MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

UNIVERSITY OF MALTA, MSIDA

MATRICULATION EXAMINATION
ADVANCED LEVEL
MAY 2016

SUBJECT:	COMPUTING
PAPER NUMBER:	I
DATE:	10th May 2016
TIME:	4.00 p.m. to 7.05 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.*

The following data might be useful in certain questions.

MOV	Moves byte or word to register or memory
PUSH	Push a word on stack
POP	Pop a word from stack
NOT	Logical not (1's complement)
AND	Logical and
OR	Logical or
XOR	Logical exclusive-or
ADD , ADC	Add and Add with carry
SUB, SBB	Subtract and Subtract with borrow
INC	Increment
DEC	Decrement
CMP	Compare
JMP	Unconditional Jump
JE	Jump on Equal
JNE	Jump on Not Equal
JL	Jump if Less
JLE	Jump if less or equal
JG	Jump if Greater
JGE	Jump if Greater or Equal
JC, JNC	Jump on carry or Jump on No Carry
CALL	Call Subroutine
RET	Return from subroutine
CLC	Clear Carry
STC	Set Carry
SHL, SHR	Logical Shift Left or Right
RCL, RCR	Rotate through Carry Left or Right

Section A

1. a. Consider the following method.

```
public static int recursive(int n)
{
  if (n == 1)   {
        return 100;
}   else if (n == 2)   {
        return 200;
}  else {
        return (2 * recursive (n-1) + recursive (n-2) + 1);  }
        }
```

What is the number that is returned by this method for the call *`recursive(4)`*? Show your working. [2 marks]

b. Define the term *recursion*. [1 mark]

c. Outline **ONE** advantage and **ONE** disadvantage of recursion. [2 marks]

2. a. Consider the following method:

```
public int add(int num1, int num2){
       int sum = num1+num2;
       return sum;
}
```

i. Identify the parameters in this method. [1 mark]
ii. Identify the return type of this method. [1 mark]

b. Define method *overloading*. [1 mark]

c. With reference to method signatures, what is the difference between *pass by value* and *pass by reference*? [2 marks]

Section B

3. Using Boolean algebra, show that:

$$A + B \quad \bar{A} + C \quad = AC + \bar{A}B$$

[5 marks]

4. a. Briefly *describe* the main differences between the *ASCII* and *Unicode* codes. [2 marks]

   b. In ASCII, the letter 'A' is encoded as the value 41 hex, the letter 'Z' is encoded as 5A hex, and the letter 'a' is encoded as 61 hex. Determine the hexadecimal value of the following letters:
   i. 'z'
   ii. 'X'
   iii. 'm' [3 marks]

5. A single-precision floating-point binary format uses 1 bit for the sign, 8 bits for the exponent, and 23 bits for the significand/mantissa. Determine the representation of the following number using this format:

$$13.75 \times 2^{-5}$$

[5 marks]

6. a. For each of the following, state **ONE** typical use in computer systems:
   i. ROM; [1 mark]
   ii. Dynamic RAM; [1 mark]
   iii. Static RAM; [1 mark]
   iv. Flash RAM; [1 mark]

   b. Distinguish between *ROM* and *EPROM*. [1 mark]

7. Name the addressing mode of the operand in boldface in each of the following assembly instructions:
   a. `ADD AX, **0F000H**` [1 mark]

   b. `SUB **DX**, AX` [1 mark]

   c. `MOV DX, **[BX]**` [1 mark]

   d. `MOV DX, **[BX+DI]**` [1 mark]

   e. `MOV **[31F0H]**, AX` [1 mark]

Please turn the page.

8. a. Identify **THREE** differences between natural and formal languages. [3 marks]

   b. Give **ONE** example of **ANY TWO** of the differences you mention in part (a). [2 marks]

9. a. Formal languages make use of certain techniques to unambiguously express the correct syntax. Name **TWO** such techniques. [2 marks]

   b. Use a suitable example to describe **ONE** of the techniques mentioned in part (a) above. [3 marks]

10. a. Consider the following expression and write its equivalent in *Reverse Polish Notation* (RPN):

    (3+9)*6

    [1 mark]

    b. How would the resulting expression of part (a) be interpreted on a stack? List down each of the steps made on the stack. [4 marks]

11. The *Waterfall Life Cycle* and *Rapid Application Development* (RAD) are methodologies that help in the development of software.

    a. Briefly explain the main difference between the two methodologies. [2 marks]

    b. Briefly explain the Implementation stage of the Waterfall model. [3 marks]

12. a. In which stage of the *Software Development Life Cycle* (SDLC), are *Jackson Structured Programming* (JSP) and *Flowcharts* used? [2 marks]

    b. Using the appropriate *JSP* diagram, draw:
       i. a sequence;
       ii. a selection;
       iii. an iteration. [3 marks]

13. A teacher has five students, whom she wants to award for good behaviour. The list of students is shown below:

Names
Fabio
Stefan
Elton
Liam
Kurt

a. Construct the binary tree that stores the above list of names in alphabetical order, showing the information that would need to be held at each leaf of the tree. [4 marks]

b. Explain **ONE** advantage of storing the data in a binary tree over storing it in a linked list. [1 mark]

