



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**  
**SCHOOL OF INFORMATICS AND INNOVATIVE SYSTEMS**  
**UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE**  
**ACTURAL SCIENCE**  
**3<sup>rd</sup> YEAR 2<sup>nd</sup> SEMESTER 2017/2018 ACADEMIC YEAR**  
**MAIN CAMPUS**

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**COURSE CODE: SCS 318**

**COURSE TITLE: DESIGN AND ANALYSIS OF ALGORITHM**

**EXAM VENUE: LAB 2<sup>ND</sup> FL**

**STREAM: (BSc. Actuarial)**

**DATE: 26/04/2017**

**EXAM SESSION: 9.00 – 11.00 AM**

**TIME: 2.00 HOURS**

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**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**

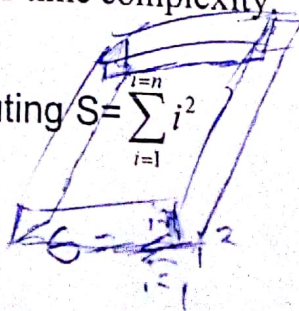
- a) What is an algorithm? State any two reasons why we study algorithms. (4 Marks)
- b) Give three ways you can describe an algorithm and state atleast one advantage of each. (6 Marks)
- c) Using an example Clearly distinguish between a program and an algorithm. (4 Marks)
- d) Algorithm growth rates 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 characteristics 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  $n \leq 1$  and value  $n*(n-1)!$  when  $n > 1$ . Write both a recursive and an iterative algorithm to compute  $n!$  (8 Marks)

**QUESTION THREE 20 MARKS.**

- 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  $S = \sum_{i=1}^n i^2$  (4 Marks)





QUESTION FOUR 20 MARKS

- 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)

QUESTION FIVE 20 MARKS

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.

FROM \ TO	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
<u>A</u>	-	8	6	11
<u>B</u>	14	-	13	25
<u>C</u>	14	9	-	17
<u>D</u>	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)