

Thapar Institute of Engineering and Technology, Patiala
Computer Science & Engineering Department
Auxiliary Exam (August 2023)

Course Name: Data Structures
Course Code: UCS301


Time: 3 Hours
M. Marks: 100

Q1. A two-dimensional array defined as $A[-4 \dots 6][-2 \dots 12]$ requires 2 bytes of storage for each element. If the array is stored in row major order form with the address $A[4][8]$ as 4142. Compute the address of $A[0][0]$. **[10 marks]**

Q2. Convert the following infix expression into an equivalent postfix expression using a stack (For the precedence of operators, use Table 1): **[10 marks]**

$$(A \$ B + C) \# (K + L - M * N + O \wedge P * W / U)$$

Table 1. Precedence table

Operator	Precedence
#	Highest
\wedge	
*, /	
+, -	
\$	Lowest

Q3. a) Data are enqueued to (ENQ operation) and dequeued from (DEQ operation) a queue in the following order: ENQ 3; FRONT; ENQ 7; FRONT; ENQ 6; ENQ 9; FRONT; DEQ; DEQ; FRONT; where FRONT operation return the value of the item at front end of the queue without deleting it. Write the values returned by FRONT for the sequence of operations above. **[5 marks]**

Q3. b) What do you mean by circular queue? Explain the condition of overflow and underflow in a circular queue. **[5 marks]**

Q4. What does the following function `fun1()` do for a given Linked List with first node as head? Explain. Also, what would be output if executed on the linked list: **[10 marks]**

1->2->3->4->5->6

```
void fun1(struct node* head)
{
    if(head == NULL)
        return;
    printf("%d ", head->data);
    fun1(head->next);
}
```

Q5. Write the pseudo code of following sorting algorithms and discuss the time complexity. **[10 marks]**

- a) Quick sort
- b) Merge sort

Q6. Explain the following with example:

[15 marks]

- Binary tree
- Complete binary tree
- Full binary tree
- Binary search tree
- AVL tree

Q7. Show how breadth-first search (BFS) works on the undirected graph given in **Fig. 1** (show all steps including final BFS tree). Assume that the source vertex is s . Also assume that each adjacency list (corresponding to respective node) is ordered alphabetically. [10 marks]

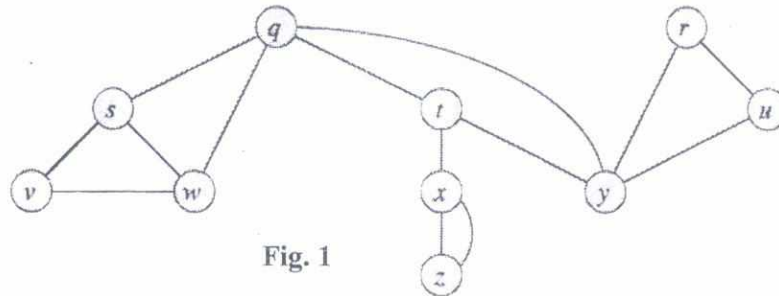


Fig. 1

Q8. Run the Bellman-Ford algorithm on the directed graph shown in **Fig. 2**, using vertex z (zed) as the source to find out the shortest distance to all other vertices. show the value d and π values after each pass. In each pass, relax edges in the following order: (t, x) , (t, y) , (t, z) , (x, t) , (y, x) , (y, z) , (z, x) , (z, s) , (s, t) , (s, y) . [15 marks]

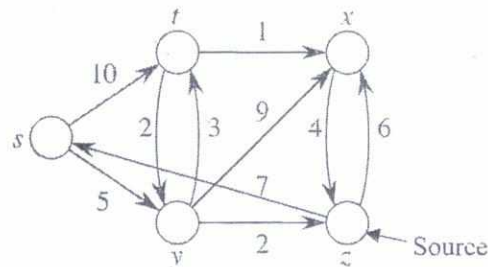


Fig. 2

Q9. The size of a hash table is 11 (indices are from 0 to 10) and the hash function is defined as $h(k) = k \bmod 11$. If we apply linear probing, then find out the indices of the following records in the hash table (Assume the elements are inserted in sequence): [10 marks]

43, 36, 92, 87, 11, 4, 71, 13, 14