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UNIVERSITY OF COLOMBO, SRI LANKA**UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING****BACHELOR OF SCIENCE IN COMPUTER SCIENCE****Second Year Examination – Semester I – 2018*****SCS2101– Data Structures and Algorithms III******TWO (2) HOURS (For Part A & B)******PART A*****To be completed by the candidate****Examination Index No:****Important Instructions to candidates:**

1. The medium of instruction and questions is **English**.
2. Note that questions appear on both sides of the paper. If a page or a part of the question paper is not printed, please inform the supervisor immediately.
3. Write your index number on each and every page of the question paper.
4. This paper has **04** questions across **Part A** and **Part B**.
5. Students are required to answer both **Part A** and **Part B** in **two hours**.
6. Answer **ALL** questions. There are **02** questions in **Part A (Question Numbers 1-2 & Page Nos 2 to 12)** and **02** questions in **Part B (Question Number 3-4)** of the paper.
7. **Part A** of the paper contains **50 marks** and **Part B** of the paper will total to **50 marks**.
8. Any electronic device capable of storing and retrieving text including electronic dictionaries and mobile phones are **not allowed**.
9. **Non-Programmable** calculators are **allowed**.

For Examiner's use only

Question No	Marks
1	
2	
Total	

1)

- i) Compare and contrast 'Recursive algorithms' and 'Iterative algorithms'.

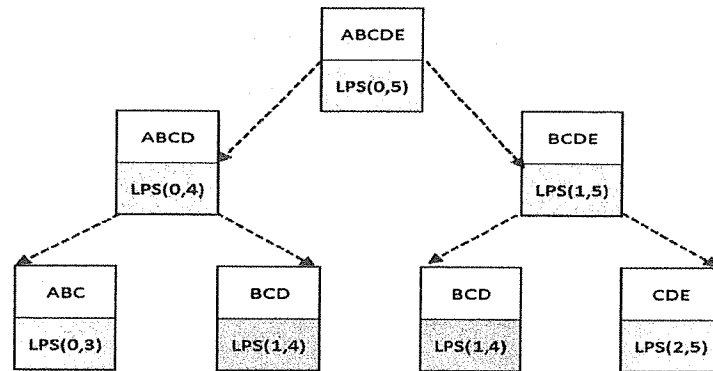
[3 marks]

- ii) A **palindrome** is a word, number, or other sequence of characters which reads the same backward as forward, such as *madam*. A **subsequence** is a sequence that can be derived from another sequence by deleting some or no elements without changing the order of the remaining elements. For example, the sequence ABD is a subsequence of ABCDEF obtained after removal of elements C, E, and F. A **longest palindromic subsequence (LPS)** is a subsequence which is a palindrome, however with the maximum length. For example, for the sequence "AABCDEBAZ" Longest Palindromic subsequence can be ABCBA or ABDBA or ABEBA.

Given below is an algorithm to return the length of the LPS of a given sequence:

```
Len_LPS(seq, i, j)
    if (i == j)
        return 1;
    if (seq[i] == seq[j] && i+1 = j)
        return 2;
    if (seq[i] == seq[j])
        return Len_LPS (seq, i+1, j-1)+2;
    return max(Len_LPS(seq, i, j-1), Len_LPS(seq, i+1, j));
```

The recursion of the *Len_LPS* algorithm is given below.



- a) Write down the recurrence relation of *Len_LPS* algorithm and compute the running time.

[5 marks]

- b) Explain with reasons whether the running time of the algorithm *Len_LPS* can further be improved with dynamic programming.

[3 marks]

- c) Modify the algorithm to improve the running time of the recursive algorithm.

[4 marks]

- d) Write down the recurrence relation of the modified algorithm in part (c) and solve the recurrence to compute the running time of the modified algorithm. Explain with reasons how the new running time is achieved.

[4 marks]

- iii) Consider the recurrence relation $T(n) = 9T(n/3) + n^2$
a) Solve the recurrence relation using master method.

