EDITH COWAN UNIVERSITY PERTH WESTERN AUSTRALIA		**INTERNAL** Semester One, 20xx
Unit Code and Title	**CSP2204 Data Structures**	**SAMPLE PAPER**
Student Number	SURNAME/FAMILY NAME	OTHER OR GIVEN NAME/S
Please print clearly		

Duration	Reading time 5 minutes Working time 3 hours Total time 3 hours 5 minutes
Attempt	All question in Section A, THREE (3) questions out of FOUR (4) in Section B, and THREE (3) questions out of FOUR (4) in Section C.
Marks	As indicated on paper. Total marks: 100
Type of Exam	This is a restricted **OPEN BOOK** (textbook only) examination. The textbook (Watt and Brown: ***Java Collections***) may contain annotations but must **not** contain inserted sheets.
Special Instructions	• **RECORD YOUR ANSWERS IN THE EXAMINATION PAPER.** • **The 3-page booklet MUST be returned with the exam paper for recording your exam mark.** • Use the 3-page booklet as scratch paper if needed during exam. • Calculator (non-programmable) is optional. • There are a total of *13* pages.

Students are not permitted to write on the examination or any other paper during reading time.

Do not commence the examination until you are told to do so.

Section A: Algorithms and Fundamentals of Abstract Data Types (40 marks)
There are two (2) questions in this section, and each is worth 20 marks. **Attempt these two (2) questions**.

1. Algorithms Analysis (20 marks)

1) Answer the following questions [4 marks]

a) Apply *Floor* and *Ceiling* functions to Log_2111. (Must show your workings)

b) The notation $O(n^4)$ means that its algorithm's time (or space) growth rate is proportional to _____.

c) An algorithm that takes a certain number of steps to complete any given tasks has a time complexity of _____.

d) What are the differences between an algorithm and a program?

2) For the following expressions, sort them into the order from slowest growth to fastest growth. (Must show your workings) [4 marks]

$10n^2 + 3n + 500$

$0.001n^8 + 3n^7 + 11n^6$

$(2n + 11)^3$

$n^3 – 13n^2 + 10^{10}$

$17n + 60log n$

$100n + nlog n$

$2^n + 3n^3$

$(11n^3 + 0.2n)/(n^2 + 175)$

3) What is the growth rate of the following method? (Must show your workings) [2 marks]

```
public static int count(int[]a) {
    int j;
    int count = 0;
    for (j = 1; j < a.length; j++) {
          if (a[j] > a[0]) count++;
          }
          return count;
     }
```

4) Find the GCD of 51 and 85 by hand-testing the Euclid GCD algorithm shown on page 3 in the textbook (Algorithm 1.3). (Must show your workings) [3 marks]

Plus 2 more questions

2. Fundamentals of Abstract Data Types (20 marks)

You can find almost all the answers from Chapter 5 to the questions on this topic. Therefore no sample question is given here.

Section B: Java Data Structures (30 marks)

There are four (4) questions in this section, and each is worth 10 marks. **Attempt ONLY three (3) out of these 4 questions**. If you attempt all 4 questions, only the first 3 will be counted.

3. Arrays (10 marks)

1) Answer the following questions: [5 marks]

a) The number used to refer to a particular element of an array is called _____.

b) The process of placing the elements of an array in order is called _____ the array.

c) Which of the following sorting methods is the most efficient method to sort a nearly sorted array?

A) Selection sort B) Insertion Sort
C) Merge Sort D) Quick Sort

d) True or False: An array can store many different types of values?

e) True or False: An array index should normally be of data type **integer**.

2) Consider the following array data set. Using the idea of binary search to work out step-by-step the search for values 30 and 450, respectively. [2 marks]
(Must show your workings)

a[0]	a[1]	a[2]	a[3]	a[4]	a[5]	a[6]	a[7]	a[8]
11	30	52	100	137	203	400	410	500

Plus one more question

4. Linked Lists (10 marks)

1) Answer the following questions [3 marks]

a) The reference to the next node in a SLL is referred to as _____.

b) True or False: The **length** of a linked list is the number of **nodes** in it.

c) Visiting some or all of the nodes in a SLL in a predefine order is called _____ of the SLL.

2) Give explanations to the following questions [4 marks]

a) Why the binary search algorithm is unsuitable for linked lists?

b) What are the differences between a SLL and a Stack?

