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CENTRE REGIONAL MOCK EXAMINATION	SUBJECT CODE NUMBER 0795	PAPER NUMBER 2
CANDIDATE NAME: …… **CANDIDATE NUMBER: ……** **CENTRE NUMBER: ……**	**SUBJECT TITLE** **COMPUTER SCIENCE**	
ADVANCED LEVEL	DATE**: Monday 25 March 2024**	

Two and a half hours (2½ hrs)

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 will be marked on your ability to use good English, to organize information clearly and to use specialist vocabulary where appropriate.

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

Where an imperative programming language is required to write program code, either standard (ISO) Pascal or the standard (ANSI C) programming language may be used.

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1. i. a) The access time for a device such as a magnetic disk is measured in three stages: ***seek time, rotational delay (latency), & data transfer time***. Explain what is meant by each of the underlined terms. **(3 Marks)**

b). Show how the denary value −9.125 can be represented in normalised floating-point format, using 8 bits for the mantissa and 4 bits for the exponent, both in two's complement. **(3 Marks)**

ii.. A combinational logic circuit is designed to carry out addition in base 2. The circuit will add three bits $\boldsymbol{A, B \& C_{in}}$ to produce a ***sum (S) and a carry*** $\boldsymbol{(C_{out})}$ as outputs.

a) What is a combinational logic circuit? **(1 Mark)**

b) Draw the truth table for addition in this circuit **(2 Marks)**

c) From the truth table above, obtain and simplify the Boolean expressions for the outputs ***Sum (S) and carry*** $\boldsymbol{(C_{out})}$ **(4 Marks)**

d) Implement the logic circuit above using only **NAND gates** **(4 Marks)**

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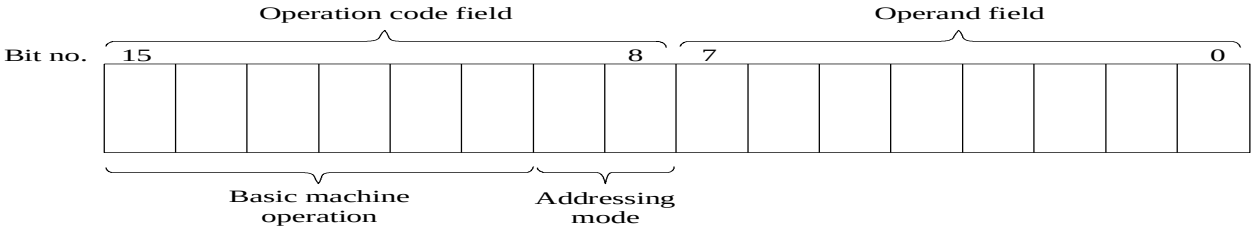
2. i. A computer design company has been asked to produce a design for an elementary computer to be used to teach students about machine architecture, machine operations and the design of an *instruction set.* Both the current instruction register and accumulator have lengths of 16 bits each. The structure of a machine instruction is as follows:



a) How many different **basic machine operations** may be coded? **(2 Marks)**

b) The operation code denotes basic machine operations like **STORE and LOAD.** Explain the difference between the **STORE and LOAD operations**. **(2 Marks)**

c) With reference to the operand field of a machine instruction, define the following addressing modes.
Immediate, Memory Direct and Memory Indirect **(4 Marks)**

ii. a) A particular computer system uses a 32-bit address bus and a 8-bit data bus. Each addressed memory location can store one byte of data. What is the maximum amount of memory, in GB, that could be accessed**?** **(3 Marks)**

b) Explain the **fetch phase** of the machine instruction cycle using the **register transfer notation** **(3 Marks)**

c) The capacity of 2K × 16 PROM is to be expanded to 16 K × 16. Find the number of PROM chips required and the number of address lines in the expanded memory**.** **(3 Marks)**

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3. i. An operating system has to manage a system's resources. One aspect of this is memory management.

a) Explain the difference between virtual address space and physical address space. **(2 Marks)**

b) Explain how an operating system may overcome the problem of physical memory being full. **(2 Marks)**

Another job of an operating system is to deal with interrupts.

c) Describe what happens in the CPU when it receives an interrupt. **(4 Marks)**

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ii. Consider the following set of processes, with their arrival times and burst times given in milliseconds:

Process	Arrival Time	Burst Time
A	0	3
B	2	6
C	4	4
D	6	5
E	8	2

a) Draw ***THREE*** Gantt charts illustrating the execution of these processes using Shortest Job First ***(SJF),*** Shortest remaining time first ***(SRTF),*** and ***RR (quantum = 4)*** scheduling. **(3 Marks)**

b) Determine the ***average turnaround time*** for each of the scheduling algorithms in part a **(6 Marks)**

