

**NATIONAL INSTITUTE OF TECHNOLOGY ROURKELA**  
**MID SEMESTER EXAMINATION, 2018**  
 SESSION: 2018 – 2019 (Autumn)

**Subject Code: CS2005**

**Subject Name: Data Structures and Algorithms**

**Dept. Code: CS**

No. of pages: 2

Full Marks: 30

Duration: 2 Hrs.

**Marks**

- 1 Define abstract data type? Give some examples. 1
- 2 What is the difference between abstract data type and data type? 1
- 3 What is the difference between **Big O** and **little o** notation? 1
- 4 Give the limit definition of theta and omega asymptotic notations. 1
- 5 What is an activation record? What is its use? 1
- 6 Write a C program to implement a stack of letters, from the English alphabet, using array. Use character “#” to check if the stack is empty or full before calling pop or push operation respectively. The use of any other top pointer is not allowed. The program should contain the following functions:
  - i void CreateEmptyStack ( char \*\*stack, int maxsize ) 1
  - ii int IsStackFull ( char stack[ ], int maxsize ) 1
  - iii int IsStackEmpty ( char stack[ ] ) 1
  - iv void push ( char stack[ ], char data, int maxsize ) 1
  - v char pop ( char stack[ ], int maxsize ) 1

**\*Note:** stack[ ] is the stack of letters from the English alphabet; maxsize is the maximum size of the stack; data is a character from the English alphabet to be pushed/poped into stack.
- 7 A robot is positioned at the Start cell of the given matrix. This robot can only make ‘L’ shaped moves. That is, the robot first makes two consecutive straight moves in right or left or up or down direction, from its current cell, and then it makes one straight move in up/down or up/down or right/left or right/left direction, respectively, so as to form a ‘L’ shaped path. Diagonal moves are not permitted. Also, it cannot move outside the matrix. Assume that shaded and unshaded cell are labelled as black(B) and white(W) respectively. The other assumption is that the robot cannot move into a shaded cell. The order of move is 1. Lmove-right-up 2. Lmove-right-down 3. Lmove-left-up 4. Lmove-left-down 5. Lmove-up-right 6. Lmove-up-left 7. Lmove-down-right and 8. Lmove-down-left.  
 Your task is to help the robot to reach the Target cell of the matrix.

	0	1	2	3
0				<b>Target</b>
1				
2	<b>Start</b>			

- i State and justify the data structure that you would use to help the robot to reach the Target? 1
- ii Write the pseudo code of the function ‘MOVE’ with which you will help the robot to move towards the target. Also compute its time complexity. Consider the above matrix and its associated structures and operations to be in the global section. 3
- iii Graphically, show each move (along with its associated operations) taken by the robot to reach the Target. Also, graphically show the content of the data structure associated with each move of the robot. 2

- 8 A palindrome is a word or a sequence of characters which reads the same from backward as well as from forward direction, such as madam or racecar. Write a recursive program to check if a given string is a palindrome. Also compute its time complexity. 2
- 9 Write a non-recursive C program to compute  $B^E$ , using array stack data structure. Given, **B** is an integer base and **E** is integer exponent. Also compute its time complexity. 2
- 10 A circular queue can store ten elements. Let the contents of the queue be [3,1,8,9,3,2,77]. Let front point to data 3 and let rear point to data 77. Graphically, show the contents of the queue and the positions of front and rear pointers after the following operations have been performed according to the sequence given below. 2
  - i Dequeue( ), Enqueue(6), Dequeue( )
  - ii Enqueue(6), Enqueue(26), Dequeue( ), Dequeue( ), Enqueue(44), Dequeue( ),
  - iii Dequeue( ), Dequeue( ), Enqueue(12), Enqueue(85),
  - iv Dequeue( ), Enqueue(17), Dequeue( ), Enqueue(99), Dequeue( ), Dequeue( ),
  - v Dequeue( ), Enqueue(11),
- 11 A priority is associated with a data element. Higher the value of the priority, higher is the priority. Write an algorithm that takes data elements with its priority from a user and then stores it according to its priority to obtain a linked list, in which the elements are arranged in the descending order of their priorities. Also compute its time complexity. 3
- 12 Given two linked lists, LL-1 = [1,2,3,4,5] and LL-2 = [6,7,8,9,10]. Write an algorithm to obtain a resultant linked list RLL = [1,6,2,7,3,8,4,9,5,10] using LL-1 and LL-2. Also compute its time complexity. 2
- 13 Given a doubly linked list DL= [5,6,8,5,7,2,6,1,9,8,2]. Write an algorithm to obtain a doubly linked list without duplicate elements, i.e., DL2 = [5,6,8,7,2,1,9]. Also compute its time complexity. 3

\*\*\*\*\*