[3 marks]

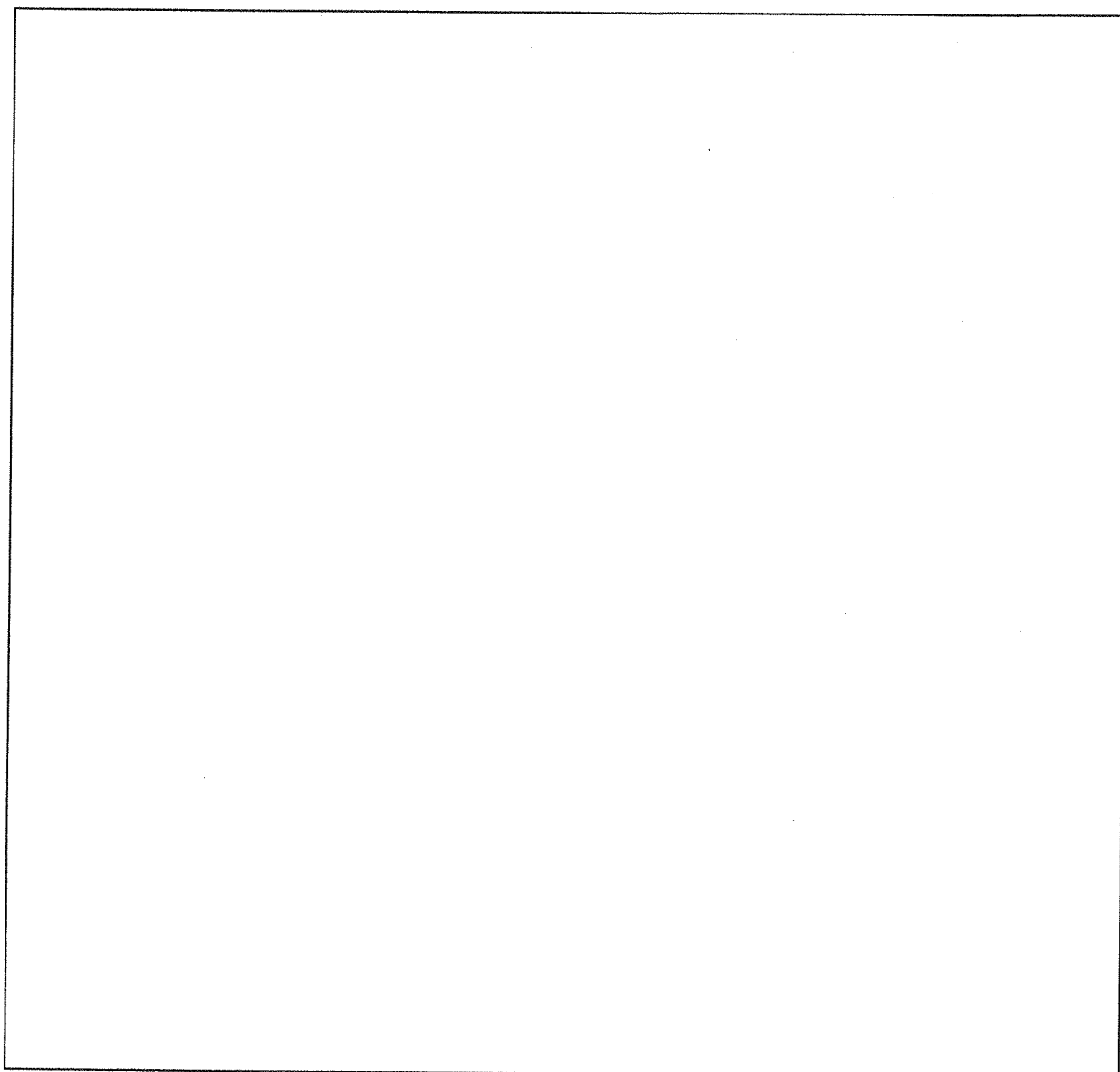
b) Use substitution method to prove the running time obtained in part (a).

