



DUBLIN INSTITUTE OF TECHNOLOGY

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**DT211C BSc. (Honours) Degree in Computer Science  
(Infrastructure)**

**Year 1**

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**SUMMER EXAMINATIONS 2016/2017**

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**INTRODUCTION TO ALGORITHMS  
[CMPU1014]**

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DR. DEIRDRE LILLIS

FRIDAY 12<sup>TH</sup> MAY                      4.00 P.M. – 6.00 P.M.

TWO HOURS

INSTRUCTIONS TO CANDIDATES

ANSWER **THREE** QUESTIONS OUT OF **FOUR**.

ALL QUESTIONS CARRY EQUAL MARKS.  
EACH STUDENT WILL BE AWARDED A BONUS OF 1 MARK

**Question 1**

a) Define what is meant by the terms:

- (i) *Algorithms,*
- (ii) *Circular Queue,*
- (iii) *Big O notation,*
- (iv) *Divide and conquer,*
- (v) *Dynamic programming.*

(15 marks)

b) Given an array A with N elements: A[0], A[1],...,A[N-1], draw a flowchart to search the array for a **key** using binary search algorithm, and print out a suitable message at the end.

(10 marks)

c) List clearly all the steps of sorting the following array using insertion sort, by showing the sequence of values after each pass through the array:

E A S Y Q U E S T I O N

(8 marks)

**Question 2**

a) Give the order of growth (as a function of big O notation) of the running times of each of the following code fragments:

(i) `int sum = 0; □`

`for (int n = N; n > 0; n /= 2)`

`for(int i = 0; i < n; i++)`

`sum++;`

(ii) `int sum = 0; □`

`for (int i = 1 i < N; i *= 2)`

`for (int j = 0; j < i; j++)`

`sum++;`

(iii) `int sum = 0; □`

`for (int i = 1 i < N; i *= 2)`

`for (int j = 0; j < N; j++)`

`sum++;`

(12 marks)

- b) Write a program that, given two sorted arrays of  $N$  int values, prints all elements that appear in both arrays, in sorted order. The running time of your program should be proportional to  $N$  in the worst case.

(12 marks)

- c) Write down the pseudocode for the two algorithms for *push* void *push*(int  $x$ ) and *pop* void *pop*() on a stack that is implemented using a linked list

(9 marks)

### Question 3

- a) With the help of a stack, evaluate the following expressions given in postfix form. Show the stack contents after each operation:

(i) 1 2 6 5 \* 73 - 48 + \* +

(ii) 500 3 + 40 20 - \* 84 24 - /

(iii) 6 7 \* 6 5 - / 3 2 + 5 10 + \* +

(12 marks)

- b) Insert the following integers into a binary search tree, in the order given:

3, 5, 6, 1, 2, 4, 7

Write down the (i) pre-order and (ii) in-order (iii) post-order traversals of the resulting tree.

(12 marks)

- c) Define what is meant by the terms:
- (i) Complete Binary search tree,
  - (ii) Balanced Binary Trees,
  - (iii) Perfect Binary Tree,

(9 marks)

### Question 4

- a) Write down pseudocode, with the help of a diagram, to find the maximum element from a tree.

(10 marks)

- b) Write down pseudocode, with the help of a diagram, to reverse all the data (integers) stored in a linked-list. You are given the head of the list, *head*. The algorithm should be of the form **reverseList(head)**. Explain briefly each line of pseudocode.

(12 Marks)

- c) Write down the pseudocode for the enqueue (queue, item) and dequeue (queue) functions for a queue implemented using an array with size elements.

(11 Marks)