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4. i. a) What is a computer network? **(1 Mark)**

b) Give **THREE** differences between peer-to-peer networking and client-server networking. **(3 Marks)**

ii. A company is setting up a computer network to help manage its business. The company sets up a computer that will act as a server. The server's primary role will be to act as an email server. It will also allow technicians to remotely login so that the server can be managed from other computers.

a) What is a network protocol? **(1 Mark)**

b) State the names of **THREE application layer protocols** that the server must implement and explain what each will be used for. **(6 marks)**

c) The company's network makes use of a number of network devices. Explain the role of the following devices in the network: ***Modem and Router*** **(4 Marks)**

d) Describe one security measure that can be used to protect the email server from unauthorised access. **(2 Marks)**

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5. i. a) Explain two advantages of relational databases over flat-file databases **(4 Marks)**

b) Explain the conditions for a database table to be in the third normal form (3NF) **(2 Marks)**

ii. A company uses a relational database to store employee information and the projects employees work on. The database design has the following two relations:

- EMPLOYEE(Employee_ID, First_Name, Last_Name, DateOfBirth, Hire_Date)
- PROJECT(Project_ID, Project_Name, Start_Date, End_Date)

There is a many-to-many relationship between EMPLOYEE and PROJECT.

a) Describe how this relationship is implemented in a relational database. **(3 Marks)**

b) Explain what is meant by referential integrity, giving an example which refers to the database above. **(2 Marks)**

c) Write an SQL statement to retrieve the full name and number of projects carried out by the employee for employees with more than 5 years of service with the company? **(4 Marks)**

iii.. Differentiate between ***Data Manipulation Language*** and ***Data Definition Language*** **(2 Marks)**

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6. i. Differentiate between the following pairs of terms, giving an example in each case:

a) Static data structure and Dynamic data structure **(2 Marks)**

b) Composite data type and Non-composite data type **(2 Marks)**

ii. A binary search tree is an example of a data structure

a) Insert the following names in a binary search tree in the order they are given: ***John, Sonia, Agatha, Williams, Ben, Paul, & Tonia*** **(3 Marks)**

b) Explain how you would determine if the name ***Tonia*** is in the binary search tree. **(2 Marks)**

c) State the result of the ***PreOrder and PostOrder transversals*** of the above tree **(2 Marks)**

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iii.. Let a and b denote positive integers. Suppose a function Q is defined recursively as follows:

$$Q(a,b) = \begin{cases} 1, & b = 0 \\ 1, & b = a \\ Q(a-1,b-1) + Q(a-1,b), & 0 < b < a \end{cases}$$

a) Evaluate Q(6,4) **(2 Marks)**

b) What does this function do? **(1 mark)**

c) Write an algorithm in pseudocode for the recursive subroutine Q defined above **(3 Marks)**

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7. i. a) With reference to object-oriented programming, **Explain** the following terms: **Encapsulation and Inheritance** **(4 Marks)**

b) Describe what happens during **lexical analysis** when code is compiled **(2 Marks)**

ii. Consider the following subroutine.

```
Boolean whatPropertyIsIt(String s)
Start
    i ← 0;
    j ← s.length() – 1;
    WHILE (i < j) DO
        IF (s.charAt(i) ≠ s.charAt(j)) THEN
            Return False;
        ENDIF
        i ←i + 1;
        j ← j – 1;
    ENDWHILE
    Return True;
Stop
```

Note that ***s.charAt(i)*** is the character in the ith position of string s. For example, where s is the string "abcde", s.charAt(2) is the character 'c'. ***s.length()*** returns the number of characters in the string s.

a) What is a subroutine? **(1 Mark)**

b) With the help of trace tables, dry run the subroutine for the call **whatPropertyIsIt("xyzdyx") and whatPropertyIsIt("racecar").** **(4 Marks)**

c) Identify the purpose of this algorithm. **(2 Marks)**

d) Identify the termination conditions for the loop. **(2 Marks)**

e) Explain the effect of changing the condition in the **while** loop to i ≤ j. **(2 Marks)**

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8. i. Commercial software usually undergoes acceptance testing and integration testing.

a) Distinguish between acceptance testing and integration testing.by stating: ***who does the testing, when the testing occurs and the specific purpose of each type of testing*** **(3 Marks)**

b) Name **two** types of maintenance that the software may require **and** give a reason for each. **(4 Marks)**

ii.. a) Explain the difference between incremental prototyping and evolutionary prototyping **(2 Marks)**

b) Explain the waterfall model of software development life cycle. State two of its main limitations **(3 Marks)**

iii.. Data representing a worker's hourly rate of pay is to be entered into a computer software. The minimum rate is 2500 per hour and the maximum rate is 5500 per hour.

a) Construct an algorithm for a subroutine ***validate( )*** to validate the inputted value. Assume that the value is of the appropriate data type. The subroutine should **return false if the data is invalid and true if the data is valid**. **(3 Marks)**

b) Construct the part of the algorithm required to call the validation check and then ask for the value to be re-entered if it is invalid.

(2 Marks)

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