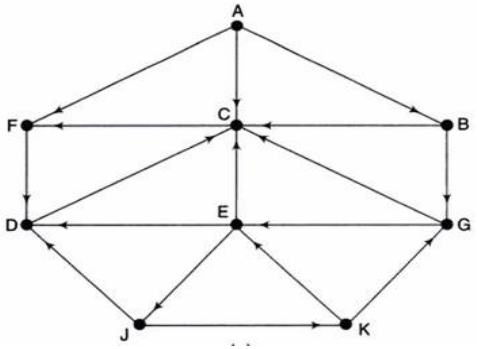
(b) Consider the graph shown in the Fig.1. Suppose the graph represents the daily flights between cities of some airline, and suppose we want to fly from city A to city J with the minimum number of stops. Find out the minimum path from A to J using BFS traversal. Show every step with explanation.



Adjacency lists	
A:	F, C, B
B:	G, C
C:	F
D:	C
E:	D, C, J
F:	D
G:	C, E
J:	D, K
K:	E, G

Fig.1

4 + 8 = 12

Group – E

8. (a) Consider the list of numbers : 99, 78, 72, 66, 54, 48, 42, 34, 22, 19, 11, 7. Assume your target is 34 and the value of lo and hi are 0 and 11 respectively at the beginning. You are applying Binary Search algorithm to find it.
   (i) What will be the value of hi and lo when you find your target?
   (ii) What will be the exact number of key comparisons to find your target? Show every step.

   (b) Write a recursive algorithm for Binary search. How can it be modified so that we can get interpolation search?

6 + (3 + 3) = 12

9. (a) Consider the initial list:- 11, 7, 12, 14, 19, 1, 6, 18, 8, 29, 3. You are going to sort the above numbers by Quick sort and your pivot is the first number. Show step by step, how pivot will partition the list such that on the left side of the pivot will be the numbers less than or equal to pivot and on the right side of the pivot, only those numbers which are greater than the pivot.

   (b) Under what circumstances, the time complexity of quick sort is $O(n^2)$.

   (c) Deduce the average case time complexity of Merge Sort.

7 + 2 + 3 = 12

B.TECH/AEIE/IT/3RD SEM/CSEN 2001(BACKLOG)/2019

DATA STRUCTURE & BASIC ALGORITHMS
(CSEN 2001)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i) Let G be a graph with n vertices and m edges. What is the complexity of Depth First Search of G? Assume that the graph is represented using adjacency matrix.
   (a) O(n) (b) O(m+n)
   (c) $O(n^2)$ (d) O(mn).

   (ii) Here is an infix expression: 4 + 3 * (6 * 3 - 12). Suppose that we are using the usual stack algorithm to convert the expression from infix to postfix notation. What is the maximum number of symbols that will appear on the stack at one time during the conversion of this expression?
   (a) 4 (b) 3
   (c) 2 (d) 1.

   (iii) As a part of the maintenance work, you are entrusted with the work of rearranging the library books in a shelf in proper order, at the end of each day. The ideal choice will be
   (a) Bubble sort (b) Insertion sort
   (c) Selection sort (d) Heap sort.

   (iv) A Binary Tree of Height h has at most
   (a) h – 1 elements (b) 2^h elements
   (c) 2^{h-1} elements (d) 2^h - 1 elements.

   (v) A machine needs a minimum of 100 seconds to sort 1024 names by Merge sort. The minimum time needed to sort 512 names will be approximately
   (a) 49.5 seconds (b) 45 seconds
   (c) 72.7 seconds (d) 50 seconds.

(vi) Using Bubble sort, to sort 100 names, the maximum number of comparisons will be
(a) 4950 (b) 5050
(c) 10000 (d) 100.

(vii) The postfix equivalent of (A+B) * (C-D) is
(a) ABCD + - * (b) AB+ * CD-
(c) AB + CD - * (d) CD- AB+ *.

(viii) In a modified Towers of Hanoi problem, you have to move 5 disks from peg 1 to peg 3. To do that first you need to move 4 disks from peg 1 to peg 2. How many legitimate moves will it take to move 4 disks from peg 1 to peg 2?
(a) 31 (b) 16
(c) 32 (d) 15.

(ix) A full binary tree with 2n+1 nodes contain
(a) n leaf nodes (b) n non leaf nodes
(c) n-1 leaf nodes (d) n-1 non leaf nodes.

(x) A graph is a collection of nodes, called ..... and..... connect pair of nodes.
(a) edges, vertices (b) vertices, edges
(c) vertices, path (d) graph node, edges

Group – B

2. (a) Write down the basic features of an algorithm.

(b) What is the difference between linear and nonlinear data structure?

(c) Define Big-O notation. Let $f(n) = 3n^2 + 4n+1$. Show $f(n)$ is $O(n^2)$.

4 + 4 + (2 + 2) = 12

3. (a) Polynomials can be represented either by an array or linked list. Compare and contrast these two types of representation. How can a polynomial such as $7y^4 – 4x^3 + 16x – 23$ be represented by a linked list?

(b) Write down the algorithm to insert a new node at the end of a singly linked list.

(c) Write a C function to count the number of nodes in a singly linked list.

(2 + 2)+ 4 + 4 = 12

Group – C

4. (a) Consider the following queue of characters, where QUEUE is a circular queue with a size of 6. At some point, FRONT = 2, REAR = 4 and
QUEUE: _, A,C,D, _, _
Here "_" denotes an empty cell in the array. What will be the value of FRONT and REAR, also describe the QUEUE as the following operations takes place.

(i) F is added to the queue (ii) Two letters are deleted
(iii) K,L and M are added to the queue (iv) Two letters are deleted
(v) R is added to the queue (vi) Two letters are deleted.

(b) Write an algorithm to evaluate a postfix expression using stack. Using the above algorithm evaluate the following postfix expression:
5 6 2 + * 3 4 2 / - *

6 + (3 + 3) = 12

5. (a) Suppose STACK is an array of size 6 and initially STACK is empty, i.e. TOP=0. A, B and ITEM are integer variables, and STACK operates on LIFO principle. Find the output of the following:

```
Set A:= 2 and B := 5;
PUSH (STACK, A);
PUSH (STACK, 4);
PUSH (STACK, B+2);
PUSH (STACK, 9);
PUSH (STACK, A+B);
Repeat while (TOP is not equal to zero)
{ POP (STACK, ITEM)
  PRINT: ITEM;
}[ End of loop]
Return;
```

(b) Write a recursive function for calculating nth fibonacci number. Compute the time and space requirement of the above function by drawing the recursion tree for the value of n as 5.

5 + (3 + 4) = 12

Group – D

6. (a) A binary tree T has 12 nodes. The Inorder and Preorder traversals of T yield the following sequences of nodes:
Inorder : Q B K C F A G P E D H R
Preorder: G B Q A C K F P D E R H
Draw the tree. State briefly the logic used to construct the tree.

(b) Construct an expression tree for the expression E = a + b / c – d * e + f.

(c) Write the algorithm for post-order traversal of a binary tree.

6 + 3 + 3 = 12

7. (a) What is adjacency matrix and adjacency list, explain with example.