RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Information and Communication Technology
Second Year – Semester I Examination – October /November 2015

ICT 2301 – Design and Analysis of Algorithm

Answer **All** Questions   Time allowed: Three hours

1.

a) Name three properties of an algorithm.

(3 Marks)

b) Why do we interest space complexity and time complexity of a program? What are the components of space complexity?

(5 Marks)

c) Define O, Ω, and Θ notations then give a rough sketch for each of them.

(6 Marks)

d) What are the running times of the following procedures as a function of n? Use asymptotic notation, making your bounds as tight as possible.

(3*2 Marks)

    i. *Moo (positive integer n)*
        For i←1 to n-1 do
            For i←i+1 to n do
                Sum= i+j

    ii. *Power (real x, positive integer n)*
        result← x
        For i←1 to n-1 do
            *result←result * x*
        return result

    iii. *Goo(positive integer n)*
        If n=1 then
            Return 1
        Else return Goo(n-1)+ Goo(n-1)

2.

a) Define the three steps in divide and conquer approach? (3 Marks)

b) Using a recursive tree illustrate the operation of merge sort on the given array.

| 3 | 41 | 52 | 26 | 38 | 57 | 9 | 49 |

(3 Marks)

c) Compare and contrast divide and conquer and dynamic programming algorithmic techniques using suitable examples. (4 Marks)

d) Pseudocode for Insertion Sort is given below.

```
Inserton Sort (A)
    for j=2 to A.length
        key= A[j]
        // Insert A[j] in to the sorted sequence A[1......j-1]
        i=j-1
        while i>0 and A[i]>key
            A[i+1]= A[i]
            i=i-1
        A[i+1]= key
```

i. Analyze the running time of insertion sort algorithm using step countdown method and asymptotic notation. (4 Marks)

ii. "Insertion Sort, is an efficient algorithm for sorting a small number of elements" do you agree with this? Explain. (3 Marks)

iii. Illustrate the operation of Insertion Sort on the array A= {31,41,59,26,41,58}. Clearly illustrate your answer with intermediate steps.
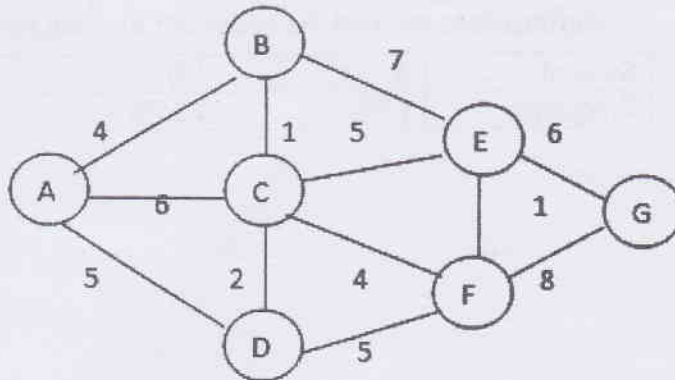
(3 Marks)

3.

a) Compare and Contrast followings
   i. General Tree and Binary Tree
   ii. Full binary tree and complete binary tree
   iii. Trees and Graphs
   iv. Simple graph and multiple graph

(1*4 Marks)

b) How do you represent graph using a linked list? Explain by illustrating an example. (4 Marks)

c) Use Prim's algorithm to find MST (Minimum Spanning Tree) for the graph given below. Clearly illustrate your answer with intermediate steps.   (6 Marks)

d) Graphically illustrate Breadth-First search algorithm on the above (c) graph.

(6 Marks)

4.

a) Is the sequence (23,17,14,6,13,10,1,5,7,12) a heap? Explain.

(2 Marks)

b) Illustrate the operation for Build-Max-Heap(A) on the array A={27,17,3,16,13,10,1,5,7,12,4,8,9,0}. You should clearly illustrate your answer through intermediate steps.   (6 Marks)

c) What is the greedy strategy? Explain using suitable example(s).

(4 Marks)

d) You are the first-prize winner in a grocery contest, and the prize is a free cart load of groceries. There are n different items available in the store and, and the contest rules stipulate that **you can pick at most one of each**. The cart has capacity of c, and item i takes up wi amount cart space. The value of item i is pi. Your objective is to fill the cart with groceries that have the maximum value. Write an algorithm to fill the cart with maximum valued items. When solving this problem what is the algorithmic technique that you used?   (8 Marks)

5.

a) Define three techniques that can be used to handle collision in hash tables.

(3 Marks)

b) Consider inserting the keys 18,41,22,44,59,32,31,73 into a hash table of length m=13 using open addressing with the hash function h1(k)=k mod m. Illustrate the result of inserting these keys using double hashing with h2(k)=8-k mod8.

Probe Sequence is

h1(k)

(h1(k)+1.h2(x))mod size

(h1(k)+2.h2(x))mod size

....   (6 Marks)

c) What are the benefits of data compression?   (3 Marks)

d) Discuss the differences between fixed length coding and variable length coding.

(2 Marks)

e) The following statistics are obtained by analyzing a text message. Construct a Huffman tree and find the codeword for each symbol. (6 Marks)

Symbol	A	B	C	D
Frequency	13%	25%	50%	12%