14. a. What do *IP*, *DNS* and *URL* stand for? [3 marks]

b. Briefly describe the main function of IP addressing. [2 marks]

15. a. What is *round-robin* scheduling used for? [2 marks]

b. Mention another scheduler and briefly explain how it works. [3 marks]

16. a. Explain what the term *deadlock* means within an Operating System. [1 mark]

b. Explain how a *deadlock* is detected and avoided. [4 marks]

17. a. Which networking model do the physical, network and presentation layers form part of? [2 marks]

b. Name **THREE** other layers of the model mentioned in part (a) above. [3 marks]

18. a. What does *DMA* stand for? [2 marks]

b. Why is *DMA* associated with interrupt handling? [3 marks]

Please turn the page.

19. Consider the following **Patient** table:

patient_code	name	phone_no	year_of_birth	health_condition	released
1234	John Borg	21223833	1964	diabetes	yes
4682	Mark Cutajar	21848388	1987	thyroid	no
8790	Maria Zammit	21448677	1991	cholesterol	no
4659	Joanne Zarb	21494999	1973	thyroid	no
2492	Daniel Costa	21657382	1981	glaucoma	yes
2213	Katia Ellul	21345321	1966	glaucoma	yes

What is the result of the following SQL queries? Write your answer in table format.

a.
```
SELECT name, phone_no
FROM Patient
WHERE health_condition = 'thyroid'
ORDER BY name
```
[3 marks]

b.
```
SELECT patient_code, name
FROM Patient
WHERE released = 'no'
HAVING year_of_birth >1980
```
[2 marks]

20. a. List **TWO** tools usually provided with a *DBMS*. [2 marks]

b. Choose and explain **TWO** drawbacks of a relational database system. [2 marks]

c. Explain what is meant by a *data dictionary*. [1 mark]

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MATRICULATION EXAMINATION
ADVANCED LEVEL
MAY 2016

SUBJECT:	COMPUTING
PAPER NUMBER:	II
DATE:	11th May 2016
TIME:	4.00 p.m. to 7.05 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.*
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1. A system is required to compare a decimal digit D with the number five. If the digit is less than five, that is $0 \leq D \leq 4$, then the output of the system must be false. If the digit is greater than or equal to five, that is $5 \leq D \leq 9$, then the output must be true. The decimal digit D is to be input to the system using binary-coded decimal (BCD).

   a. State the number of binary inputs to the system. [2 marks]

   b. Draw the truth table of the required function. In the table, include all the possible combinations of the input bits. [4 marks]

   c. Using the Karnaugh map technique, obtain a minimised expression for the function. [5 marks]

   d. The Boolean expression $AB + AD + BC$ contains AND operations of the form XY and OR operations of the form $X + Y$. Using Boolean algebra, convert the expression to one that uses only NAND operations of the form $\overline{XY}$. [4 marks]

   e. Draw a diagram showing an implementation of the minimised expression in part (c) above using only NAND gates. [5 marks]

2. An assembly subroutine foo is defined as follows:

```
foo:    MOV  DX, AX     ;set DX equal to AX
        SHL  DX, 8      ;logical shift left DX by 8 bits
        SHR  AX, 8      ;logical shift right AX by 8 bits
        OR   AX, DX     ;set AX to bitwise OR of AX, DX
        MOV  DX, AX     ;set DX equal to AX
        SHL  DX, 4      ;logical shift left DX left by 4 bits
        AND  DX, 0F0F0H ;bitwise logical AND with hex F0F0
        SHR  AX, 4      ;logical shift right AX by 4 bits
        AND  AX, 0F0FH  ;bitwise logical AND with hex 0F0F
        OR   AX, DX     ;set AX to bitwise OR of AX, DX
        RET             ;return from function foo
```

The assembly snippet below makes use of the subroutine `foo`.

```
begins: MOV  AX, 61356  ;set AX equal to 61356 decimal
        CALL foo        ;call function foo
        PUSH AX         ;push AX onto the stack
        CALL foo        ;call function foo
        MOV  DX, AX     ;set DX equal to AX
        POP  AX         ;pop the stack into AX
ends:                   ;end of snippet
```

a. Determine the hexadecimal representation of the decimal value 61356. [4 marks]

b. Determine the contents of the registers AX and DX in hexadecimal after the instructions in the snippet between begins and ends are executed. [13 marks]

c. Hence, deduce and describe the effect of the subroutine foo on the contents of the register AX. [3 marks]

3. An operating system has the function to manage memory.

a. Identify and define **THREE** ways of how memory mapping works. [12 marks]

b. How are files physically stored by the operating system? [5 marks]

c. Name **THREE** other functions of the operating system. [3 marks]

4. Social implications of computing and the Internet.

a. Define a social network. [4 marks]

b. Name **THREE** social networking services together with their main distinguishing feature. [6 marks]

c. What sort of computer crimes can happen on social networks? [5 marks]

d. What is the effect of global communication on the concept of citizenship and culture Web 2.0? [5 marks]

