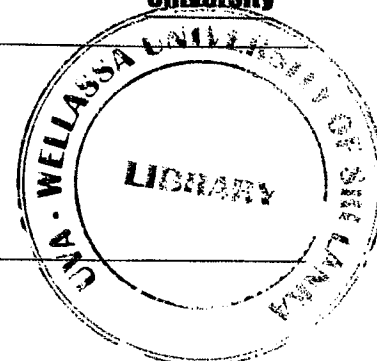
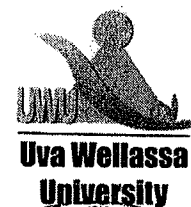


Uva Wellassa University of Sri Lanka  
Faculty of Science and Technology  
Department of Computer Science and Technology  
200 Level 2<sup>nd</sup> Semester Examination – Jan. / Feb. 2016  
CST 225-2 Data Structures and Algorithms



**Instructions to candidates**

**Duration:** 02 hours

**Number of questions:** Four (04) essay questions

**Answer all questions**

**Mark allocation:** 100 mark

1.

- a. Consider the following statement and the set of instructions.

*"A finite, clearly specified sequence of instructions to be followed to solve a problem"*

```
int function(int x) {
    y = x;
    while (y>1) {
        if (y%2 == 0)
            y=y/2;
        else
            y=3*y+1;
    }
    return x;
}
```

Does the set of instructions follow the given statement? Explain the reason for your answer. (5 mark)

- b. Functions of running time of algorithm A and B with N inputs are given by

$$T_A(N) = 1000N$$

$$T_B(N) = N^2$$

Explain the behavior of algorithm A and B when the number of inputs increase up to a large (infinity) value. (5 mark)

- c. Why do we use asymptotic notations instead of Random Access Machine (RAM) model to analyze algorithms? (5 mark)

- d. Prove the following equations

i.  $2n^2 = O(n^3)$

ii.  $3n + 5 \neq \Omega(n^2)$

iii.  $\frac{1}{2}n^2 - 3n \in \Theta(n^2)$

iv.  $T(n) = pn^2 + qn + r$  is  $\theta(n^2)$

v.  $n^n + n! + 7n = O(n^n)$

(5 mark)

- e. A person deposits Rs. 10 000.00 in a savings account, yielding 12% interest per year with interest annually compounded. At the same time, the bank charges 2% of the account balance (before compound the interest) as an annual service charge. Formulate a recursive relationship to calculate the account balance after 10 years. (Note: simplification of the final answer is not necessary)

(5 mark)

2.

- a. Explain the characteristics of Binary Search Tree.

(5 mark)

- b. Draw a Binary Search Tree that shows the result of the tree after inserting the following keys (from left to right): Initially the tree is empty and ignore the spaces between letters.  
DATASTRUCTURES

(5 mark)

- c. Explain the three cases need to be considered when deleting a value from Binary Search Tree?

(5 mark)

- d. You are given a Binary Search Tree with the values {17, 9, 26, 12, 11, 7, 30, 20, 21, 10}. Write the output sequence of pre-order, in-order and post-order traversing.

(5 mark)

e.

- i. What is a "Successor" in Binary Search Tree?  
ii. Find the successor for removing the key 20 of the Binary Search Tree given in part d.

(5 mark)

3.

- a. Explain Divide and Conquer strategy in sorting.

(5 mark)

- b. Write the Merge Sort algorithm and analyze its complexity.

(5 mark)

- c. How do you determine the pivot value in Quick Sort? Explain the behavior of the pivot in point form.

(5 mark)

- d. Assuming the Binary Search for key q in array A [1 . . n] and Explain the basic idea of Binary Search algorithm

(5 mark)

- e. Discuss the worst-case complexity of Binary Search algorithm used to search an element in an array of 1024 elements.

(5 mark)

4.

- a. What is **Hashing** and explain how does work?  
(5 mark)
- b. Define Collision in Hashing and explain the Collision Resolution.  
(5 mark)
- c. You are given a set of values as (397, 176, 2344, 4234, 2832, 430, 29, 3918, 1456, 2013), a hash table of size 11 and hash function  $h(i) = i \text{ mod } 11$ . Draw the resulting tables after insertion of the values in the given order with each of these collision resolution strategies.
- Separate Chaining
  - Linear Probing
  - Double Hashing with the secondary hash function  $h'(i) = (2i - 1) \text{ mod } 11$ .  
(5 mark)
- d.
- What are the Heap properties?
  - Illustrate Max-Heap and underlying array using an example.  
(5 mark)
- e. Use the following array of 10 elements: 15, 19, 10, 7, 17, 16, 20, 23, 55 and 35. Sort the array in ascending order using Heap Sort mechanism by listing all the steps.  
(5 mark)

