



**RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES**

**B.Sc. General Degree in Applied Science
Second Year Semester I Examination - April/May 2016**

COM 2307 – Data Structures and Algorithms

Time allowed: Three Hours

Instructions for candidate

- This is a closed book examination.
- Time allowed **THREE(3)** hours.
- Paper consists of **SIX (6)** questions.
- Answer any **FIVE (5)** questions
- All questions carry equal marks.

Q1.

1. What are the steps to insert a new item before head of a Singly Linear Linked List? Use one short sentence for each step. (3 marks)
2. Suppose that p is a pointer to a node in a doubly linked list, and *p is not the tail node. What are the steps to removing the node with *p? Use one short sentence for each step. (5 marks)
3. Implement the following function that calculate and returns the sum of a linked list. A list node comprises an integer data and a link to next node. (5 marks)

```
int sum( node* head_ptr);
    // Precondition: head_ptr is the head node of a linked list.
    // The list might be empty or not.
    // Postcondition: The return value is the sum of all the data components
    // of all the nodes. NOTE: If the list is empty, the function returns 0.
```

4. What are the advantages of using Linked Lists instead of Arrays? (3 marks)
5. Find the worst case running time of the algorithm given below in Big O notation. (4 marks)

Algorithm Array Sum

Input: nonnegative integer N, and array A[1..N]

Output: sum of the N integers in array A

Body:

j:=1

sum:=0

while j<N

 sum := sum + A[j]

 j:=j+1

end while

End Algorithm Array Sum

[Total Marks: 20]

Q2.

1. Examine the following code segment.

```
push(21);
push(17);
push(3);
printf(pop( ));
printf(pop( ));
```

6	
5	
4	
3	
2	
1	7
0	4

Suppose that the array based stack and is partially filled as illustrated. Draw the state of the Stack after executing each statement. (4 marks)

- If the stack *s* is Linked List based, what is the state after you run the code? (3 marks)
- List three applications of stacks. (3 marks)
- Illustrate how to convert the following infix expression to postfix using a stack.
 $A * B - (C + D) + E$ (5 marks)
- Show how to evaluate the given postfix expression using a stack.
 $823+-384/+*$ (5 marks)

[Total Marks: 20]

Q3.

- Consider the following code segment and the current state of a queue .

```
enqueue(11);
enqueue(22);
enqueue(33);
printf(getFront());
```

		21	14		
0	1	2	3	4	5

Front = 2

Suppose that the queue is an array based circular queue. Draw the state of the queue after each statement of the above code. (4 marks)

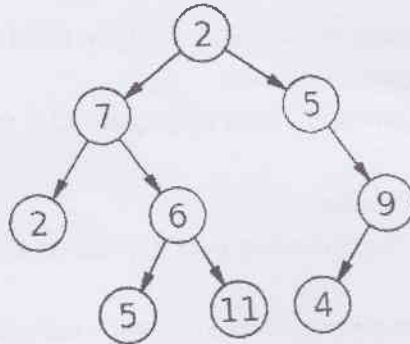
2. "Queue is a LIFO structure" is the statement true? Justify your answer using a suitable example. (3 marks)
3. Compare and contrast normal Queue and a priority Queue? (3 marks)
4. Considering following priority queue, explain how to add element 4 to the queue. (5 marks)

10	18	32	24	62		
0	1	2	3	4	5	6

5. Explain how to remove an item from the queue in part 4 above. (5 marks)
- [Total Marks: 20]

Q4.

1. Copy the given binary tree onto your answer script:



Circle all the leaves. Put a square box around the root. Draw a star around each ancestor of the node that contains 6. Put a big X through every descendant of the node that contains 5. (4 marks)

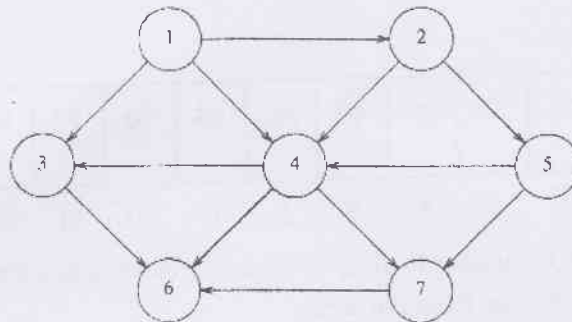
2. Draw a full binary tree with at least 8 nodes. (3 marks)
 3. What is the difference between a full binary tree and a complete binary tree (4 marks)
 4. Illustrate inserting the given list of items into a Binary Search Tree (BST). (4 marks)
List: 12,4,18,8,2,21,34,20
 5. Devise an algorithm to remove an item from the BST. (5 marks)
- [Total Marks: 20]

Q5.

1. Draw an undirected graph with five edges and four vertices. The vertices should be called v_1, v_2, v_3 and v_4 and there must be a path of length three from v_1 to v_4 . Draw a dotted line along this path from v_1 to v_4 . (4 marks)
2. Draw the directed graph that corresponds to given adjacency matrix. (3 marks)

	0	1	2	3
0	true	false	true	false
1	true	false	false	false
2	false	false	false	true
3	true	false	true	false

3. Draw the adjacency lists that correspond to the graph the in part 2. (4 marks)
4. Draw two spanning trees of the graph given below. (2x3 marks)



5. List three applications of graphs. (3 marks)

[Total Marks: 20]

Q6.

1. Find the running time in asymptotic notation for the given algorithm. (5 marks)

```

procedure selection sort

```

```

  list : array of items

```

```

  n : size of list

```

```

  for i := 1 to n - 1

```

```

    min := i

```

```

    for j := i+1 to n

```

```

      if list[j] < list[min] then

```

```

        min := j;

```

```

      end if

```

```

    end for

```

```

    if indexMin != i then

```

```

        swap list[min] and list[i]
    end if
end for
end procedure

```

2. Find the Big O value of the followings

(1x3 marks)

- $T(n) = 3 + 5n + 3n^2$
- $F(n) = 2^n + n^2 + 8n + 7$
- $T(n) = n + \log n + 6$

3. Here is an array with exactly 15 elements:

12	13	16	21	35	37	48	49	62	64	70	77	83	94	100
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

If you use Binary Search technique to find an element, circle any elements that will be found within three or fewer steps from the array.

(3 marks)

4. Compare and contrast Insertion sort and Selection sort using a suitable example.

(4 marks)

5. Given below is an array of 8 elements, Illustrate how to sort the array using Bubble sort algorithm.

(5 marks)

13	12	21	16	37	35	40
0	1	2	3	4	5	6

[Total Marks: 20]

--End of the Paper--