RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences
Second Year - Semester I Examination – June/July 2018

COM 2307 – DATA STRUCTURES AND ALGORITHMS

Time: Three (03) Hours

Answer all questions

1. a) "Applying the correct data structure in designing algorithms increases its performance". Do you agree with the above statement? Justify your answer. (05 Marks)

   b) What are the common operations on data structures? (04 Marks)

   c) Explain the factors that you have to consider when measuring the running time of an algorithm. (05 Marks)

   d) Following equations represent the running time of two algorithms. Find the "Big O" values (asymptotic upper bound) of them. (06 Marks)

      i. $T(n)=n^2+2n+1$
      ii. $T(n)=T(n/2)+n$; Where $T(1)=1$ and $n/2$ is an integer division

2. a) Compare and contrast array-based lists and dynamic lists

(04 Marks)

b) Suppose that there is a class with maximum 40 students. The enrolling process of the class required to be computerized. At the enrolment name, address and telephone number of the student are recorded along with a unique registration number. Suggest a suitable structure to keep students' records of the class.

(05 Marks)

c) Devise an algorithm to add a student to your structure suggested above. (04 Marks)

d) Write a C function to remove a student from the structure.

(04 Marks)

e) If the maximum number of students is not known in the scenario b) in above, what is your suggestion? (03 Marks)

3. a) Declare a structure of an array based stack in C assuming that the stack contains only integers. (05 Marks)

b) Implement the *push()* and *pop()* methods for the above structure.

(06 Marks)

c) Sum of digits of an integer can be computed by repeatedly dividing the number by 10 and getting the sum of remainders. Write an algorithm for this process and analyze it. (04 Marks)

d) Explain how to use a stack to evaluate the postfix expression

5 2 ^ 5 6 2 / - 3 * + 9 3 / + 2 - 3 *. Note that all operands of the given expression are single digit integers. (05 Marks)

4. a) Formally define a tree, a binary tree and a binary search tree.

(04 Marks)

b) Consider the following algorithm;

```
printTree(TREE T)  ▷ T – a binary search tree
   Declare Q as a Queue  ▷ Q -- a FIFO queue
   Q ← T
   While Q is not empty
        Node=dequeue(Q)
        print Node->value
        if (Node->left) not empty
              enqueue(Node->left)
        if (Node->right) not empty
              enqueue(Node->right)
```

Explain the expected output of the algorithm. (04 Marks)

c) Insert the items 15, 20, 25, 10, 12, 8, 18, 22, 11, 13 into a binary search tree. (05 Marks)

d) Apply the algorithm in b) above to the tree constructed in c) above and illustrate the forming of output. (04 Marks)

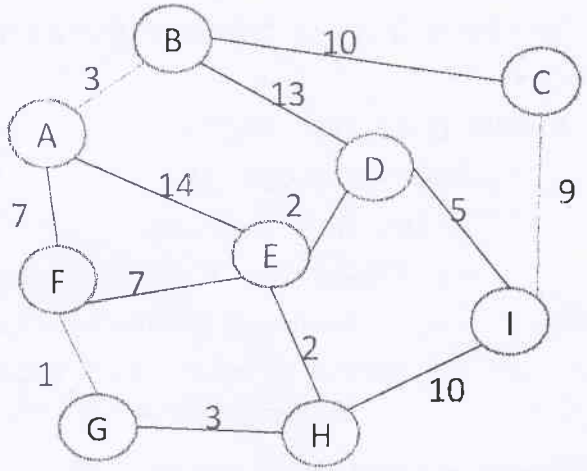
e) Briefly explain how to represent a binary search tree using an array.

(03 Marks)

5. a) Define spanning tree and minimum spanning tree of a graph. (04 Marks)

b) Briefly explain <u>two</u> applications of minimum spanning tree. (04 Marks)

c) Consider the given graph below;



Represent the graph using an Adjacency Matrix and an Adjacency List. Find the space complexities in both representations. (04 Marks)

d) Draw the minimum spanning tree of the graph above. (04 Marks)

e) Find the shortest path from node *A* to node *I*. Explain the algorithm you used to find the shortest path. (04 Marks)

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