SOUTH EASTERN KENYA UNIVERSITY

UNIVERSITY EXAMINATIONS 2017/2018

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND BACHELOR OF INFORMATION TECHNOLOGY

SCI 311: ANALYSIS AND DESIGN OF ALGORITHMS

DATE: 4TH DECEMBER, 2017   TIME: 1.30 -3.30 PM

INSTRUCTIONS TO CANDIDATES

a) Answer <u>**ALL**</u> questions from section A(Compulsory)

b) Answer <u>**ANY TWO**</u> questions from section B

SECTION A (30 MARKS)
Compulsory

1.
- a. For each of the following functions, indicate how much the functions' values will change if its argument is increased fourfold.
  - i. $\log_2 n$
  - ii. $\sqrt{n}$
  - iii. n^2 (6 Marks)
- b. Explain the basic asymptotic efficiency classes.   (6 Marks)
- c. Prove that $\frac{n^2(n-1)}{2} \in \Theta(n^3)$ (6 Marks)
- d. Given a sequence of numbers, design an algorithm to find the maximum number.
                                                                                         (6 Marks)
- e. Use Algorithm 1 to answer the questions that follow:
```
Algorithm 1: BubbleSort(A)
for Phase k = 1, 2, …, n
for Position j = 1, 2, …, n - 1
if A[j] > A[j + 1]
Swap the entries A[j] and A[j + 1]
```

  - i. Prove the correctness of Algorithm 1 by '*loop invariants*'. (4 Marks)
  - ii. Show that the number of inverted pairs is exactly equal to the number of swaps when we perform BubbleSort.   (2 Marks)

SECTION B (40 MARKS)
Attempt ANY TWO questions from this section

2.
   a. Using an appropriate example, explain brute-force method?   (4 Marks)
   b. Explain sequential search algorithm with an example. Analyze its efficiency.
                                                                      (6 Marks)
   c. Write the merge sort algorithm and discuss its efficiency.   (4 Marks)
   d. Sort the list E, X, A, M, P, L, E in alphabetical order using merge sort   (6 Marks)

3.
   a. Consider the Algorithm II. Use it to answer questions that follow.
   ```
   Algorithm II
        (A[0.. n -1, 0.. n- 1])
              for i →0 to n-2 do
                   for j← i+1 to n-1 do
                        if A[i, j] + A[j, i]
                            return false
                   end for
              end for
                   return true
   end algorithm
   ```

   i. State the function of the algorithm   (1 Mark)
   ii. Identify the basic operation   (1 Mark)
   iii. Infer the number of times the basic operation identified above is executed
                                                                      (2 Marks)
   iv. Analyze the efficiency of the algorithm   (4 Marks)
   v. Suggest an improvement to the algorithm   (2 Marks)

   b.
   i. Write depth first search algorithm.   (07 Marks)
   ii. Briefly explain how breadth first search can be used to check correctness
       of a graph and also to find the number of components in a graph.
                                                                      (03 Marks)

4.

   a. Write the quick sort algorithm.   (4 Marks)
   b. Using the algorithm in (a) above, sort the data set 5, 3, 1, 9, 8, 2,4,7.
                                                                      (6 Marks)
   c. Write an algorithm to find the height of binary tree.   (4 Marks)
   d. Outline an exhaustive search algorithm to solve a travelling salesman problem.
                                                                      (6 Marks)