MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

UNIVERSITY OF MALTA, MSIDA

MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
MAY 2012

SUBJECT:	COMPUTING
PAPER NUMBER:	I
DATE:	28th May 2012
TIME:	4.00 p.m. to 7.00 p.m.

Directions to Candidates

- *Answer **ALL** questions.*
- *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.

1. a) Clearly **explain** the difference between the **default** (no explicit modifier) and the **protected** access modifiers. [4 marks]

   b) Why is it **important** to make instance variables **private**? [1 mark]

2. **Compare** and **contrast** the complexities of the **Quicksort** and **Bubblesort** algorithms. Use the Big "O" notation and make reference to the **best** and **worst** cases. [5 marks]

3. **Polymorphism** is an important principle in Object Oriented languages.
   a) Explain this concept using a suitable example. [3 marks]

   b) Mention **one** advantage of using polymorphism in your design. [2 marks]

Section B.

4. Describe five different types of Operating System. [5 marks]

5. a) What is unauthorized access in the context of File management? [1 mark]

   b) Explain two facilities against unauthorized access. [4 marks]

6. a) What is an interrupt handler? [2 marks]

   b) Explain the process used in (6a). [3 marks]

7. In point-to-point communication, explain the following terms:
   i.   simplex;
   ii. half duplex;
   iii. full duplex;
   iv. analogue;
   v.   serial. [5 marks]

8. a) What is meant by the term **cyber-crime**?   [2 marks]

    b) Give three examples of internet crimes.   [3 marks]

9. The Waterfall Life Cycle and Rapid Application Development are two different methodologies which help software developers. Compare and contrast these two methodologies.   [5 marks]

10. a) Briefly describe the differences between a **compiler** and an **interpreter**.   [2 marks]

    b) i.   What is a **debugging tool?**   [1 mark]
        ii. At what stage can it be used?   [1 mark]
        iii. Why is it required?   [1 mark]

11. During the compilation process, a **symbol table** is used. Briefly describe the contents of such a symbol table.   [5 marks]

12. Explain the term **strongly typed language** and give an example of such a language.
                                                                                   [5 marks]

13. Choose the correct language translator from the five listed below: [5 marks]
    an **Assembler**, an **Interpreter**, a **Compiler**, a **p-code compiler** and a **Cross-compiler**, which corresponds with each of the statements listed below:
        i.   Creates executable code for a platform other than the one on which it is run.
        ii. Generates the executable code of a low-level language program.
        iii. Produces executable code which can be saved on disk.
        iv. Generates code for a virtual stack machine.
        v.   This translator is required every time the program is run.

14. a) Give the 8-bit representation of 100.   [3 marks]

    b) Represent in hexadecimal your 8-bit binary number from 14(a) above.   [2 marks]

15. Build up the truth table for the logic function given by:
    $$F \;=\; \overline{AB} + \overline{\overline{BC}}$$ [5 marks]

16. a) Using the two's complement code four bit representation, write down the representation for:

        (i) - 5;   (ii)   0;   (iii) -1   [3 marks]

    b) Using the scheme in (16a), and starting from decimal 1, which is the first positive decimal number that CANNOT be represented?   [2 marks]

17. The following table shows memory addresses and their respective contents.

Address in Hexadecimal	Data in Hexadecimal
0145	A065
0146	1234
0147	EDCB

    a)   What is the binary logical relation between the contents of location 0146 hex and location 0147 hex? [2 marks]

    b)   An Assembly Language program is given by:

        MOV BX, (0145)   ; move the contents of memory at 0145 hex to BX

        AND BX, FF00   ; logical AND of contents of BX with FF00 Hex

        MOV   (0145), BX   ; move the contents of BX back to memory

        What are the final contents of location 0145 hex? [3 marks]

18. For a dynamic RAM and a static RAM, which one of the two has:

    i)   the faster memory access speed;
    ii)   the higher number of transistors per memory cell;
    iii)   the need for a refresh circuit;
    iv)   the higher number of memory bits per unit area;
    v)   the higher power consumption per memory bit. [5 marks]

19. a) The content of files can be logically organised in a number of ways. Explain in detail **one** such way. [3 marks]

    b) Explain, using a simple example, **one** advantage of databases over a traditional file system. [2 marks]

20. a) Distinguish between a **database** and a **Database Management System**. [2 marks]

    b) Name the **three** levels of a DBMS. [3 marks]

SUBJECT:	COMPUTING
PAPER NUMBER:	II
DATE:	30th May 2012
TIME:	4.00 p.m. to 7.00 p.m.

