RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. in Information Technology
Second Year - Semester I Examination – May/July 2022

ICT 2301 – DESIGN AND ANALYSIS OF ALGORITHMS

Time: Three (03) hours

- **Answer ALL the questions.**

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1. a) Explain how to determine what is more important between space complexity and time complexity? **(04 marks)**

   b) Explain why the step count method is not suitable for measuring the performance of complex algorithms. **(04 marks)**

   c) Formally define **Big O** and **Big Ω** in complexity analysis of algorithms. **(06 marks)**

   d) Explain why Super Polynomial Time Algorithms are not recommended. **(04 marks)**

2. a) What are the major steps of Greedy algorithmic technique? **(04 marks)**

   b) For what type of problems, you would suggest the Greedy approach? **(04 marks)**

   c) The following table contains the frequencies of appearing characters of a message to be sent over a network.

Character	A	B	C	D	E	F	G	H
Frequency	24	10	14	12	18	8	14	7

   i. Construct a Huffman tree that helps to encode and compress the original message.
   ii. Calculate the compression ratio of the encoded message.

   (12 marks)

3. a) Compare and contrast Recursive and Brute-force algorithms **(05 marks)**

b) Backtracking is a methodical way of trying out various sequences of decisions, until you find one that "works".
What are the features of problems that you would apply backtracking technique to solve? **(05 marks)**

c) i. What is a State Space tree?
ii. Write a common algorithm to explore a Space Tree for solutions.
iii. Suppose S = {1,2,3,5,7,8}. Find the subsets of S whose sum is 10 by drawing a State Space tree. **(12 marks)**

4. Suppose that you have \$15 in hand. You can use this amount of money to purchase some items and sell them to earn a profit. The following table shows the list of available items and profits you can make from each item. Using your knowledge of various algorithmic techniques, you have to select a set of items such that you earn the maximum profit.

Item (i)	Price (\$)	Profit (\$)
A	8	5
B	5	3
C	3	3
D	5	4
E	2	2

a) Find the maximum profit you can make if Brute-force strategy is used. **(04 marks)**

b) What is/are the drawback(s) of above method? **(04 marks)**

c) Describe an algorithm to select set of items if Dynamic strategy is used. Find the running time of the algorithm you used. **(10 marks)**

5. a) What are stable and unstable sorting algorithms? Explain using examples. **(04 marks)**

b) Compare and contrast the Merge sort and Quick sort algorithms. **(04 marks)**

c) Explain, using examples, the processes of percolating-up and percolating-down in heap sort algorithm. What are the time complexities of these processes? **(06 marks)**

d) Illustrate constructing a max-heap structure using the list [10, 12,8, 9, 13, 6,4, 11]. **(04 marks)**

e) Write an algorithm to build a sorted list using a max-heap and find its time complexity. **(04 marks)**

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