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Daffodil International University

Faculty of Science & Information Technology

Department of Software Engineering

Midterm Examination, Fall 2026

Course Code: SE214; Course Title: Algorithm Design and Analysis

Sections & Teachers: AS (A, B, C), MMSI (D, E, H), MK (F, G), AAS (I, J), ABS (K), DP (L)

Time: 1 Hour 30 Mins **Marks: 25**

Answer ALL Questions

[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]

1. *a)* Consider the following pseudocode for sorting an array of (n) integers in ascending order.

```
Algorithm Sort (A, n)
  for i ← 1 to n - 1 do
    key ← A[i]
    j ← i - 1
    while j ≥ 0 AND A[j] > key do
      A[j + 1] ← A[j]
      j ← j - 1
    end while
    A[j + 1] ← key
  end for
End Algorithm
```

A B C D E F G H I J K L M N O

i)	**Identify** the sorting algorithm represented by the pseudocode.	[Mark-1]	CLO-1 *Level-4*
ii)	**Trace** the algorithm for the input array **[77, 44, 55, 22, 66]** by showing the states of the array after completion of each loop.	[Marks-2]	
iii)	**Analyze** the best-case and worst-case time complexities of the algorithm and give a brief justification for each.	[Marks-2]	

2. *a)* Suzuki and Fujimoto are two undergraduate students taking an Algorithm course in their second year of study. Both students have been asked to sort the following array in ascending alphabetical order.

B	O	O	K	M	A	R	K	E	D

Suzuki uses an iterative sorting technique that places one element in its correct position during each pass. Fujimoto uses a recursive sorting technique that selects the first element as a pivot and divides the remaining elements into two groups. While analyzing their algorithms, they observe that Suzuki's algorithm has quadratic time complexity in all cases, whereas Fujimoto's algorithm may have quadratic time complexity when the array is already sorted.

Answer the following questions:

i)	**Classify** the sorting algorithms used by Suzuki and Fujimoto.	[Marks-1]	CLO-2 *Level-2*
ii)	**Visualize** the steps performed by Suzuki's algorithm to sort the given array.	[Marks-3]	

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		iii)	**Express** the pseudocode for the sorting algorithm used by Fujimoto.	[Marks-3]	
		iv)	**Compare** the two algorithms in terms of time and space complexity, and **explain** which algorithm is more suitable for the given situation.	[Marks-3]	
	b)	A delivery company has a truck with a maximum capacity of 50 kg and wants to maximize the total profit from the goods transported. The company can take fractions of any item. The available items are listed below.		[Marks-5]	

Item	Weight(Kg)	Profit
A	10	130
B	15	165
C	12	120
D	20	140
E	18	90
F	25	100

Compute the profit-to-weight ratio of each item and the optimal selection of items, including any fractions, to maximize the total profit within the truck's capacity. **Describe** the algorithm design strategy used in this problem.

3.	A file contains only colon, spaces, newlines, commas, and digits in the following frequency: colon (100), space (605), newline (100), comma (705), 0 (431), 1 (242), 2 (176), 3 (59).			CLO-3 *Level-4*
	i)	**Illustrate** the Huffman tree and **identify** the Huffman code for each symbol.	[Marks-3]	
	ii)	**Explain** why Huffman coding is used for data compression and how symbol frequencies influence code lengths.	[Marks-2]	