

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA
MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
SEPTEMBER 2012

SUBJECT:	COMPUTING
PAPER NUMBER:	I
DATE:	4th September 2012
TIME:	9.00 a.m. to 12.00 noon

Answer ALL 20 questions. Write your answers on the booklet provided.

SECTION A

1. a) **Explain** why the following code will generate an exception: [2 marks]

```
public static void main(String[] args){  
    int[] nums = {5, 10, 15, 20};  
    System.out.println(nums[4]);  
}
```

- b) Describe, using an example, **one** way through which it is possible to **handle exceptions** in java. [3 marks]
2. A list can be implemented either using a **static data structure** such as an **array** or else using a **dynamic data structure** such as a **linked list**. Explain how **insertions** differ between the static and dynamic implementations of a list. [5 marks]
3. Mention **two modifications** that can be done to a linked list data structure so that it is converted into a binary tree data structure. [5 marks]

SECTION B

4. Write down the truth table for:
- a) a 3-input NOR gate; [2 marks]
 - b) a 3-input XOR gate. [3 marks]
5. a) Is it possible to have a memory address given by the number 567 decimal, if the address bus is 8 bits wide? [2 marks]
- b) What is the highest address in binary that can be represented with 8 bits? [3 marks]
6. a) A memory IC has 16-bits (A_0 to A_{15}) used for the address lines. What is the number of addresses, in decimal, that can be used by the IC? [2 marks]
- b) A computer is described as having 256 megabytes of RAM. Which one of the following is the correct memory size in decimal?
- i) 256×10^6 bytes;
 - ii) 2^{28} bytes.
- Give reasons for your choice. [3 marks]
7. Show the steps necessary to fetch an instruction from memory in a simple processor. [5 marks]
8. A processor IC has only ONE input interrupt line. Mention ONE way how two sources of interrupts can be serviced by the processor. Include a simple diagram in your answer. [5 marks]
9. A **Feasibility Study** is commissioned at an early stage in the life cycle of a project. What does one expect to gain from this study? [5 marks]
10. In computer science,
- i) what is the **Backus-Naur Form (BNF)**? [1 mark]
 - ii) what is it used for? [1 mark]
 - iii) consider this BNF for a name:

```

<name-part> ::= <personal-part> <last-name> <opt-suffix-part> <EOL>
              | <personal-part> <name-part>
<personal-part> ::= <first-name> | <initial> "."
<opt-suffix-part> ::= "Snr." | "Jnr." | ""
    
```

Translate its meaning into plain English by writing a sentence for each definition of <name-part>, <personal-part> and <opt-suffix-part>. [3 marks]

11. Explain why **code optimization techniques** are used and describe ONE such optimization technique. [5 marks]
12. a) Clearly distinguish between **Alpha** and **Beta** testing. [2 marks]
b) Clearly distinguish between **Pseudo-code** and **p-code**. [3 marks]
13. Give FIVE reasons to explain the importance of **software maintenance** in the development life cycle of software. [5 marks]
14. a) Explain what is meant by the term **Deadlock**. [1 mark]
b) Give examples of **deadlock avoidance** and **detection**. [4 marks]
15. a) Explain what is meant by the terms **interrupt** and **polling**. [2 marks]
b) Give **three** examples of their use. [3 marks]
16. a) Explain what is meant by the term **broadband**. [2 marks]
b) Give **three** examples to explain this term (broadband). [3 marks]
17. a) What is meant by **network topologies**? [2 marks]
b) Explain the difference between a **bus**, **ring** and **star** network. [3 marks]
18. a) What is an **IP address**? [2 marks]
b) Why is this IP address important for the Internet? [3 marks]
19. a) What does it **mean** when a relation is said to be in **Third Normal Form**? [2 marks]
b) Why is it **important** for relations to be in **Third Normal Form**? [3 marks]
20. a) Mention **two** items that need to be considered when making a table in SQL. [2 marks]
b) What is the **purpose** of each of the following SQL commands?
i) DROP TABLE
ii) WHERE
iii) DISTINCT [3 marks]

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SUBJECT:	COMPUTING
PAPER NUMBER:	II
DATE:	5th September 2012
TIME:	9.00 a.m. to 12.00 noon

Answer any FIVE questions. Write your answers on the booklet provided.

1. (a) A decimal floating point unit uses one (1) digit for the sign, six (6) digits for the mantissa and four (4) digits for the exponent to represent floating point numbers. The exponent uses ten's complement representation. Table 1 gives examples of three floating point numbers using this method of representation:

	Number		Representation
(i)	43.25	0.4325×10^2	0 432500 0002
(ii)	-0.073245	-0.73245×10^{-1}	1 732450 9999
(iii)	0.00043	0.43×10^{-3}	0 430000 9997

Table 1

With reference to the above examples in Table 1, what is the representation for the following two numbers:

- (i) 75624; (ii) - 0.78923 ? [6 marks]
- (b) An integer unit uses an eight-bit two's complement binary number representation. What is the range of valid integer numbers that it can represent? [4 marks]
- (c) What is the minimum number of bits necessary to be able to represent – 512 (minus 512) using two's complement binary number representation? Give reasons for your answer. [4 marks]
- (d) A RAM is described as being a 4096 address by 8-bit RAM. For this RAM:
- (i) how many memory bits are there; [2 marks]
- (ii) how many address lines are necessary; [2 marks]
- (iii) how wide is the data bus? [2 marks]

2. A short assembly code program is given below. Assume that:
- all instructions use either 16 or 32 bits as shown;
 - the addresses are in hexadecimal and are 16 bits long;
 - all processor registers are 16 bits wide;
 - initially the stack pointer register points at location 0100 Hex in stack memory, which is also the first free location on the stack memory;
 - the stack grows down;
 - main memory is organised with two bytes (16 bits) of data at each memory address.

