ELIZADE UNIVERSITY

ILARA-MOKIN

FACULTY: BASIC AND APPLIED SCIENCES
DEPARTMENT: MATHEMATICS AND COMPUTER SCIENCE
1st **SEMESTER EXAMINATION**
2015 / 2016 **ACADEMIC SESSION**

COURSE CODE: CSC 313

COURSE TITLE: Algorithms and Complex Analysis

COURSE LEADER: Dr. Olarewaju Ajayi

DURATION: 2 Hours

HOD's SIGNATURE

INSTRUCTION:

The paper will contain FIVE Questions. You should answer THREE Questions.
For each Question 20 marks are available. There are 60 marks in total for the exam paper, each question will be marked out of 20. The exam paper is worth 60% of the overall mark.

Students are warned that possession of any unauthorized materials in an examination is a serious offence

Question #1

a) What are the characteristics of algorithms? Briefly describes key features considered when analysing algorithms.

b) Define the following terms

i) Searching ii) Intractable iii) Dynamic programming

v) Memoization vi) Recurrence relation vii) Tractable

c) Write the pseudo code of the *insertion-sort* algorithm, and illustrate its execution on the array $A = [7, 17, 89, 74, 21, 7, 43, 9, 26, 10]$. Do that by writing the content of the array at each main (outer) iteration of the algorithm.

Question #2

a) Explain steps often undertaken when employing Experimental studies for complexity analysis of algorithms.

b) Determine the running time of the following algorithm

```
UNKNOW( n, P[1 . . . n])
for i =1 to n do
        m ← true
        for j ←1 to n do
                if (i != j) and (P[i].x ≤ P[j].x) and (P[i].y ≤ P[j].y) then
                        m ← false; break
        if (m = true) then
        output P[i].x, P[i].y
```

c) Consider the following algorithm that takes an integer argument n:

```
Algo-X(n)
s←0
for i ←1, n
s←s+i
return s
```

(i) What will Algo-X return?

(ii) What is the complexity of Algo-X in terms of Big Oh?

(iii) Write an algorithm that does exactly the same thing as Algo-X but with a strictly better asymptotic time complexity.

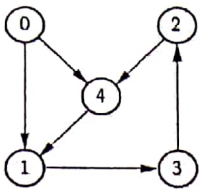
Question #3

a) Mention two ways(forms) in which graphs can be represented in computers.

b) Show how the graphs given in Figure Q3 can be represented using the forms mentioned in (a).

c) Using any of the form mentioned in (a), write Python statements to determine the in-degree of node 4 of Figure Q3(ii).

i)



ii)

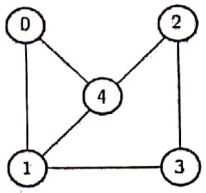


Figure Q3: Graphs

Question #4

a) A thief robbing a gourmet store finds n pieces of precious cheeses. For each piece i, v_i designates its value and w_i designates its weight. Considering that W is the maximum weight the robber can carry, and considering that the robber may take any fraction of each piece, you must find the quantity of each piece the robber must take to maximize the value of the robbery. Devise a dynamic programming strategy that solves the problem.

b) Suppose certain amount of money (in Naira) is to be counted using the fewest possible notes and coins. For instance N640 can be counted using one N500 note, N100 note and two N20 notes. Write a greedy algorithm implementation in Python to achieve this.

Question #5

a) Write Dijkstra's algorithm for solving a single-source shortest-path problem on a weighted directed graph.

b) Draw the weighted directed graph G = (V;E; c), where the edges/costs are given by
E = [(s; t; 10); (s; y; 5); (t; x; 1); (t; y; 2); (x; z; 4); (y; t; 3); (y; z; 2); (z; s; 7); (y; x; 9); (z; x; 6)]
For this graph, find the minimum cost path from vertex s to vertex z using Dijkstra's algorithm

c) Write a Python method that implement linear search algorithm