RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree
SecondYear Semester I Examination – Oct/Nov 2015

COM 2307–Data Structures and Algorithms

Time allowed: Three Hours

Instructions to candidates

- This is a closed book examination.
- There are **FOUR (4) pages** in the question paper.
- Question paper consists of **SIX (6) questions.**
- **Answer any FIVE (5) questions**
- All questions carry equal marks.

Q1.

i. What is an Algorithm? Write down the Properties of an Algorithm? (4 marks)

ii. Explain the Time Complexity of a program and it's importance. (3 marks)

iii. Write an algorithm to find the sum of the given data set. (3 marks)

05	10	08	12	14
0	1	2	3	4

iv. Find the Big O value of the following functions.

a. F(n) $=2n^2 + 6nlog_2 n + 3n$
b. F(n) $=2^n + 4n^4$
c. F(n) $=6log_2 n + 48$

(3 marks)

v. What is the difference between a Doubly Linked List and a Singly Linked List (3 marks)

vi. Illustrate and explain how to delete a given item from a Doubly Linear Linked List. (4 marks)

Total Marks: 20

Q2.

i. Compare and Contrast Queue and Stack giving suitable examples.

(4 marks)

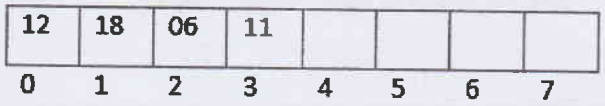
ii. Explain how to calculate the number of free spaces in an array-based circular queue.

(3 marks)

iii. Implement Insert and Delete functions of an Array based Circular Queue using C/C++.

(6 marks)

iv. Illustrate the insertion of the following list of data elements to the given array based Queue. After each insertion, identify the first_free index.
List: 25,43,32,10



first_free = 4

(2 marks)

v. Explain a method to remove an item from a Priority Queue. Illustrate removing of highest priority item of the given Priority Queue.

(5 marks)

Total Marks: 20

Q3.

i. List four applications of stacks in real world. (2 marks)

ii. Evaluate the given postfix expression step by step using Stack
7 6 4 - + 3 8 2 / + - 4 ^ 5 +
(3 marks)

iii. Explain step by step, how to solve an N-Queens problem using Stack. What is the Algorithmic technique you used? (5 marks)

iv. Implement Push and Pop function of a Linked List based Stack in C/C++ (6 marks)

v. Identify the Time complexities of the functions in part ivusing Big O notation.

(4 marks)

Total Marks: 20

Q4.

i. Define a Binary Search Tree (BST). How does it differ from a Binary Tree?

(3 marks)

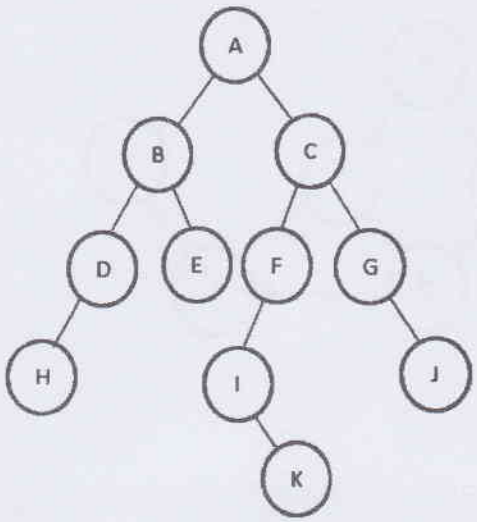
ii. Illustrate step by step insertion of the given list of elements to a BST.
List: 82,94,18,36,09,104,59,25

(4 marks)

iii. Explain how to delete 18 and 94 from the Tree in part ii. (4 marks)

iv. Represent the Tree in part ii using an Array. (3 marks)

v. Write the order in which the nodes are processed in the following traversal methods of the given Tree



a. In Order
b. Pre Order
c. Post Order (3 marks)

vi. Implement a function to insert an item into a BST using C/C++. Assume that a node contains an integer data item (3marks)

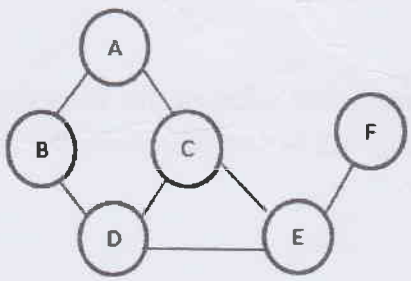
Total Marks: 20

Q5.

i. Differentiate Trees and Graphs. (2 marks)

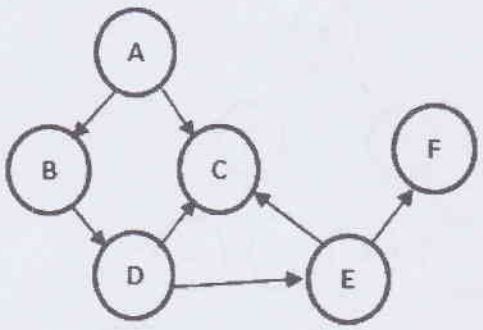
ii. List three applications of Graphs. (3 marks)

iii. Indicate the set of Vertices (V) and set of Edges (E) of the given Graph. (4 marks)



iv. Write the order in which the nodes are processed in the graph in part iii using thefollowing traversal methods. Illustrate all the steps clearly.
   a. Breadth First Traversal
   b. Depth First Traversal (6 marks)

v. Represent the following Directional Graph using Adjacency Matrix and Adjacency List.



(5 marks)
Total Marks: 20

Q6.

i. What are the two criteria that the output of a Sorting Algorithm should satisfy? (2 marks)

ii. Compare and contrast the properties of Merge Sort and Bubble Sort. Discuss, Time Complexity, Space Complexity. (5 marks)

iii. What is the Stability of an Algorithm? Explain using a suitable example how toidentify a stable algorithm. (3 marks)

iv. Illustrate the steps of applying Selection Sort Algorithm to the given Array.

07	19	31	05	11	52	21	02
0	1	2	3	4	5	6	7

(4 marks)

v. Write an Algorithmfor Linear Search and calculate the Best Case, Average Case and WorstCase Time complexities using Big O notation. Write the number of comparisons in each case. (6 marks)

Total Marks: 20

End of the Paper