The Open University of Sri Lanka
Bachelor of Software Engineering
Department of Electrical and Computer Engineering
ECX 4265 – Data Structures & Algorithms
Final Examination 2015/2016

Date: 20th November 2016	Time: 0930 - 1230hrs

< INSTRUCTIONS>

1. Answer the **Compulsory Question 1** in **Part A.**
2. Answer **4 questions out of 6** given in **Part B.**
3. This is a closed book exam and no reference books and materials are allowed.

PART A (Compulsory Question) (40 marks)

Q1. An IQ test was conducted in Grade 7B class of Narahenpita Maha Vidyalaya. A sample of 12 students marks are taken for analysis. The total of the MCQ paper was 100 and below are the marks of the sample students.

35, 52, 91, 45, 63, 48, 83, 21, 74, 82, 12, 52

(i) It is required to store these IQ marks in a suitable dynamic data structure for further processing. Write a pseudo code algorithm for declaring the data structure and for inserting data. (6 marks)

(ii) Write a pseudo code algorithm to arrange the marks of the students into ascending order by selecting the minimum value from the unsorted data using selection sort algorithm. (8 marks)

(iii) Write a pseudo code algorithm to find the average mark of students. (8 marks)

(iv) After calculating the average it was noticed that the average is influenced by the extreme values in the data set. Therefore it was decided to omit the highest and the lowest mark from the data set and calculate the average. Modify the pseudo code algorithm written in part (iii) to calculate the new average. (8 marks)

(v) It was required to have a pictorial view of the initial data set and decided to represent in a Binary search tree. Taking mark 35 as the root insert the original data set into a binary search tree. (6 marks)

(vi) Represent the initial data set in a hash table of size 5. Use separate chaining for conflict resolution. (4 marks)

PART B
Answer any four(04) questions

Q2.

(i) Big Oh notation is the most commonly used method for calculating the running time of an algorithm. Calculate the running time of the below given algorithm with respect to Big Oh notation.

```
int unknownAlgorithm(int a[], int k, int n){

int i,j, mini,tmp;
for(i=0; i< k; i++){
      mini = i;
      for(j= i+1; j < n; j++)
            if(a[j] < a[mini])
                  mini=j;
      tmp = a[i];
      a[i]=a[mini];
      a[mini]=tmp;
}
      return a[k-1];
}
```

(2 marks)

(ii) You are required to push the below given numbers to a stack data structure.
15, 22, 12, 8, 10, 20

(a) Declare a stack data structure and write a pseudo code algorithm to insert the values into the stack. (3 marks)

(b) Write a pseudo code algorithm to take out the last entered value from the stack. (3 marks)

(c) It is required to enter the values in the reverse order into another stack. Write a pseudo code algorithm to create a stack in the reverse order using the algorithms written in part (a) and (b). (7 marks)

Q3.

(i). Compare and contrast recursion vs iteration. (3 marks)

(ii) It is required to find out all the permutations of characters of a given string. For example string 'ABC' will give

ABC, ACB, BAC, BCA, CBA, CAB

(a) Write an iterative pseudo code algorithm to find the permutations of a given string. (6 marks)

(b) Write a recursive pseudo code algorithm to do the same task in part (a). (6 marks)

Q4.

A graph is represented by G = (V; E), where V is the set of vertices (or nodes) and E the set of edges of the graph.

Consider the following specification of a graph G

Set of vertices are V(G) = {A, B, C, D, E, F, G }

Set of weighted edges are E(G) = {(A,B, 3), (A,C, 3), (C,C, 4), (C,D, 5), (D,A, 6), (E,B, 4), (D,E, 4), (E,A, 5), (A,F, 4), (F,G, 4), (B,F,6), (C,G, 4), (G,D, 5), (G, E, 5)}

(i) Draw a directed graph for the above data set. (4 marks)

(ii) Draw the corresponding adjacency matrix. (4 marks)

(iii) Run Dijkstra's algorithm on this graph with start vertex A and target vertex G. You have to give the calculations of the intermediate steps as well. (4 marks)

(iv) What is the cost of the shortest path from A to G. (1 mark)

(v) Briefly describe the impact of having a cycle in a graph. (2 marks)

Q5.

The number of students attended for an Activity class on each day is given below. The total number of students in the activity class are 65.

48, 36, 22, 15, 56, 35, 24, 53, 50, 42

(i) Write a pseudo code algorithm to sort the student attendance using quick sort. (3 marks)

(ii) Considering the first element as the pivot, sort the student attendance using quick sort. You need to clearly show the intermediate steps as well. (4 marks)

(iii) Write a pseudo code algorithm to sort the above data set using bubble sort. (4 marks)

(iv) After sorting the data set it was required to find out whether there is a day with 56 attendance. Write a pseudo code algorithm to search number 56 from the sorted attendance data set. (4 marks)

Q6.

(i) Insert the following data set into a binary search tree according to the given order.

5, 3, 4, 9, 12, 7, 8, 6, 20 (3 marks)

(ii) Insert value 10 into the binary search tree created in part (i). (2 marks)

(iii) Write a pseudo code algorithm for in-order traversal of the tree and give the resulting output. (5 marks)

(iv) Write a recursive pseudo code algorithm to search for a given value in a binary search tree. (5 marks)

Q7.

Assume that you want to develop a data structure for a Telephone Company to store names and phone numbers of all customers. The data structure needs to be efficient in operations of inserting a new entry, searching for a person's phone number and removing an entry.

(i) State the data structure that you propose to implement for the Telephone Company with justification. (3 marks)

(ii) Describe the features that you have to consider in implementing the data structure. (3 marks)

(iii) Consider a hash table of size 7 with hash function h(k) = k mod 7. Draw the table that result after inserting the values 19, 26, 13 48, 17 in the given order for the following three scenarios

(a) When collisions are handled by separate chaining
(b) When collisions are handled by linear probing
(c) When collisions are handled by double hashing using a second hash function
h'(k) = 5 – (k mod 5). (3 × 3= 9 marks)

The End