



MASENO UNIVERSITY

UNIVERSITY EXAMINATIONS 2016/2017

**THIRD YEAR SECOND SEMESTER EXAMINATIONS FOR THE
DEGREE OF BACHELOR OF SCIENCE IN INFORMATION
TECHNOLOGY**

CITY CAMPUS

CIT 301: DESIGN AND ANALYSIS OF ALGORITHMS

Date: 14th June, 2017

Time: 5.30 - 8.30 pm

INSTRUCTIONS:

- Answer ALL question in SECTION A and any other TWO from SECTION B
- Write your registration number on all sheets of the answer book used.
- Use a NEW PAGE FOR EVERY QUESTION attempted, and indicate number on the space provided on the page of the answer sheet.
- Fasten together all loose answer sheets used.
- No mobile phones in the examination room.

MASENO UNIVERSITY

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SECTION A: ANSWER ALL QUESTIONS

Question one (30 marks)

a) State and briefly explain four categories of complexities that can be used to analyze algorithms

(8 marks)

b) Explain how the following algorithm design methods work, giving an example in each case

i) Brute Force

(3 marks)

ii) Backtracking and branch-and-bound

(3 marks)

c) Distinguish between greedy algorithm and dynamic algorithm

(4 marks)

d) State and briefly explain the characteristics to be considered during the design of an algorithm

(6 marks)

e) Use appropriate algorithm to explain how a binary search works

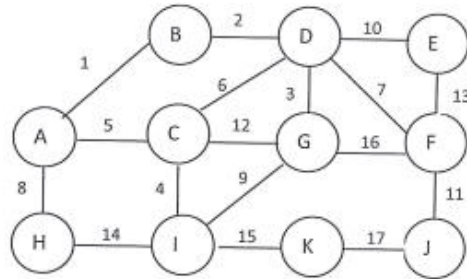
(6 marks)

SECTION B: ANSWER ANY TWO QUESTIONS

Question Two (20 marks)

- a) Find a minimum spanning tree of the following graph:

(8 marks)



- b) Explain how big-Oh(O), big-Omega(Ω), and big-Theta(Θ) notations are used in asymptotic analysis of algorithms, using relevant diagrams and examples.

(12 marks)

Question Three (20 marks)

- a) Identify and briefly explain four ways that can be used to solve recurrences

(12 marks)

- b) Solve the following recurrence relation using iterative substitution method the determine the running time of the algorithm

(8 marks)

$$T(n) = \begin{cases} 2 & , n = 1 \\ 2.T(n/2) + 7 & , n > 1 \end{cases}$$

Question Four (20 Marks)

- a) Use a merge sort algorithm to explain how a divide and conquer method of algorithm design works (12 marks)
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- b) Name two types of heap data structure and explain their properties (4 marks)
- c) Build a max-heap data structure from the following array: (4 marks)

4	1	3	2	16	9	10	14	8	7
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Question Five (20 Marks)

- a) Provide brief explanation of the principles of greedy algorithms (2 marks)
- b) Suppose there is a file with only the following characters: a, e, i, s, t, spaces and new lines, and each character is represented by 3-bits, with the frequencies as tabulated below:

Character	Code	Frequency
a	000	10
e	001	15
i	010	12
s	011	3
t	100	4
spaces	101	13
New line	110	1

- i) Determine the number of bits required to represent the file (2 marks)
- ii) Represent the information using a complete binary tree (4 marks)
- c) Use Huffman algorithm to represent the information in the above table in a binary tree. (8 marks)
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- d) Determine the number of bits required to represent each character in Huffman coding, and the total number of bits to represent the entire file (4 marks)