DHARMSINH DESAI UNIVERSITY, NADIAD
FACULTY OF TECHNOLOGY
B.TECH. SEMESTER IV [INFORMATION TECHNOLOGY]
SUBJECT: (IT-406) DATA STRUCTURE & ALGORITHMS

Examination	**: First Sessional**	**Seat No.**	**: _____**
Date	**: 11/01/2018**	**Day**	**: Thursday**
Time	**: 10:00 to 11:15**	**Max. Marks**	**: 36**

INSTRUCTIONS:
1. Figures to the right indicate maximum marks for that question.
2. The symbols used carry their usual meanings.
3. Assume suitable data, if required & mention them clearly.
4. Draw neat sketches wherever necessary.

Q.1 Do as directed.

(a) Suppose a circular queue of capacity (n – 1) elements is implemented with an array of "n" elements. Assume that the insertion and deletion operations are carried out using REAR and FRONT as array index variables, respectively. Initially, REAR = FRONT = 0. The conditions to detect queue full and queue empty are: **[2]**

(1) Full:(REAR+1)mod n==FRONT, Empty:REAR==FRONT	(2) Full:(REAR+1)modn==FRONT, Empty:(FRONT+1)modn==REAR
(3) Full:REAR==FRONT, Empty: (REAR+1) mod n == FRONT	(4) Full:(FRONT+1) mod n == REAR, Empty: REAR == FRONT

(b) Consider the following pseudo code that uses a stack **[2]**

```
declare a stack of characters
while ( there are more characters in the word to read )
{
   read a character
   push the character on the stack
}
while ( the stack is not empty )
{
   pop a character off the stack
   write the character to the screen
}
```

What is output for input "codesarecool"?

(c) For following postfix expression find result that is evaluated using a stack: **[2]**
8 2 3 ^ / 2 3 * + 5 1 * -

(d) What is the time complexity of deleting the first node of a linked list? Assume that only the head pointer is given to you. Justify. **[2]**

i)O(1) ii)O(n) iii)O(n^2) iv) O(log n)

(e) For each of the following scenarios given below, suggest the most appropriate data structure. Also justify your choice of data structure. **[4]**

1) To implement printer software so that printing jobs can be printed in the order of their arrival.

2) You need to store undo/redo operations in a word processor.

3) You have to store social network "comments" on feeds of users.

4) You need to store an image of size (1000*1000) using pixel bits.

Q.2 Attempt ***Any Two*** from the following questions. **[12]**

(a) What are circular queues? Write down routines for inserting and deleting elements from a circular queue implemented using arrays. **[6]**

(b) Write an algorithm for conversion of an infix expression to postfix expression. Apply this algorithm on following infix form to convert it into postfix by showing contents of stack for every iteration: P * (Q + R * S) + T **[6]**

(c) What is tower of Hanoi problem? Discuss its solution for 3 pegs with 4 disks. **[6]**

Q.3 (a) Assume that the structure of a Linked List node is as follows: **[4]**

struct node{ int data; struct node *next; };

What does the following function print for a given Linked List which has elements in the Order: 1->2->3->4->5->6.

```
void fun(struct node* head){     if(head == NULL)       return;
  printf("%d ", head->data);     if(head->next != NULL )     fun(head->next->next);
   printf("%d ", head->data);    }
```

(b) Suppose you are given following structure to store node in single linked list. **[8]**

Template <class T> struct node{ T data; struct node *next; };

(i) Give code snippet of a function used to reverse the directions of the list nodes. Example:-

Original input list: 1->2->3->4->5->6 Resultant Modified output list: 6->5->4->3->2->1. The function declaration is : void reverse(node * first)

(ii) Assume that the list also stores the previous node address. In this case, what changes are needed in the above code? Identify and rewrite the corresponding void reverse(node * first) function.

OR

Q.3 (a) Suppose you have a **Doubly linked circular list node** of following structure: **[4]**

Prev	Data	Next

Where "Prev" – is the pointer to previous node of current node, "Data" –stores the data and "Next"-is the pointer to next node of current node.

Now suppose you have following requirements and corresponding to it code snippets are given. Identify is given code correct? if not , find error and give correct logic.

1) Delete the node having address stored in "x" in such a list –

i)x -> prev -> next = x -> next; (ii) x -> next -> prev = x -> prev;

2) Inserting new Node having address "P" to the Right of Node "x" .

i) q = x ->next; (ii) p -> next = q; (iii) p -> prev = x; (iv) x -> next = p;

(v) q -> prev = p;

(b) A bag (also called multiset) is a generalization of a set, where elements are allowed to appear more than once. For example, the bag (a, a, b) consists of two copies of "a" and one copy of "b". **[8]**

However, a bag is still unordered, so the bags (a, b, a) and (a, a, b) are equivalent.

In this task you have to implement some features for a linked representation of bags. This representation is very similar to a regular singly-linked list, except for the following:

- In addition to the value and the reference to the next cell, each bag cell stores the number of copies of its value which is always positive.
- For a given value, **at most** one cell storing that value should appear in the data structure.

Give the specifications of Abstract Data Type. Also give the function logic for above functionalities.

The functionalities needed by this ADT are as follows :

1) Add - which adds "n: copies of element "x" to the bag.
2) Display- which displays all the elements of the list.
