

UNIVERSITY EXAMINATIONS

1ST SEMESTER 2022/2023 ACADEMIC YEAR

**THIRD YEAR EXAMINATION FOR THE DEGREE
BACHELOR OF SCIENCE (COMPUTER SCIENCE)**

COMP 313: ANALYSIS AND DESIGN OF ALGORITHMS

STREAM: R

TIME: 2 HRS

DAY: FRIDAY [2.30PM – 4.30PM] DATE: 09/12/2022

THIS QUESTION PAPER CONSISTS OF FOUR (4) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

INSTRUCTIONS: - Instructions to candidates: Answer **QUESTION ONE** and any other **TWO** questions

QUESTION ONE**(30 Marks)**

- (a) State and explain any three techniques of designing algorithms (give examples in each case. (6 marks)
- (b) An algorithm is a clearly specified set of simple instructions to be followed to solve a problem. Briefly explain any three mathematical definitions for analyzing Algorithm. (6 marks)
- (c) State and explain the time complexity of the code fragments below: -

(i) algorithm alg1

```

For m=1 to n step 1
  Display(m)
  For r=1 to n step 3
    For s=1 to n step 1
      display(s)
    next s
  next r
next m
End algorithm

```

(6 marks)

(ii) Sub algorithm

```

Integer i, sum, a[n]
total =0;
For (i=0; i<n; i++)
{
  Next i
  total =total + a[i];
  Display (total)
}

```

(2 marks)

- (d) Design the recursive Euclid algorithm and analyze it Time complexity. (4 marks)
- (e) List and explain the criteria of evaluating a search algorithm e.g. BFS. (5 marks)
- (f) Design the Quick Sort algorithm and state its running time complexity, how does Quick sort utilize Divide and conquer strategy? (5 marks)

QUESTION TWO (20 Marks)

- (a) Design Binary Search algorithm (3 marks)
- (b) Explain any three problems that can be solved using the Greedy algorithm technique (4 marks)

- (c) Explain when a decision can be termed as NP-hard problem. (2 marks)
- (d) Use the following array {22,45,12,8,10,10,6,72,81,32,30,18,50,14} to explain the concepts behind the following sorting techniques, and determine their worst case complexities
- i) bubble sort (2 marks)
 - ii) Selection Sort (2 marks)
 - iii) Counting sort (2 marks)
 - iv) Bucket sort (2 marks)
- (e) Explain any two reasons why we study algorithms performance. (3 marks)

QUESTION THREE

- (a) Write an algorithm that will accept the marks in a test for a group of 25 students then calculate and display the average mark. (4 marks)
- (b) Discuss the advantages of using a flow chart (4 marks)
- (c) State the difference between:
- i) testing and debugging (2 marks)
 - ii) syntax error and logic error (2 marks)
 - iii) logic error and run-time error (2 marks)
- (d) Explain any two advantages of the Divide and Conquer algorithm (2 marks)
- (e) Explain the order of growth of the following
- i) $4n^3 + n^2 + 2n$ (2 marks)
 - ii) $5n^2 + 3n + 2\log n$ (2 marks)

QUESTION FOUR

- (a) Using an example explain insertion sorting (4 marks)
- (b) Explain the following method of solving recurrences (4 marks)
- (i) Master method
 - (ii) Substitution method
- (c) Describe Breadth-first search strategy and state whether it is optimal (4 marks)
- (d) Describe Turing machines and their application in computer science (4 marks)
- (e) Explain duality in De Morgan's Theorem. Prove any one of De Morgan's theorem using a truth table (4 marks)

QUESTION FIVE

- (a) Define an algorithm and state any four properties of a good algorithm (4 marks)
- (b) Write an algorithm that will accept two numbers and find their sum and difference. If the sum is more than sum than the difference, display the sum otherwise display the difference. ((4 marks))
- (c) Determine the running time of the following algorithm (4 marks)

algorithm alg2

```
For r=1 to n steps 3
  s=1
  while(s<n)
    s=s+1
    if (s >=100)
      display(s)
    End if
  End while
next r
End algorithm
```

- (d) Describe the fastest-way scheduling dynamic algorithm for an automobile factory having two assembly lines (7 marks)
- (e) Determine the running time of the following algorithm (5 marks)