Directions to Candidates

- *Answer any **FIVE** questions.*
- *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.*

1. A two-bit magnitude comparator is to be built to compare two words, word A and word B. Word A consists of two bits A_1 and A_0, A_1 being the more significant bit. Similarly word B consists of two bits B_1 and B_0 and again B_1 is the more significant bit.

   a) Design a truth table for the logic circuit that gives an output logic value '1' whenever the magnitude of A is greater than or equal to the magnitude of B.   [8 marks]

   b) Using Karnaugh map techniques, minimise the truth table.   [7 marks]

   c) Hence obtain the resultant minimum Boolean function in terms of A_1, A_0, B_1 and B_0.   [5 marks]

2. a) Distinguish between memory mapped I/O and isolated I/O.   [5 marks]

   b) Describe how an indirect addressing mode is used to fetch an instruction from memory.   [5 marks]

   c) How many ALU additions are needed to add three numbers? Give reasons for your answer.   [5 marks]

   d) How is a vectored interrupt used to provide the start address of the interrupt service routine?   [5 marks]

3. A newly developed program that has a modular structure is to undergo testing.
   a) What do you understand by the term **program module**?   [5 marks]

   b) What are the advantages gained by this modular programming approach during the testing stage?   [5 marks]

   c) Describe the bottom-up testing approach that may be used with this program.   [5 marks]

   d) Explain why a program may fail even though all modules are found to be error free when tested individually.   [5 marks]

4. Backus-Naur Form (BNF) is one notation technique used for defining the syntax of a programming language.
   a) Write down the standard BNF symbols.   [2 marks]

   b) What is EBNF and why was it defined?   [2 marks]

   c) What are the EBNF meta-symbols?   [2 marks]

   d) Distinguish between literals and meta-variables when using BNF and EBNF.
                                                                              [2 marks]
   e) Define any THREE of the following using BNF and/or EBNF notation.
                                                                    [12; 4 marks each]
        i.   An integer.
        ii. A vowel (from the English language).
        iii. An alphabetical letter (from the English language).
        iv. A hexadecimal number, terminated with the letter H.
        v.   A Roman number in the range 1 to 10.

5. Within the context of the WWW, explain how **files**, **emails**, **web pages** and **messages** are sent from one computer to another. Make sure to mention the various protocols involved in your answer.   [20; 5 marks per type]

6. Explain the following terms giving examples for each: **Social Networking**; **Netiquette**; **Web 2.0** and **Hypermedia**.   [20; 5 marks each]

7. a) Briefly describe the following two OOP concepts using **suitable examples** and **class diagrams** if necessary:
      i. encapsulation;   [2 marks]
      ii. inheritance.   [2 marks]

   b) Explain the **three** concepts, **constructors**, **default constructors** and **constructor chaining** (overloading) in Java.   [4 marks]

   c) Define *class* and *instance* **variables** and **methods**, highlighting the differences between them.   [4 marks]

d) The following example includes **four** classes. What is the output after running the
   Main class?   [8 marks]

```java
public class AClass {
        public AClass() {
                System.out.println("AClass constructor");
        }
        public void print() {
                System.out.println("AClass print");
        }
}

public class BClass extends AClass {
        public BClass() {
                System.out.println("BClass constructor");
        }
        public void print() {
                System.out.println("BClass print");
        }
}

public class CClass extends BClass  {
        public CClass() {
                System.out.println("CClass constructor");
        }
        public void print() {
                System.out.println("CClass print");
        }
}

public class Main {
        public static void main(String[] args) {
                new CClass().print();
        }
}
```

8. a) Explain the **nature** and **structure** of a relational database. [5 marks]

    b) Consider the following relational database that represents, books, publishers and books published by the publishers and answer the questions below.

Books

BookID	Title	Author	Date	Edition
231	The Soul of a New Machine	Tracy Kidder	1981	1
77	Programming Pearls	Jon Bentley	2000	2
23	Programming Pearls	Nick Stokes	1981	1
2	Far from the Madding Crowd	Thomas Hardy	1850	1

Publishers

PublisherID	Publisher	City	Web Site
1	Back Bay Books	Boston	backbay.com
2	Addison Wesley	New York	addisonwesley.com
3	Modern Library	London	randomhouse.com
4	Penguin	New York	penguin.com

Published

PublisherID	BookID	Pages	Copyright
1	231	293	1981
2	77	235	2001
2	23	200	1980
4	2	565	2001
5	2	540	1990

The date in the **Books** entity represents the year when the book was originally issued.
The date in the **Published** entity represents the copyright date when that particular publisher issued it.
BookID represents unique book identifiers, similar to ISBN numbers.
PublisherID represents uniquely a publisher.

i. Does the database allow for a book to have **more** than **one** publisher? Explain your answer. [3 marks]

ii. If a publisher has more than one web site, how would the database need to be modified to accommodate this? [4 marks]

iii. Inserting the record (4, 83, 200, 1990) into the **Publishers** table fails. Explain why this happens and which database principle is violated? [4 marks]

iv. Explain the purpose of the following SQL query and write the result when it is executed on the data found in the tables. [4 marks]

```
SELECT * FROM
Books AS b1,
Books AS b2
WHERE b1.title = b2.title AND b1.author != b2.author
```