[3 marks]

2)

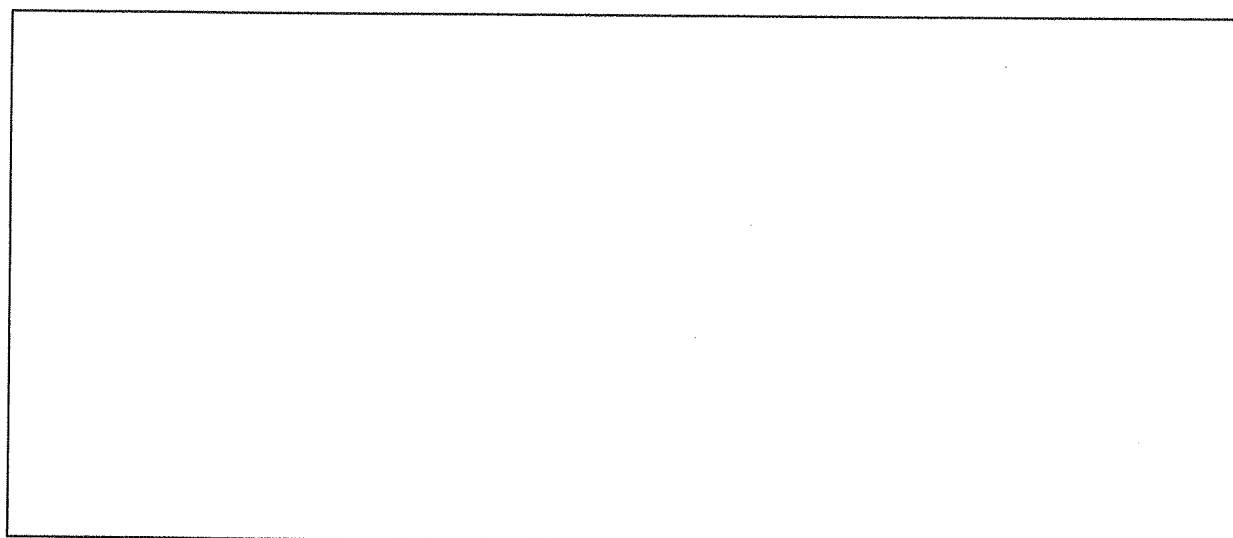
- i) Consider the text "sense and sensibility"
a) Construct a Huffman Code using the given text.

[8 marks]



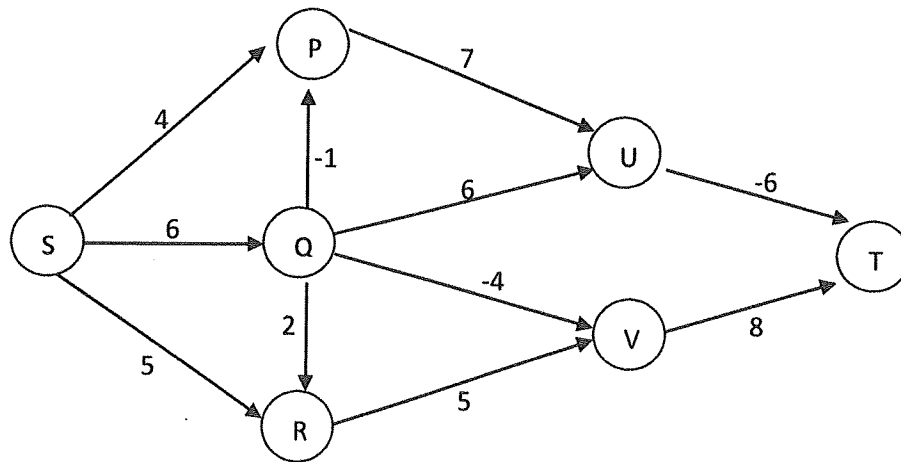
b) Encode the word 'senseless' using the generated code.

