JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF INFORMATICS AND INNOVATIVE SYSTEMS

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF ACTUARIAL SCIENCE

3rd YEAR 2nd SEMESTER 2017/2018 ACADEMIC YEAR

MAIN CAMPUS

COURSE CODE : SCS 318

COURSE TITLE : DESIGN AND ANALYSIS OF ALGORITHM

EXAM VENUE : **STREAM ACTURIAL :**

DATE : April, 2017 **EXAM SESSION :**

TIME: 2.00 HOURS

INSTRUCTIONS:

1. **Answer Question 1 (Compulsory) and ANY other two questions**
2. **Candidates are advised not to write on the question paper**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room**

QUESTION ONE 30 MARKS

a) What is an algorithm? State any two reasons why we study algorithms. **(4 Marks)**

b) Give three ways you can describe an algorithm and state atleast one advantage of each. **(6 Marks)**

c) Using an example Clearly distinguish between a program and an algorithm. **(4 Marks)**

d) Algorithm growth rates normally follow specific functions, describe the three categories of functions; polynomial, exponential and logarithmic functions. Compare their growth rates using suitable sample data. **(8 Marks)**

e) Describe four charecteristics of an algorithm **(4 Marks)**

f) Mention at least four components of an algorithm **(4 Marks)**

QUESTION TWO 20 MARKS

a) Clearly distinguish between iterative and recursive algorithms. **(6 Marks)**

b) A polynomial of degree n is a function $p_n(x) = \sum_{i=0}^{n} a_i x^i$. Assuming n = 2, 3, 4 and 5, expand the polynomial function above and state its time complexities for each of the given four values of n. **(6 Marks)**

c) The factorial function n! has value 1 when n ≤ 1 and value n*(n-1)! when n >1. Write both a recursive and an iterative algorithm to compute n! **(8 Marks)**

QUESTION THREE 20MARKS.

a) From first principles, determine the Big O the time complexities for the following functions

i. $T(n) = n^2+2n+4$ **(3 Marks)**

ii. $T(n) = 2n^4+4n$ **(3 Marks)**

b) You are required to sort into alphabetical order using merge sort algorithm the following array of marks for ten students, {60,58,49,70,88,55,40,65,68,80}. Explain the steps involved and deduce its time complexity. **(10 Marks)**

c) Write an iterative algorithm for computing S=$\sum_{i=1}^{i=n} i^2$ **(4 Marks)**

<u>QUESTION FOUR 20MARKS</u>

a) Describe the divide and conquer technique and give an example of a problem solveable using such a technique . **(6 Marks)**

b) Describe the Towers of Hanoi problem **(4 Marks)**

c) State the algorithm for solving the Towers of Hanoi problem **(4 Marks)**

d) Using a suitable example, explain how you would determine the efficiency of two algorithms for the same problem. **(6 Marks)**

<u>QUESTION FIVE 20 MARKS</u>

a) Mark is driving around the one- way system in Nairobi. The following table shows the times, in minutes for Mark to drive between four places: ***A, B, C*** and ***D***. Mark decides to start from ***A***, drive to the other places and then return to ***A***. mark wants to keep his driving time to minimum.

TO / **FROM**	***A***	***B***	***C***	***D***
A	-	8	6	11
B	14	-	13	25
C	14	9	-	17
D	26	10	18	-

i) Find the length of the tour ***ABCDA*** **(2 Marks)**

ii) Find the length of the tour ***ADCBA*** **(2 Marks)**

iii) Find the length of the tour using the nearest neighbor algorithm starting from ***A*** **(4 Marks)**

iv) Write down which of your answers to parts (a), (b) and (c) gives the best upper bound for Mark's driving time **(2 Marks)**

b) Molly is taking part in a treasure hunt. There are five clues to be solved and they are at the points ***A, B, C, D*** *and* ***E.*** The table below shows the distances between pairs of points. All of the distances are functions of ***x*, where *x* is an integer.**

Molly must travel to all five points, starting and finishing at ***A.***

	A	***B***	***C***	***D***	***E***
A	-	$x + 6$	$2x - 4$	$3x - 7$	$4x – 14$
B	$x + 6$	-	$3x - 7$	$3x - 9$	$x + 9$
C	$2x -4$	$3x - 7$	-	$2x - 1$	$x+ 8$
D	$3x - 7$	$3x - 9$	$2x - 1$	-	$2x - 2$
E	$4x - 14$	$x + 9$	$x + 8$	$2x - 2$	-

a) The nearest point to ***A*** is ***C.***

i) By considering ***AC*** and ***AB, shows that*** $x < 10$. **(2 Marks)**

ii) Find two other inequalities in x. **(2 Marks)**

b) The nearest neighbor algorithm, starting from ***A,*** gives a **unique** minimum tour ***ACDEBA.***

i) By considering the fact that Molly's tour visits ***D*** immediately after ***C,*** find two further inequalities in x. **(2 Marks)**

ii) Find the value of integer x. **(2 Marks)**

iii) Hence find the total distance travelled by Molly if she uses this tour.

(2 Marks)