Sir Abralitee

CAMEROON GENERAL CERTIFICATE OF EDUCATION BOARD
General Certificate of Education Examination

JUNE 2015   **ADVANCED LEVEL**

Subject Title	Computer Science
Paper No.	Paper 2
Subject Code No.	795

Two Hours

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.

Turn Over

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1. (i) Add 1025 and 1023 using 12 bits in 2's complement notation. Show your working. **(4 marks)**

   (ii) Convert the hexadecimal number ABCDEF to binary. **(4 marks)**

   (iii) A RAM has a capacity of 32 K × 16.
   (a) How many memory addresses does this RAM have? **(2 marks)**
   (b) How many address lines will be needed for this RAM? **(2 marks)**

   (iv) Obtain the truth table for the function $F = A\overline{B} + \overline{B}C + \overline{A}C$. **(5 marks)**

2. (i) IBM wants to build a computer chip that compares English Language words to see if they are the same. To begin with, they would like to build a smaller one that bit-wise compares two characters. Each character is coded in 8 bits. The principle they follow here is that in bit-wise comparisons, a 1 (one) is generated if the two corresponding bits are the same otherwise a 0 (zero) is generated.

   (a) Give a truth table for the comparison of two bits. **(4 marks)**
   (b) From the table generate a Boolean expression for the comparison of two bits x and y giving r as result. **(3 marks)**
   (c) Draw a digital circuit diagram for this comparison with r as the output. **(4 marks)**
   (d) What logic gate is being described here? **(1 mark)**

   (ii) Any two characters are the same if they are bit-wise the same; otherwise, they are not the same. If two characters are the same a 1 is returned, otherwise a 0 is returned.
   (a) For two eight bit characters, how many bits-wise comparisons chips are necessary? **(2 marks)**
   (b) Draw a complete digital circuit for the comparison of two characters. Use just an annotated box to represent the circuit diagram in (1c) above. **(3 marks)**

3. (i) A CPU-scheduling algorithm determines an order for the execution of its scheduled processes. Given n processes to be scheduled on one processor, how many different schedules are possible? Give your answer as a formula in terms of n. **(3 marks)**

   (ii) Explain the main difference between preemptive and non-preemptive scheduling strategies. **(4 marks)**

   (iii) Given that the following processes arrive for execution at the times indicated, each process will run for the amount of time listed. In answering the questions, use non-preemptive scheduling and base all decisions on the information you have at the time the decision is made.

PROCESS	BURST TIME
P1	8
P2	4
P3	1

   (a) Draw Gantt Charts for these processes with the first Come First Served (FCFS) and Shortest Job First (SJF) scheduling algorithms. Calculate the average waiting time for each of the above algorithms. **(10 marks)**

4. (i) Differentiate between the following programming concepts:
   (a) Program maintenance and debugging. **(4 marks)**
   (b) Top-down and bottom-up program development approaches. **(4 marks)**

   (ii) Define the following problem solving techniques: *Searching* and *sorting*. **(2 marks)**

   (iii) (a) Using an array of elements, informally explain how the selection sort algorithm works. **(3 marks)**
   (b) Apply the selection sort to the following array. Write out a row of array the elements each time an element is moved. **(4 marks)**

4	15	1	16	10

5. (i) Which data structure is used implicitly when a recursive function is executed? What does this data structure store during execution of the function? **(3 marks)**

   (ii) Match the scenarios (cases) below to the data structures most appropriate (i.e., most efficient and effective) to use; tick the cell that matches a unique data structure to a corresponding case. In your answer booklet, identify the cases and data structures by their labels, such as D1 and D2. **(5 marks)**

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S/N	CASE	DATA STRUCTURES			
		Binary Search Tree (D1)	Stack (D2)	Linked List (D3)	1-D Array (D4)
1.	Implementing a dictionary.				
2.	Student registration; number of students is unknown.				
3.	List of candidates for a competitive examination; the number of candidates is unknown and varies widely with different examinations.				
4.	Final list of candidates successful in a highly competitive exam for a very restricted number of offers.				
5.	Registration of signs seen on a journey, which are then used to trace one's way back [to journey's start].				

(iii) The algorithm below has integer variables, sum, i and j.

```
Algorithm sum (n)
sum, i, j: integer;
begin
   sum ← 0;
   for i ← 1 to n do
           P ← 0;
      for j ← 1 to i do
         P ← P + j;
      endfor
      sum ← sum + P
   endfor
end
```

(a) For $n = 5$, give the value of P for each value of i, after the SECOND for-loop is executed. **(5 marks)**

(b) Deduce what the algorithm calculates in its inner loop. Give the formula in terms of i for what the inner loop calculates, and modify your program to use this formula in place of the inner loop. **(4 marks)**

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6. (i) (a) What is a subroutine? Why is it important? **(3 marks)**

(b) How are subroutines called from the main program? **(2 marks)**

(ii) Draw a trace table for the following algorithm. What is the output of this algorithm?

$$x \leftarrow 10$$
$$y \leftarrow 15$$
$$z \leftarrow 20$$
$$x \leftarrow x + y$$
$$y \leftarrow x + z$$
$$z \leftarrow x + y + z$$

if $x > y$ then
   $$x \leftarrow x + 5$$
else
   $$x \leftarrow x - 3$$
endif
if $y < z$ then
   $$y \leftarrow y + 10$$
else
   $$y \leftarrow y - 10$$
endif
print x, y, z **(7 marks)**

(iii) (a) What is a stack? Why is it used in a program? **(2 marks)**

(b) Comment on the memory size of a stack. **(3 marks)**

Turn Over

7.   (i)   What is software testing? Why is software testing very important?   **(4 marks)**
  (ii)   What are data coupling and control coupling?   **(2 marks)**
  (iii)   Explain the waterfall model of software life cycle. State TWO of its main limitations?   **(5 marks)**
  (iv)   Why is design an important phase in the software development life cycle? Describe the design process.   **(6 marks)**

8.   (i)   With respect to program development, briefly explain what determines your choice of:
    (a)   Control structures in programs.   **(3 marks)**
    (b)   Data structures in programs.   **(3 marks)**
    (c)   Algorithms for problems.   **(3 marks)**
  (ii)   What do you understand by the structure of a program?   **(2 marks)**
  (iii)   Briefly explain the concepts of structured programming and program modularity.   **(6 marks)**

9.   (i)   Consider the following information about the attributes of the entity classes in the LIBRARY database to be

❖ Books (Title, ISBN, Price)
❖ Authors (AuName, AuPhone, AuID)
❖ Publishers (PubName, PubPhone, PubID).

  (a)   Design and draw an entity- relationship diagram that captures some information found in the database where, "*PublisherOf*" is the relationship between *Books* and *Publishers*, and "*WrittenBy*" is the relationship between the *Authors* and *books*.   **(5 marks)**
  (b)   What is the average case for comparisons in a sequential search of a database file of size *n*.   **(2 marks)**

  (ii)   The Database below is designed to store data about employees at a college.

EmployeeID	Last Name	First Name	Title	Birth Date	Hire Date
1	Bishop	Frank	Sales Representative	08/12/1968	1992
2	Fuller	Emma	Vice President	19/02/1952	1992
3	Buchanan	Judith	Sales Representative	30/08/1963	1994
4	King	Praises	Sales Manager	09/01/1958	1993
5	Peacock	Thelma	Sale Representative	02/07/1969	1994

  (a)   Mindful of how relational databases are constructed, give THREE main reasons to explain whether or not the table is in the first normal form (1NF). Justify your answer using examples from the data in the table above.   **(8 marks)**
  (b)   State TWO advantages of normalization.   **(2 marks)**

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