (or UTF-16) a better-suited character encoding standard on the Internet than ASCII? (1)

    Besides characters, binary patterns may also represent numeric values. Two ways of representing such values are Sign-and-Magnitude and two's Complement.

    d. What is the range of numbers that can be represented in 8-bit Sign-and-Magnitude? (1)

    e. Name **TWO** ways in which two's Complement is superior to Sign-and-Magnitude. (2)
    (Total: 6 marks)

8. a. The increasingly cheaper cost of digital signals, is causing a gradual decline in the use of analog communication.

    i.   What is analog communication? (1)
    ii.   Explain why digital signals are more tolerant to noise than analog. (2)
    iii. Name **ONE** shortcoming of digital signals, other than pricing issues. (1)

    b. A carrier signal can be modulated to contain and hence transmit information.

    i.   Distinguish between amplitude and frequency modulation. (1)
    ii.   Give **ONE** advantage of frequency modulation over amplitude modulation. (1)
    (Total: 6 marks)

9. a. Relatively affordable routers, like the recently-launched *Google Wi-Fi*, can easily provide homes with a mesh network. Why would one prefer a mesh network above another topology? (1)

    b. A small home network might still prefer to use an Ethernet star network.

    i.   Explain why Ethernet might be preferable to Wi-Fi. (1)
    ii.   Explain why a star network might be as acceptable as a mesh topology in the household. (1)
    iii. Suggest **ONE** shortcoming of a star network as described above. (1)
    iv.   Why does an IP address need to be assigned to every device in a network? (1)
    v.   What is the function of Domain Name System (DNS)? (1)
    (Total: 6 marks)

10. A high school requires its IT department to develop a new computerised system to handle attendance. The following are all important stages in the lifecycle of the new system:
    - Implementation
    - Requirements Analysis
    - Maintenance
    - Design

    a. Put the above stages in order. (1)

    b. Clearly explain what is done in each of the stages named above. (4)

    c. Explain the importance of the Design stage being in the position you indicated. (1)

    (Total: 6 marks)

Please turn the page.

SECTION B
Answer ONE question from this section.

1. a. The following case study is about a bookstore. A bookstore has hired you to design a database to keep track of their books. The bookstore management would like to:
    - record all the books in store with details such as title, author, supplier and price;
    - have a list of suppliers with their contact details so that they can facilitate the placing of orders;
    - keep a record of all book sales including information of which book was sold, when, at what price and the details of the client who bought it;
    - keep a list of customers to be able to send promotional material throughout the year.

    i.   Explain in detail the tables required in this database including the fields, the primary keys and any foreign keys. In your explanation, include the relationship between the tables. (6)
    ii. Describe **TWO** characteristics of a normalised database. (2)
    iii. Outline **TWO** issues caused by redundant data. (2)

    b. An array of objects is used to hold the marks for a class of 15 Maths students. Each object is a member of the Student class, part of which is outlined below.

    ```
    class Student
    {
        int studentID;
        String surname;
        String name;
        int [] marks;
        double average;
    }
    ```

    The values in the marks array represent the percentages obtained in the 9 tests done throughout the year. They are initially set to -1.

    i.   Suggest **ONE** reason for initially setting the values to -1. (1)
    ii. Give **TWO** reasons why it is convenient to store the student data as objects. (2)
    iii. Consider a class that handles the Student object. How would an array of such objects be defined? (1)
    iv. Construct a method called average() in the Student class that calculates the average mark for a particular student at any time during the year and returns this average mark to the calling class. (6)

    (Total: 20 marks)

2. A development team has been tasked with the creation of a Lifestyle Monitoring App aimed at helping young teens make healthier daily choices with regard to daily exercise routines and calorific intake.

   The app has been commissioned by a youth support group as the youth workers are convinced that a healthier lifestyle improves young people's physical and psychological well-being.

   a. List **FOUR** questions the Systems Analyst should ask the youth workers (or otherwise seek an answer to) in order to get a clear understanding of the system requirements. For each question, give an explanation of your reason for asking it. (4)

   b. In the early stages of system development, a Functional Requirements Analysis is done.
      i.   What is the role of a Functional Requirements Analysis? (1)
      ii. In the context of a DFD, distinguish between an Entity and a Process. (2)

   c. Often, new applications are designed to replace existent ones, hence the development team needs to decide on a crossover (changeover) method from the old to the new system.
      i.   Name and briefly explain **ONE** advantage of a direct cross-over method. (1)
      ii. Name and briefly describe **ONE** other crossover method. (1)

   d. Briefly explain **ONE** advantage of using a standard methodology for software development. (1)

   e. One of the aims of the app is to help young people maintain a healthy weight. The body-mass index (BMI) is an indicator of optimal weight. It is calculated by dividing the weight in kilograms by the square of one's height in metres. Write a Java method (called *getBMI*) that is passed the mass and height of a person and returns the BMI. (4)

   f. If a variable called *bmi* is declared within the method described in part (e):
      i.   What is the scope of variable *bmi*? (1)
      ii. Hence explain the terms scope and visibility of variables in Java. (1)

   g. The daily calorific intake of the last 30 days is to be stored in an array called calorieList. Show how the array calorieList could be declared. (Daily calorific intake should be a positive whole number). (1)

   h. Write a section of code that calculates and outputs the average calorie intake over a month (using the values stored in array calorieList.) (3)

   (Total: 20 marks)