Philadelphia University   **Student Name:**

Faculty of Engineering   **Student Number:**

Information for candidates
1. *This exam paper contains 5 question totaling 15 marks*
2. *The marks for parts of question are shown in round brackets.*

Advices to candidates
1. *You should attempt all sub questions.*
2. *You should write your answers clearly.*

Basic notions: The aims of the questions in this part are to evaluate the required minimal student knowledge and skills. Answers in the pass category represent the minimum understanding of basic concepts: time complexity of algorithms, Building new data structures like array list and linked list

Question 1 Multiple Choices: (3 marks)
Identify the choice that best completes the statement or answers the question.

1. In an array list, the time complexity of the `removeAt` function is identical to the time complexity of the _____ function.
   - a) `isEmpty`
   - b) `seqSearch`
   - c) `isFull`
   - d) `isItemAtEqual`
2. Building a linked list forward places the item to be added at the _____ of the linked list.
   - a) `beginning`
   - b) `end`
   - c) `middle`
   - d) `key point`
3. Because initially the list is empty, the pointer `first` must be initialized to _____.
   - a) `NULL`
   - b) `NIL`
   - c) `EMPTY`
   - d) `NOP`

Question 2   (3 marks)
a) To which Big-O belongs the following function? (Prove that)

$$f(n) = n^2 + 2n + 1$$

b) Characterize the following code in terms of Big-O notation

```
for (i=0; i<n; i++) {
        for (j=0; j<n; j++)
                A[i] = random (n);      // assume random () is O (1)
        sort (A, n);                    // assume sort() is O(n log n)
}
```

Familiar and Unfamiliar Problems Solving: *The aim of the questions in this part is to evaluate that the student has some basic knowledge of the key aspects of the lecture material and can attempt to solve familiar and unfamiliar problems of overloading operators, arrayListType and LinkedList classes.*

Question 3 *(3 marks)*

For the following class "**ComplexType**", overload the operator subtraction for this class as a member function

```
class complexType
{
public:
...
...
private:
    double realPart;        // variable to store the real part
    double imaginaryPart;   // variable to store the imaginary part
};
```

If (a, b) and (c, d) are complex numbers, then

$$(a, b) - (c, d) = (a - c, b - d)$$

Question 4 *(3 marks)*

Write a member function for the **arrayListType** class; call it **RemoveAll** that removes all occurrences of an item from the list.

Hint: you can reuse the member function removeAt(location) in your code

Question 5 *(3 marks)*

Draw the **UML** diagram of the class **LinkedListType** that contains the following functions:
default constructor, Copy Constructor, Destructor, Overloading the Assignment Operator, isEmptyList, destroyList, initializeList, print, Length, front, back, begin, end, copyList, search, insertFirst, insertLast, deleteNode.

GOOD LUCK