MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

UNIVERSITY OF MALTA, MSIDA

MATRICULATION EXAMINATION
INTERMEDIATE LEVEL
MAY 2015

SUBJECT:	COMPUTING
DATE:	19th May 2015
TIME:	4.00 p.m. to 7.00 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)

A1 a. Memory management is one function of an operating system (OS). What **type of memory** does it manage? [1]
    b. An address generated by the CPU is commonly referred to as a logical address.
        i.   What is the **logical address space**?
        ii.   What is a **physical address**? [2]
    c. One task of memory management is **memory store protection**. Briefly explain this task. [1]
    d. The type of OS embedded in a system depends on the **mode of processing** required. What type of OS is embedded if a system:
        i.   runs jobs **one after another** without human intervention;
        ii.   has a **critical response time**? [2]

A2 Study the following truth table and then answer the questions below.

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

    a. Express F in terms of A, B and C. [2]
    b. Use the laws of Boolean algebra to **simplify F** of part 'a' above. (Show all your workings by naming the law used at each step.) [3]
    c. According to Boolean algebra, what is $\overline{\overline{A}}$ **equivalent** to? [1]

A3   a.   A 2-input (A and B) logic circuit is required to output a 1 only if B is 1, otherwise the output is 0. Draw its **truth table** and derive the equivalent **logic expression.** [4]

       b.   Using Karnaugh maps, **simplify** the following expression to its lowest terms (show all your working).

$$F = A.B.C + A.\overline{B}.\overline{C} + \overline{A}.B.\overline{C} + \overline{A}.B.C + A.B.\overline{C} + \overline{A}.\overline{B}.\overline{C}$$ [2]

A4   It is imperative that during the development of a relational database, the structure of the tables and normalisation are given their due importance.

       a.   Mention THREE important **considerations** when designing the structure of tables. [3]

       b.   Distinguish between the **first**, **second** and **third normal forms**. [3]

A5   a.   In the context of process control, what is **scheduling**? [1]

       b.   Name and briefly explain THREE **objectives** a scheduling policy should consider. [3]

       c.   Some scheduling objectives may conflict with one another. Mention TWO **criteria** that may be adapted by the scheduler to avoid conflict. [2]

A6   a.   Suggest, with a reason, ONE **application** of the bus topology. [2]

       b.   Explain why a star topology is generally **preferred** to a bus topology when a network involves a large number of stations. [1]

       c.   Suggest ONE **limitation** of a star topology. [1]

       d.   Suggest ONE **application** for a ring topology, outlining ONE **advantage** offered by this topology. [2]

A7   a.   What is an **IP address**? [1]

       b.   Briefly describe the TWO **parts** of an IP address. [2]

       c.   In relation to networking, what is a **protocol**? [1]

       d.   Why are networking protocols **standardized**? [1]

       e.   With reference to modems, what is **modulation**? [1]

A8   a.   **Convert** the following numbers into 8-bit two's complement representation:

           i. 1_{10}; and

           ii. -1_{10}. [2]

       b.   What is the **range of numbers** (in decimal) that can be represented in:

           i.   7-bit unsigned binary; and

           ii.   7-bit sign and magnitude? [2]

       c.   Mention TWO a**dvantages** of two's complement representation over sign and magnitude representation. [2]

A9   After studying the current system, a systems analyst designs and implements a new system.

       a.   Briefly describe THREE **methods** that may be used to collect information on the current system. [3]

       b.   Name and briefly describe TWO **types** of crossover procedures. [2]

       c.   Suggest ONE **reason** why a newly developed system may require maintenance.

[1]

A10 a. A **Java application** deals with athletes' records for a 1km race. A section of the class *Athlete* is shown below:

```java
import java.util.Scanner;

public class Athlete {

    String name;
    String surname;
    _____;

    public void enterAthlete() {
        Scanner input = new Scanner(System.in);
        System.out.println("enter athlete's name");
        this.name = input.nextLine();
        System.out.println("enter athlete's surname");
        this.surname = input.nextLine();

        for (_____) {
            _____;
                    _____;
        }
    }
}
```

a. **Declare** and **instantiate** a property in class *Athlete* that can hold the record for ten trials. The property should be an array called *trialList*.   [1]
b. Complete the **for loop** in the method *enterAthlete()* so that it reads ten entries for the 1km race into the array *trialList*.   [2]
c. Write a **method** called *average1km* that returns the average of the ten values in the array *trialList*.   [3]

Section B
(Answer **ONE** question from this section)

B1   *This question is about Object Oriented Programming (OOP) in Java.*

   a. Why is Java known as an **object-oriented language**?   [2]
   b. Distinguish between the data types **int** and **String**.   [2]
   c. What is a **conditional** construct?   [1]
   d. Name TWO **decision constructs** in Java.   [2]
   e. Create a simple Java **class** called *Room* that has the following properties: *roomID, type, length, breadth*.
       Include in this class a **method** called *enterRoom* that allows the user to input room details.
       Include also a **method** called *findCarpetCost*, that finds and outputs the area of the floor and also the cost of carpeting given that carpet material is €10 per square metre.   [6]

    f.   Create a second **class** called *RoomApp* that will include the main method for this application. This method creates an array of ten objects of room and hence calls the method *enterRoom* for each. [5]

    g.   Explain how implementing an **array** makes the code of part 'f' above more efficient. [2]

B2   *This question is about computer architecture and assembly language.*

    a.   Choose the correct answer for the following.
        i.   **Assembly language** programs are written using:
            [a] Hex code;   [b] Mnemonics;   [c] ASCII code.
        ii.   One task of the **assembler** is to produce the:
            [a] Source code;   [b] Intermediate code;   [c] Object code.
        iii.   The **type of memory** that requires continuous refreshing is:
            [a] Static RAM;   [b] Dynamic RAM;   [c] Cache memory.
        iv.   The **synchronisation** of the various subunits of a computer system is the task of the:
            [a] I/O subsystem;   [b] CPU;   [c] System clock.
        v.   The **stack pointer** stores the address of the:
            [a] Current instruction being executed;   [b] Data item to be fetched;
            [c] Top element of the data structure. [5]

    b.   Consider the following three assembly language instructions, each with a different addressing mode:

            MOV BX, 000FH
            MOV CX, [1000H]
            ADD AX, DX

        i.   Which instruction is using **register addressing**?
        ii.   Which instruction is using **immediate addressing**?
        iii.   Which instruction is using **direct addressing**?
        iv.   From the above instructions give an example of an **opcode**.
        v.   From the above instructions give an example of an **operand**. [5]

    c.   Mention THREE **reasons** why a programmer may opt to develop a program in assembly language rather than a higher level language. [3]

    d.   AX and BX are typical representations of two 16-bit general purpose data registers.
       What is **wrong with the instruction** 'ADD AX, BX' if AX and BX are holding the decimal numbers 70,000 and 80,000 respectively? [1]

    e.   A subset of assembly language instructions is called the **jump** (or branch) instructions. Explain briefly why this subset is required. [1]

    f.   The fetch-decode-execute cycle is the process by which a computer retrieves an instruction from memory, determines the action required and carries out the necessary operation.
       Describe the **steps of this cycle** making reference to the program counter (PC), the memory address register (MAR), the memory data register (MDR) and the current instruction register (CIR). [5]