Computer Engineering Department,S V N I T, Surat.
Mid-Semester Examinations, September 2017

B Tech – II (CO)–3rd semester
Course: (CO-203) Data Structures and Algorithms

Dated: 18th September 2017 Time: 11:00 to12:30 Max Marks: 30

Instructions:
1. Write your B Tech Admission No/Roll No and other details clearly on the answer books while write your BTech Admission No on the question paper, too.
2. Assume any necessary data but give proper justifications.
3. Be precise and clear in answering the questions.

Q.1 Answer the following. **[12]**

1. Number is represented in linked list such that each digit corresponds to a node in linked list. Write an algorithm to add 1 to it. For example 1999 is represented as (1→ 9 → 9 → 9) and adding 1 to it should change it to (2→ 0 → 0 → 0) [04]

2. Given a linear linked list and a key to be deleted. Write an algorithm to delete last occurrence of key from linked list. The list may have duplicates. For example input: 4→2→3→5→3→7, key = 3, output: 4→2→3→5→7 [04]

3. a) If $T_1(n) = O(f(n))\&T_2(n) = O(g(n))$ than prove that $T_1(n) + T_2(n) = \max\{O(f(n)), O(g(n))\}$ [04]
   b) Find the upper bound and lower bound for following function.
      i. $f(n) = 45n^2 + 56n + 67$
      ii. $f(n) = 6 * 2^n + 3n + 5$

OR

A large ship is to be loaded with containers of cargos. Different containers, although of equal size, will have different weights. Let $w_i$be the weight of the i^{th}container, $1 \leq i \leq n$, and the capacity of the ship is c, we want to find out a way to load the ship with the maximum number of containers, without tipping over the ship. Let $xi \in \{0,1\}$. If $x_i = 1$, we will load the i^{th} container, otherwise, we will not load it. We wish to assign values to x_i's such that $\sum_{i=1}^{n} w_i < c$, and $\sum_{i=1}^{n} x_i$ is maximized. We don'thave any extra space to complete the task. Write an algorithm to solve the given problem in efficient time. [04]

Q.2 Answer the following. **[18]**

1. The Tower of Hanoi is a mathematical game. The game consists of 3 rods, and N disks of different sizes which can slide onto any rod. The puzzle starts with the disks stacked in ascending order of size on rod number 1 (the smallest disk is on the top). The objective of the game is to move the entire stack to rod number 3, obeying the following rules: [5]

   1. Only one disk can be moved at a time.

   2. Each move consists of taking the upper disk from one of the rods and sliding it onto another rod, on top of the other disks that may already be present on that rod.

   3. No disk may be placed on top of a smaller disk.

Formulate the recursive solution and write an algorithm for this problem. Also find out the number of moves required for moving N disks.

2. a) Justify the need for Prefix or Postfix expressions in computer system.
   b) Show the progress of converting the infix expression "2+1-(4-3*1)*3" to its postfix expression. [5]

3. Consider a process of generating Index from the document in several document processing softwares. Suggest suitable data structure for storing the section and subsection headings and later generate index from it. Explain your answer with illustration. (No need to write algorithm) [3]

4. A vertical scroll bar commonly located on the far right of a window that allows user to move the window viewing area up and down. Suggest a suitable data structure for simulating the functionality of a vertical scroll bar on the screen. (No need to write algorithm) [3]

5. Suggest a suitable node structure `struct node` for a Binary Search Tree for storing contents of a dictionary of words. Write a definition of `getnode()` function that creates a node with a given word using C language. [2]

   The prototype of a function:

```
struct node *getnode(char *word);
```