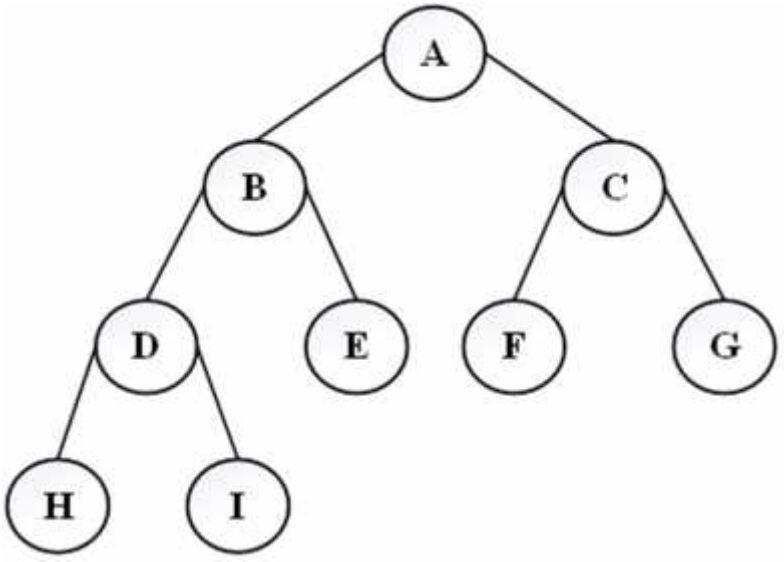
5. *Backus-Naur Form* (BNF) and *Extended BNF* (EBNF) are notation techniques used for defining the syntax of a programming language.

   a. Why was *EBNF* defined? [2 marks]

   b. Define any **THREE** of the following using the *BNF* notation:
      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. [12 marks]

   c. Name and describe the **THREE** most common binary tree-traversal methods. [3 marks]

   d. Traverse the following binary tree using each of the traversal methods mentioned in part (c) above. [3 marks]

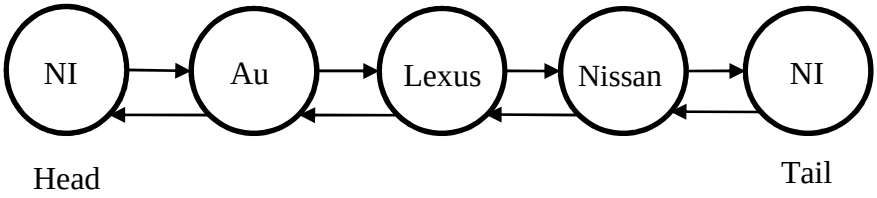


6. a. How can the *Unified Modelling Language* (UML) be used to help the systems analyst/s to model parts of a system? [4 marks]

   b. Referring to *Use Case Diagrams,* describe in some detail each of the following (you may make use of diagrams or examples to help you describe the various parts – *please note that diagrams alone are not enough*):
      i. Actor; [4 marks]
      ii. Use Case; [4 marks]
      iii. System boundary; [4 marks]
      iv. Association. [4 marks]

.

7. A set of car brands is held in alphabetical order in a doubly-linked list with pointers to the head and tail:



a. Describe the structure of each node in this doubly-linked list. [3 marks]

b. It was decided that the node containing the car name Lexus is deleted. Explain the steps involved to delete this node. [6 marks]

c. Assuming that the deletion in question (b) was not done, a new node containing Daewoo is to be inserted in the correct position in the list. Explain the steps involved to insert this node. [6 marks]

d. Outline **TWO** advantages of storing the list as a doubly-linked list compared with a single-linked list. [4 marks]

e. Draw a balanced binary tree that contains the three nodes as the list drawn above. [1 mark]

8. A supermarket buys frozen foods from Frozen Co LTD. The supermarket requested a statement of all the invoices that were issued from the beginning of the year. The statement shows the following data:

- Invoice No
- Invoice Date
- Product Code
- Description
- Quantity
- Price per Unit
- Total Price

This is an extract of the statement given by Frozen Co LTD to the supermarket:

Invoice No	**Invoice Date**	**Product Code**	**Description**	**Quantity**	**Price Per Unit**	**Total Price**
001	02/01/2015	PIZ 01 PIZ 03 PIZ 05	Margherita Pizza Funghi Pizza Marinara Pizza	20 10 05	3.00 3.20 3.80	 111.00
002	15/01/2015	BUR 01 SAU 02	Beef Burgers Turkey Sausages	10 05	2.80 1.50	 35.50
003	30/01/2015	ORI 03	Oriental Platter	15	10.30	154.50
…	…	…	…	…	…	…

a. State **THREE** advantages of normalisation. [3 marks]

b. Outline why the table above is **not** in 1st Normal Form. [3 marks]

c. Recreate the table(s) in 1st Normal Form for the data given above. [3 marks]

d. Explain why the field "Total Price" cannot be a primary key. [2 marks]

e. Outline a way to ensure that "Description" contains atomic values. [2 marks]

f. Outline the condition that attributes must meet, in relation to composite primary keys to produce 2nd Normal Form. [2 marks]

g. Referring to the answer given in part (c), construct the table(s) in 3rd Normal Form. [5 marks]