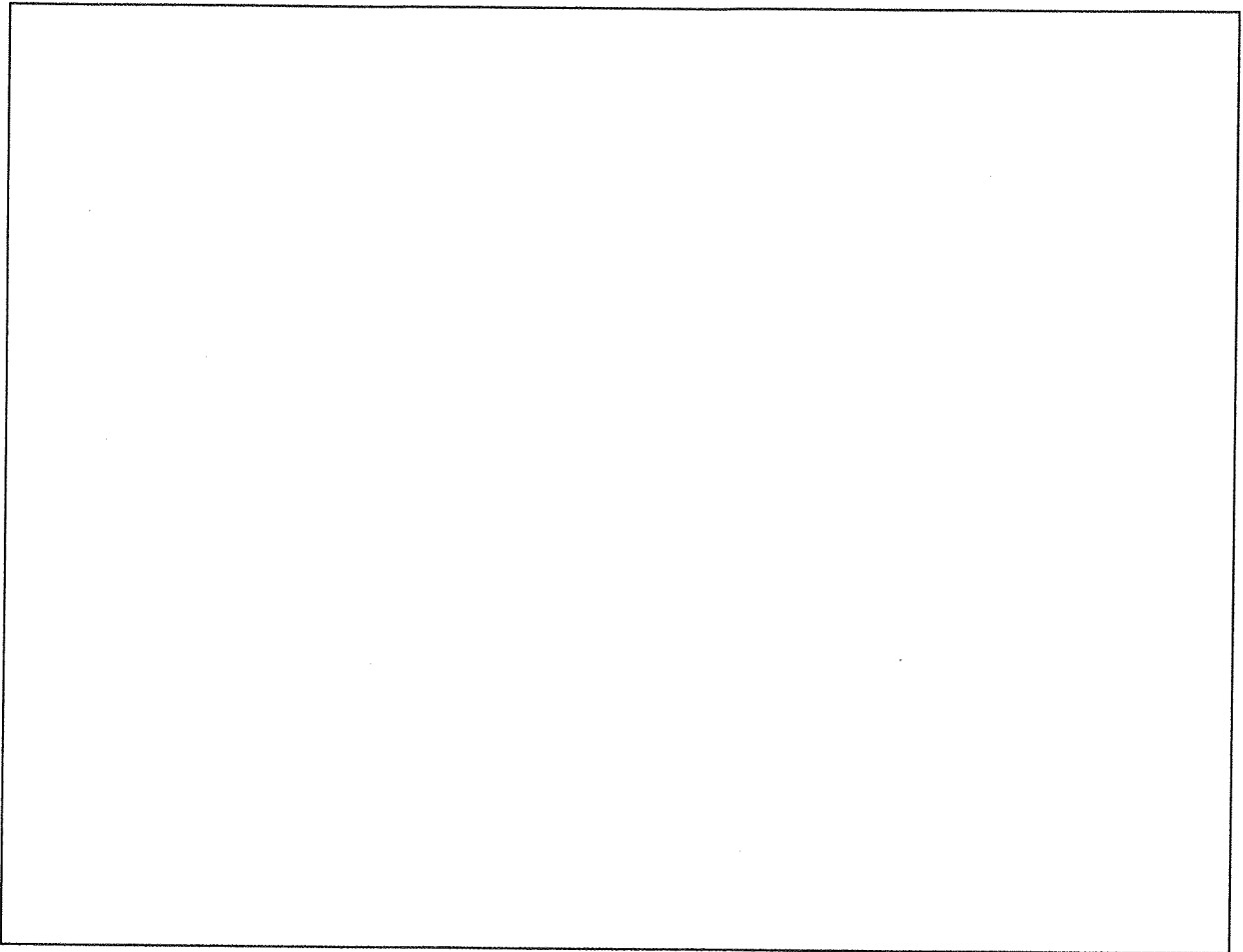
[2 marks]



- ii) Find the shortest path from S to T in the given graph using a suitable shortest path algorithm you have learned in the course.

