SOUTH WEST REGIONAL MOCK EXAMINATION
GENERAL EDUCATION

THE TEACHERS' RESOURCE UNIT (TRU)
Cellule d'appui à l'action Pédagogique

IN COLLABORATION WITH
En collaboration avec

THE REGIONAL INSPECTORATES OF PEDAGOGY AND

THE SUBJECT TEACHERS' ASSOCIATIONS (STA)

MONDAY, 27TH MARCH 2023   ADVANCED LEVEL

Subject Title	**Computer Science**
Paper Number	**Paper 2**
Subject Code Number	**0795**

TWO AND A HALF HOURS

INSTRUCTIONS TO CANDIDATES:

Answer any SIX questions.

All questions carry 17 marks each. For your guidance, the approximate mark for each part of a question is indicated in brackets.

You are reminded of the necessity for good English and orderly presentation in your answers.

In calculations, you are advised to show all the steps in your working, giving your answer at each stage.

Calculators are NOT allowed

1. (i) **Figure 1** shows an 8-bit pattern.

1	0	1	1	0	1	1	0

Figure 1

(a) If the bit pattern in Figure 1 is a two's complement binary integer, what is the denary equivalent of this bit pattern?

(2 marks)

(b) What is the range of denary numbers that can be represented using 8-bit two's complement binary integers?

(2 marks)

(c) What is the hexadecimal equivalent of the bit pattern in Figure 1? **(2 marks)**

(d) Why are bit patterns often displayed using hexadecimal instead of binary? **(1 mark)**

(ii)(a) Simplify the Boolean expression $B \cdot (\overline{\overline{A} + \overline{B}})$. **(3 marks)**

(b) Draw a logic circuit diagram for the expression $Q = A \cdot B + (A \oplus B)$. **(3 marks)**

(c) Ignoring cost, state **two** advantages of simplifying a Boolean expression before it is implemented in hardware.

(2 marks)

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2. (i) (a) The size of the memory in a computer system is 512 mega words where each word is 32 bits. Determine the size of the address bus and the size of the data bus. **(3 marks)**

(b) How many memory chips of capacity 128 by 8 are needed to provide a memory capacity of 4096 by 16? **(2 marks)**

(c) What is cache memory? How is cache memory different from main memory? **(3 marks)**

(ii)(a) RISC processors use of a *load/store* architecture. Explain the implication of the load/store architecture on RISC instruction sets. **(2 marks)**

(b) State **two** advantages of RISC processors over CISC processors. **(2 marks)**

(c) Consider the high-level language statement: **C = A + B**, that instructs the computer to add the values of two variables A and B, and then assign the sum to a variable C.

Using the mnemonics LDR, ADD and STR which represent the operations *load*, *add* and *store* respectively, show how the above statement would be evaluated in a *load/store* based CPU organization. **(4 marks)**

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3. (i) (a) What is a scheduling policy in operating systems? **(1 mark)**

(b) Describe the terms *throughput* and *turnaround time* as used in scheduling, stating how each can be used as a metric for a given scheduling policy. **(4 marks)**

(c) Explain what a convoy effect is and state a scheduling policy that could cause convoy effect when scheduling processes. **(3 marks)**

(ii)(a) State **two** activities of the operating system in relation to memory management. **(2 marks)**

(b) Explain the difference between a virtual address and a physical address. **(2 marks)**

(c) Describe how virtual memory can allow a word processor and a spreadsheet to run simultaneously on a computer even when both applications are too large to fit into the computer's main memory. **(3 marks)**

(d) State **two** advantages of dynamic partitioning in contiguous memory allocation. **(2 marks)**

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4. (i) A bank uses a computer file to store customer records. One field in the the customer record is a 4-digit customer ID (in the range 1000 and 1999).

The file can store a maximum of 1024 records. An algorithm for inserting a new record in this file uses the following *hash function*:

RecordKey= CustomerID**mod**1024, *where RecordKey is the record's position in the file and* **mod** *is the modulus arithmetic operator.*

(a) In database context, what is a record? **(1 mark)**

(b) State the type of file organization that is used to store records in this file and give **two** advantages of using this file organisation. **(3 marks)**

(c) Determine the RecordKey values for the CustomerIDs: 1081, 1239 and 1999. **(3 marks)**

(ii) Consider the database schema below.

tblStudents(studentId, studentName, DOB)
tblSubjects(SubjectCode, SubjectTitle)
tblResults(studentId, subjectCode, grade)

(a) Give an SQL DDL definition for the table *tblResults*. **(4 marks)**

(b) Explain the term *referential integrity* as used in databases. **(2 marks)**

(c) Identify **one** referential integrity constraint that has been included in the DDL definition in ii(a) above. **(1 mark)**

(d) Present exactly **one** row of sample data for the table *tblStudents* and **two** rows of sample data for each of the tables *tblSubjects* and *tblResults*. **(3 marks)**

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5. (i) Consider a sorting algorithm whose steps are given below.