Plus one more question

5. Binary Trees (10 marks)

1) Answer the following questions (Must show your workings) [3 marks]

   a) How many nodes does a fully-balanced binary tree of depth 6 have?

   b) What is the range of possible depths of a binary tree with 120 nodes?

2) What are the advantages and disadvantages of using a BST? [2 marks]

3) How many internal nodes (ie, nodes excluding leaf nodes) does a fully-balanced binary tree of depth 8 have? (Must show your workings) [2 marks]

Plus one more question

6. Hash Tables (10 marks)

1) What is a hash table? [1 mark]

2) What is the difference between CBHTs and OBHTs? [1 mark]

3) True or false: Clustering is associated with CBHTs. [1 mark]

4) Suppose the following list is part of a student record.

a) Use the hash function
Hash(elem) = name's first letter – 'A'
to construct a CBHT to represent this list. [2 marks]

Plus one more question

Section C: Java Abstract Data Types (ADTs) (30 marks)

There are four (4) questions in this section, and each is worth 10 marks. **Attempt ONLY three (3) out of these 4 questions**. If you attempt all 4 questions, only the first 3 will be counted.

7. Stack and Queue ADTs (10 marks)

1) Answer the following questions [2 marks]

   a) Would it make sense to call a stack a FILO (first-in-last-out) structure? Why?

   b) Would it make sense to call a queue a LILO (last-in-last-out) structure? Why?

2) Trace the following code, showing the contents of the `stack` after each invocation [note: `push()`= `addLast(); pop()` = `removeLast()`]:

[2 marks]

```
Stack stack = new Stack();
stack.push("Alice");
stack.push("Bart");
stack.pop();
stack.push("Carl");
stack.push("Doug");
stack.pop();
stack.push("Emma");
stack.pop();
```

3) Trace the following code, showing the contents of the queue `q` after each call [note: `enqueue()`= `addLast(); dequeue()` = `removeFirst()`]:

[2 marks]

```
ArrayQueue q;
q.enqueue("Eagles");
q.enqueue("Lions");
q.dequeue();
q.enqueue("Cats");
q.enqueue("Tigers");
q.dequeue();
q.enqueue("Swans");
q.dequeue();
q.dequeue();
```

Plus one more question

8. List ADTs (10 marks)

1) Answer the following questions: [2 marks]

a) Explain whether the following expression is true or false.

Feeling = <<I, want, to, pass, this, exam, but, I, do, not, know, if, I, can, pass, it>>

b) In deciding whether to use an `ArrayList` or a `LinkedList` in an application, what factors make one choice better than the other?

2) On pages 173-175 in the textbook, Program 8.1 shows the Java implementation of text editor. [4 marks]

a) In this implementation, methods `find(), insertBefore(), delete()` and `replace()` all have a statement `if (sel < 0)`…. Could we use only one such a statement at a position in the beginning of this program to replace the same statement in all methods above? Why?

b) In this implementation, suppose we apply method `delete()` to the following text file, which line will be selected after line 5 and line 0 are deleted, respectively?

Line 0	CSP1250 is Data Structures with Java.
Line 1	This is a new unit to replace CSP1243.
Line 2	It is a core unit to B38 and B39.
Line 3	It is elective to other steams.
Line 4	I believe I will pass this unit.
Line 5	It is one of the hardest units in computer science.

Plus 2 more questions

9. Set ADTs (10 marks)

1) Answer the following questions: [5 marks]

   a) What is the difference between a `List` and a `Set`?

   b) What happens when you try to `add()` an element to a `set` that already contains it?

   c) What happens when you try to `remove()` an element from a `set` when it is not in the set?

   d) What are the advantages and disadvantages of using a `HashSet` compared to a `TreeSet`?

   e) Explain whether the following expression is true or false.

Feeling = {I, want, to, pass, this, exam, but, I, do, not, know, if, I, can, pass, it}

Plus tow more questions

10. Map ADTs (10 marks)

1) Answer the following questions: [4 marks]

a) A map is also called a _____.

b) An entry is a pair of _____.

c) The cardinality of a map is the number of entries, which equals to the number of _____ in the map.

d) What are the advantages and disadvantages of using a `HashMap` compared to a `TreeMap`?

2) Using examples to explain whether the following statements are true or false. [3 marks]

a) A key may have more than one value in the same value field.
b) A value may have more than one associated key.

Plus one more question

END OF EXAMINATION PAPER