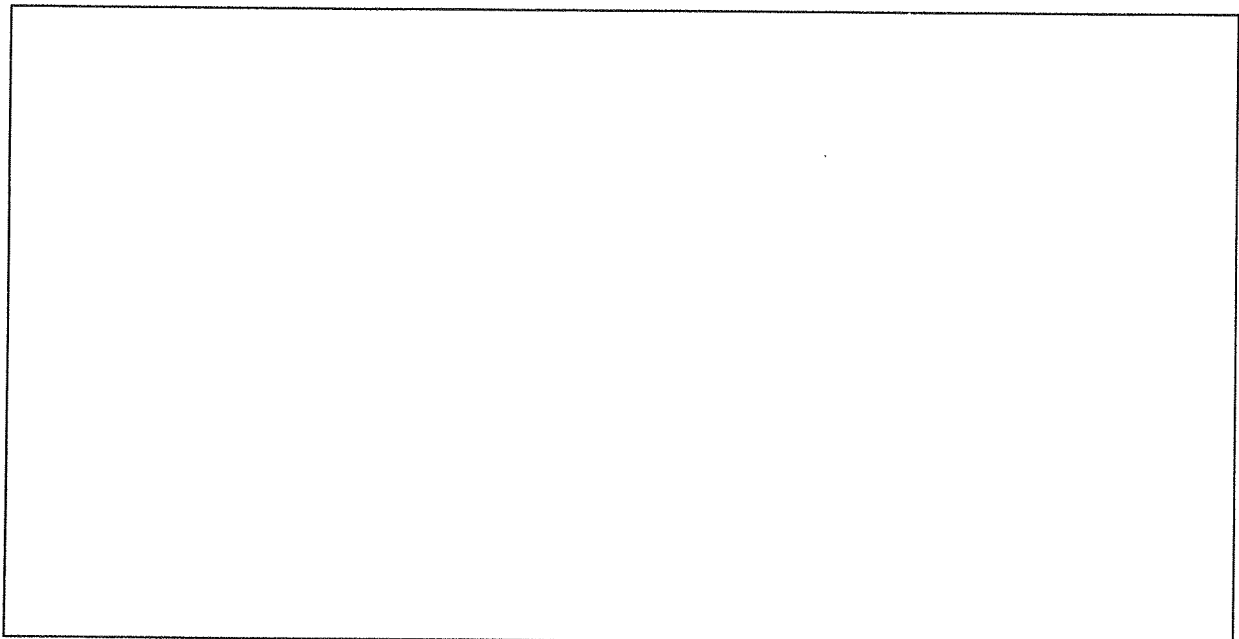
[6 marks]



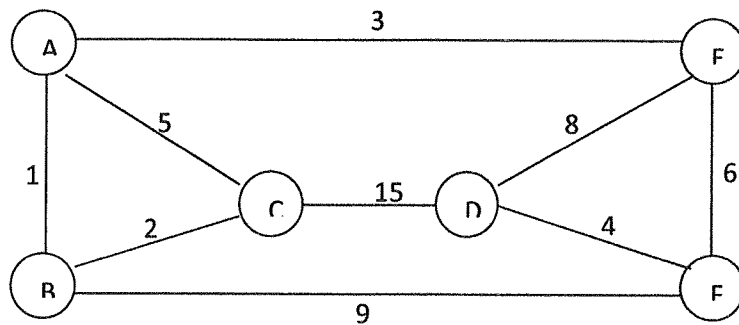


- iii) Assume that you are given a graph $G = (V, E)$, which has a minimum spanning tree T . Suppose that we delete one of the edges (u, v) from G where $(u, v) \in T$. Let's say the new graph is G' . Is G' guaranteed to have a minimum spanning tree? Justify your answer with a suitable example.

[3 marks]

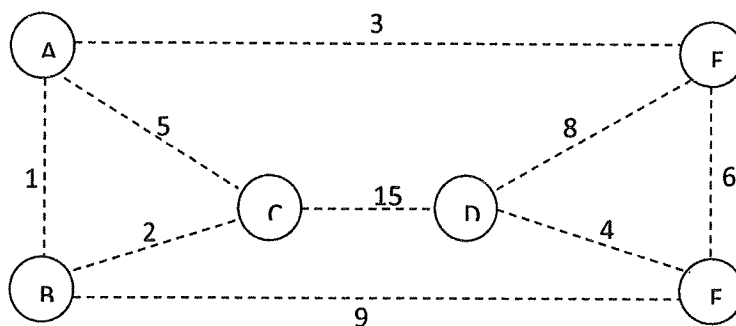


iv)



a) Draw the minimum spanning tree of the above graph in the diagram given below.

[2 marks]



b) Write down the order in which the edges are added to the MST in part (a) if;

I) Prim's Algorithm was used to construct the MST (Consider node A as the root).

II) Kruskal's Algorithm was used to construct the MST

[4 marks]

(I)

1.
2.
3.
4.
5.

(II)

1.
2.
3.
4.
5.