Memory Address (Hexadecimal)	Instruction	Comments
0500	MOV R0, 3800	; put 3800 Hex in R0
0502	MOV R1, 0000	; put 0000 Hex in R1
0504 LOOP1:	SHL R0	; logical shift left R0
0505	PUSH R0	; place present contents of R0 on stack
0506	CMP R0, R1	; compare contents of R0 and R1
0507	JG LOOP1	; jump if R0 > R1
0508	CALL SUB1	; call subroutine SUB1
0509	INC R1	; increment R1
.....	
.....	
0570 SUB1:	PUSH R0	; place contents of R0 on stack
0571	MOV R0, 0008	; put 08 Hex into R0
0573 LOOP2:	SHR R0	; logical shift right R0
0574	CMP R0, R1	; compare R0 and R1
0575	JNE LOOP2	; jump if not equal
0576	POP R0	; pop from stack, place in R0
0577	RET	; return

Assuming that the program has just finished executing the instruction at 0509 Hex:

- (a) Work out the number of **instructions** used in order to execute the part of the program shown (i.e. from address 0500 Hex up to and including the instruction at memory address 0509 Hex). [10 marks]
- (b) Give the contents of **stack memory** starting from 0100 Hex that are modified by this part of the program. [6 marks]
- (c) What are the contents of the **stack pointer register** at this point? [4 marks]
3. (a) What is the difference between a natural and a formal language? [6 marks]
- (b) How is the syntax of a formal language defined? [8 marks]
- (c) What is the difference between the syntax and the semantics of a programming language? [6 marks]
4. (a) What does the abbreviation JAD stand for? In what circumstances is it best to use JAD? [5 marks]
- (b) What does the abbreviation UML stand for? What is its purpose? [5 marks]
- (c) Explain the term ‘Use Case Diagram’ and describe its association with UML. [5 marks]
- (d) Describe (giving examples) the fundamental concepts of Data Flow Diagrams. [5 marks]
5. Within the context of Process control explain:
- (a) the various states of a process; [5 marks]
- (b) the meaning of scheduling; [5 marks]
- (c) in detail two scheduling techniques. [10 marks]
6. (a) What is meant by the term **File System**? Give examples. [5 marks]
- (b) Explain the difference between the following three blocks: **Contiguous**, **Linked** and **Indexed**. What are the pros and cons of each? [15 marks]
7. (a) Explain the concept of a **pointer** and how it is used within a suitable data structure such as a linked list. [3 marks]
- (b) A **queue** data structure can be implemented using a linked list. Explain how the **enqueue** (adds a new element to the queue) algorithm works, by making references to pointer manipulation. [4 marks]
- (c) A **hash table** is a data structure that can store and retrieve data items quickly and efficiently. Within this context:
- (i) explain the main **characteristics** of such a data structure; [3 marks]
- (ii) mention **two** characteristics of a “**good**” **hash function**; [2 marks]
- (iii) give an **example** of a typical **hash function**. [2 marks]

- (d) A hash table can be simply implemented using an **array** data structure, however **collisions** can result in inefficiencies and need to be resolved. Within this context:
- (i) explain the meaning of the term **collision**; [2 marks]
 - (ii) explain how a strategy such as **chaining** (or open hashing) can be used to resolve collisions. [4 marks]
8. (a) Explain what is meant by the term **normalisation**. Describe in your answer its various **forms** and highlight its importance in overcoming inefficiencies within relational databases. [5 marks]
- (b) A newspaper company manages subscriptions to a number of magazines. Customers can subscribe to receive one or more of the magazines. Each magazine has a category, such as Motoring or Current Affairs and a yearly subscription rate, which is the cost of subscribing to receive a magazine for 12 months.
- The details of customers' subscriptions to magazines are stored in a database using the three entities: Magazine, Subscription and Customer.
- i) Define the details of the **three** entities, making sure that they are normalised up till the **Third-Normal Form**: appropriately name the **entities** and explain the inclusion of the **attributes** and your choice of **primary** and **foreign** keys. [6 marks]
 - ii) Define the **data types** for the attributes within the Magazine entity. [3 marks]
 - iii) Define clearly, using a **short notation** (as in the example of **ENTITY** shown below), the three entities Magazine, Subscription and Customer. **ENTITY (attrb1, attrb2,....attrbN)**. [3 marks]
 - iv) Construct an Entity-Relationship diagram for the database. [3 marks]