Step 1: Scan through the list, comparing adjacent elements
Step 2: Swap adjacent elements in ascending order if they are in wrong order
Step 3: Repeat steps 1 and 2 for the unsorted part of the list until the list is sorted

(a) Show all the steps of the above algorithm for sorting the list [18, 15, 25, 7]. **(6 marks)**

(b) How many comparisons and swaps were required to sort the list in (a) above? **(2 marks)**

(c) Show that the runtime complexity for the total number of comparisons when the above algorithm is used to sort a list of size n, is $O(n^2)$ or quadratic time. **(3 marks)**

(ii)(a) What is software testing? **(1 mark)**

(b) State **two** reasons why testing is necessary in the software development process. **(2 marks)**

(c) Describe **three** types of data that should be used in a test plan. **(3 marks)**

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6. (i) (a) What is an IP address? What are the component parts of an IP address? **(3 marks)**

(b) Give two examples of an IPv4 address, one Class A and one Class B. **(2 marks)**

(ii) The data byte 10011101 is to be transmitted using asynchronous serial data transmission.

(a) Explain what is meant by serial data transmission. **(2 marks)**

(b) Serial transmission can be synchronous or asynchronous. Explain the difference between synchronous and asynchronous data transmission. **(2 marks)**

(c) A parity bit will be added to the data byte before it is transmitted. Explain the purpose of the parity bit and state the value of the parity bit that will be added if odd parity is used. **(2 marks)**

(iii) Describe the purpose of the following devices on a network.

(a) Router **(2 marks)**

(b) Bridge **(2 marks)**

(c) Modem **(2 marks)**

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7. (i) Some programming languages require that each variable be declared before it can be used.

(a) Explain the terms *variable* and *variable declaration* in this context. **(3 marks)**

(b) State **two** reasons why it is important for a computer to know the data type of each variable used in a program.

(2 marks)

(c) What type of error occurs when a programmer fails to declare a certain variable? **(1 mark)**

(ii)(a) State **two** differences between a while loop and a repeat loop. **(2 marks)**

(b) Write a pseudo code algorithm that shows how a **for** loop can be used to add up five numbers entered by the user and then print out the total. **(5 marks)**

(c) What is a recursive function? Why is iteration faster than recursion at run-time? **(4 marks)**

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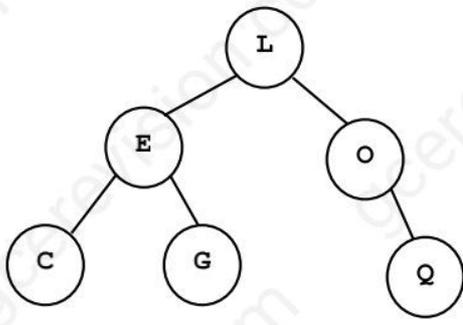8. (i) Consider the binary search tree in **Figure 2**.

Figure 2

(a) What is a complete binary tree? Is the tree above complete? **(2 marks)**

(b) State in what order a *Node*, its *Left* child and its *Right* child would be visited in each of pre-order and post-order. Hence, determine the pre-order and post-order traversals of the tree above. **(4 marks)**

(c) Node **L** is to be deleted from the tree above. Draw the resulting binary tree when a replacement node is chosen from the left subtree. **(2 marks)**

(d) Give an array representation of the binary tree in Figure 4. **(3 marks)**

(ii) Suppose you have three stacks **S1**, **S2** and **S3** with starting configuration shown on the left of **Figure 3**, where stack **S1** contains the letters **A**, **B**, **C** and **D**, and finishing configuration shown on the right, where the letters have been moved into stack **S3**. Give a sequence of push and pop operations which move the letters *A*, *B*, *C*, and *D* from **S1** to **S3** as shown below. For example, to pop the top element of **S1** and push it onto **S2**, you would write *S2.push(S1.pop())* or *x = S1.pop()* and then*S2.push(x)*. **(6 marks)**
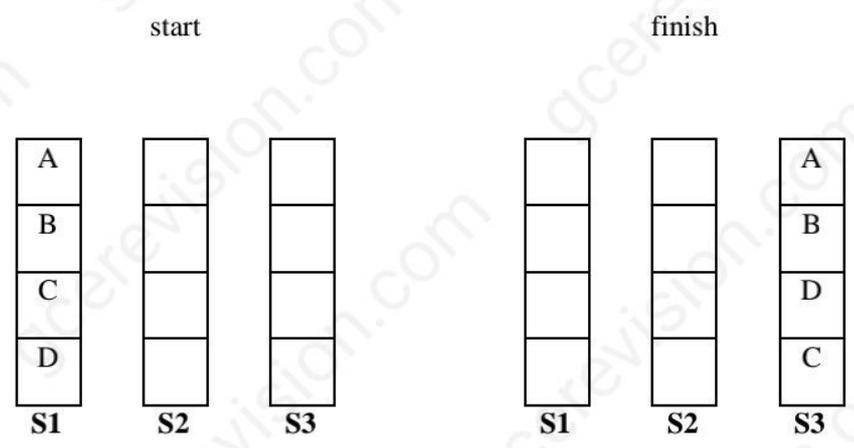

Figure 3