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Total Number of Pages : 03

B. Tech

RAU4G003, REC4G002, RME4G003, RMF4G003,
RML4G003, RMM4G003, RMN4G003, RPL4G003,
RPR4G003

4th Semester Regular / Back Examination: 2021 - 2022

DATA STRUCTURE

**BRANCH(S): AUTO / ECE,ETC / MECH / MANUTECH /
MINERAL / METTA / MME / MINING / PLASTIC / PE**

Time : 3 Hour

Max Marks : 100

Q.Code : J728

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

21 **Answer the following questions:**

(2 × 10)

- What are the types of linked lists? Give an example of circular linked list with 3 nodes.
- Suppose a circular queue of capacity n elements is implemented with an array of n elements. Assume that the insertion and deletion operation are carried out using REAR and FRONT as array index variables, respectively. Initially, REAR = FRONT = -1. Write the conditions to detect queue full and queue empty.
- How the doubly linked list can be represented? Give an example of double linked list with 4 nodes.
- Consider a situation where swap operation is very costly. Among insertion sort, selection sort and merge sort, which algorithms should be preferred so that the number of swap operations is minimized in general? Justify your answer.
- Evaluate the following postfix expression with single digit operands using a stack:
 $8\ 2\ 3\ \wedge / 2\ 3\ * + 5\ 1\ * -$
- Assume that the operators $+$, $-$, \times are left associative and \wedge is right associative. The order of precedence (from highest to lowest) is \wedge , \times , $+$, $-$. Find the postfix expression corresponding to the following infix expression
 $a + b \times c - d \wedge e \wedge f$
- Solve the Recurrence relation $T(n) = 3T(n/2) + n$, $n > 1$
- A priority queue is implemented as a max heap. Initially, it has 5 elements. The level order traversal of the heap is $\{10, 8, 5, 3, 2\}$. Two new elements "1" and "7" are inserted in the heap in that order. Draw the heap.
- How a threaded binary tree is different from a binary tree.
- The preorder traversal of a binary search tree T is:
 $\langle 23, 12, 11, 9, 6, 45, 32, 67, 56 \rangle$.
What are the inorder and post-order traversals of T?

Part-II

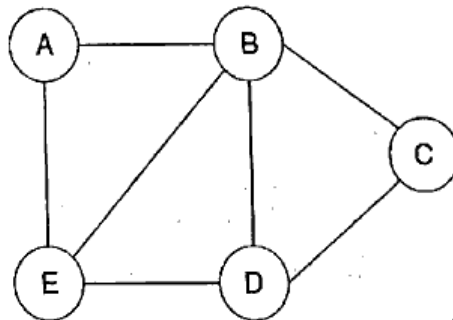
Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- a) What is meant by an abstract data type (ADT)? Differentiate between linear and nonlinear data structure.
- b) How many queues are needed to implement a stack? Consider the situation where no other data structure like arrays, linked list is available to you. Justify your answer with a suitable example.
- c) Let a and b denote positive integers. Suppose a function Q is defined recursively as follows;

$$Q(a, b) = \begin{cases} 0, & \text{if } a < b \\ Q(a - b, b) + 1, & \text{if } b \leq a \end{cases}$$

Construct a recurrence tree or use a stack to:

- i) Find the value of Q (2, 3) and Q (14, 3)
 - ii) What does this function do?
- d) A circular queue has a size of 5 and has 3 elements 10, 20 and 40 where F=2 and R=4. After inserting 50 and 60, what is the value of F and R. Trying to insert 30 at this stage what happens? Delete 2 elements from the queue and insert 70, 80 & 90. Show the sequence of steps with necessary diagrams with the value of F & R.
 - e) Write an ADT to implement stack of size N using an array. The elements in the stack are to be integers. The operations to be supported are PUSH, POP, and DISPLAY. Take into account the exceptions of stack overflow and stack underflow.
 - f) Explain the operation in a B+ tree with suitable examples. <https://www.bputonline.com>
 - g) Insert the following keys one by one into a B-tree of order 3. Assume that tree is initially empty.
14, 10, 2, 8, 15, 12, 9, 20, 11, 3, 5
 - h) Construct an expression tree for the expression $(a+b*c) + ((d*e+f)*g)$. Give the outputs when you apply inorder, preorder and postorder traversals.
 - i) Represent the following graph in adjacency list and explain how breadth first searching algorithm is used to traverse this graph.



- j) Justify with suitable example the advantage of AVL tree over BST. Show the result of inserting $\langle 3, 2, 5, 6, 12, 4, 9, 17, 2 \rangle$ into an initial empty AVL tree.
- k) Write an algorithm for quick sort. Show the workout of quick sort over the following unsorted array considering pivot as the first element:
 $\langle 48, 44, 19, 59, 72, 80, 42, 65, 82, 8 \rangle$
- l) Given the input $\{4371, 1323, 6173, 4199, 4344, 9679, 1989\}$ and a hash function of $h(X) = X \pmod{10}$ show the resulting:
 - a. Separate Chaining hash table
 - b. Open addressing hash table using linear probing

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** Explain the steps involved in insertion and deletion into a singly linked list. How polynomial additions are performed with singly linked lists? Explain the operations. **(16)**
- Q4** Explain the array implementation of queue ADT in detail? Explain the insertion and deletion operations performed on a circular queue with necessary algorithms. **(16)**
- Q5** How to insert and delete an element into a binary search tree and write down the code for the insertion routine. Create a binary search tree for the following numbers start from an empty binary search tree.
45, 26, 10, 60, 70, 30, 40
Delete keys 10,60 and 45 one after the other and show the trees at each stage. **(16)**
- Q6** Write functions to perform linear search and binary search on n data elements for a given key k. What is the worst case, best case, and average case time complexities on these two search operations. **(16)**