THE OPEN UNIVERSITY OF SRI LANKA
B.Sc DEGREE PROGRAMME: LEVEL 04
DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE
FINAL EXAMINATION - 2013/2014
CSU2279: DATA STRUCTURES AND ALGORITHMS

DURATION: **THREE HOURS** (3 HOURS)

Date: 22nd November, 2014	Time: **1.30 p.m – 4.30 p.m**

Answer FOUR Questions ONLY.

Q1.

a) What is an Algorithm?

b) What are the **five (05)** main steps involved when writing a computer program to solve a given problem?

c) *"Problem identification is the most difficult and the most important step of the above five (05) main steps"*
   Do you agree with this statement? Give reasons briefly.

d) What are the aspects you should consider when selecting an algorithm for implementation?

e) Consider the following segment of instructions. Is it an Algorithm? Justify your answer.

   N=1
   Print n
   N=N+1
   GO TO STEP 2

f) Explain the factors on which the running time of a program depends on.

Q2.

a) What are the main differences between the internal and external sorting methods?

b) Compare and contrast the *Bubble sort* algorithm with the *Insertion sort* algorithm.

c) Write a Pascal program to implement the *insertion sorting* algorithm.

d) Explain how your program works on the following set of data.

   44, 55, 12, 42, 94, 18, 06, 67, 48, 40

Q3.

a) What is a *data structure*?

b) Write **three (03)** main differences between the *array based* and *pointer based* implementations of a list.

c) Write **three (03)** main differences between singly- *linked lists* and *doubly-linked lists*?

d) Explain the process of the following question (i) and (ii) by means of appropriate diagrams. (Show the pointer manipulations clearly)

    i. Deleting an element from the singly linked list

    ii. Inserting an element into the singly linked list.

e) State whether the following statements are *true* or *false*, if it is *false* give the reason.

    i. A pointer is a *cell* whose value indicates another cell.

    ii. In singly linked list data structures a cell has two components; they are *value of the cell* and the pointer *value which refers to the previous cell*.

    iii. In the pointer representation of a data structure, the *header* cell has the *address of the first cell*.

    iv. Singly linked lists can transverse both *forward* and *backward*.

    v. A doubly linked list uses more memory per node than a Singly linked list.

Q4.

a) State why a stack is called "*a push down List*"?

b) How does *LIFO data structure* differ from a *FIFO data structure*?

c) A stack has two basic operations called PUSH(X,S) and POP(S),
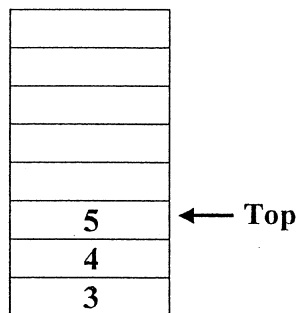

Figure 1: Current state of the stack

Figure 1 shows the current state of the stack. **Graphically show** the following operations that can be performed on the above Stack. Indicate the *top* pointer in each state of the stack.

PUSH(6, S)

PUSH(7, S)

POP(S),

PUSH(8, S)

POP(S),

POP(S),

d) Write a Pascal function/procedure to perform the **PUSH** and **POP** operations.

Q5.

a. Define the following String operations.

    i.   POS(S1, S2)

    ii. COPY(S1, p, 1, S2)

    iii. LENGTH(S1)

    iv. CONCAT(S1, S2, S3)

b. What is a **Set?** What do set ***union, difference*** and ***intersection*** mean?

c. Write Pascal procedures/functions to implement the following Set operations.

    i.   INISET(S): A procedure to initialize the set S.

    ii. UNIONSETS (S1, S2): A procedure to create the union of the two sets, S1 and S2.

    iii. INTERSECTS (S1, S2): A procedure to create the intersection of the two sets, S1 and S2.

Q6.

a. Using an appropriate diagram, explain the following terms.

    i.   Binary tree

    ii.   Leaf nodes

    iii. Depth of a binary tree

    iv. Level of a binary tree

    v.   Sub tree

    vi. Ancestors

    vii. Siblings

b. Answer the following questions using the following tree structure B1 (figure 2).
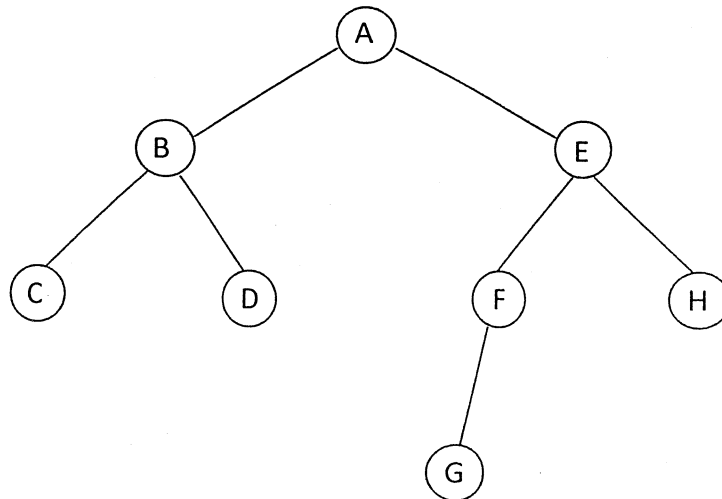

Figure 2: B1 tree

    i. Give the preorder, inorder, postorder transversal of the tree B1.

    ii. Is B1 a binary tree? Justify your answer.

    iii. Show B1 after inserting the 9th node. Explain the concept that you used when inserting the 9th node. (Call the resultant tree B2)

    iv. Explain what should be done more carefully insertion or deletion? Justify your answer.

    v. Is B2 a strictly binary tree structure? Justify your answer.