



Indian Association for the Cultivation of Science

(Deemed to be University under the *de novo* category)

Integrated Bachelor's – Master's program

MID-Semester Examination-2025 (Spring Semester)

COM 1201

Subject: Data Structures & Algorithms

Subject Code(s): ~~COM2101~~

Full marks: 25

Time allotted: 2 hrs

Instruction: Answer Q1 and any three questions from the rest.

Best of luck for your exam!

Q1. Answer any five from the following questions with correct explanation.
No mark will be awarded without any explanation. {5 × 2 Marks}

- ✓ i) Why should we use a doubly linked list to implement a deque, instead of a singly linked list?
- ✓ ii) Say, a 1-D array implementation of a circular list initializes rear and front indices to -1 and increments them while insertion and deletion, respectively. What are the distinguishable indicators to understand whether the queue is empty or full?
- ✓ iii) After three passes of selection sort the partly sorted list looks as follows, 10 20 30 40 60 70 80. Can we conclude from the partly sorted list, at least how many elements in the unsorted list (before the sorting had started) were already in the position they will be in the sorted list?
- ✓ iv) You have been given a sorted list and asked to search for a key using interpolation search. Would you a) perform a test on the sorted list to decide suitability of interpolation sort on it or b) use a combination of binary and interpolation search? Explain your strategy.
- ✓ v) Solve the recurrence relation, $T(n) = T(\sqrt{n}) + c$

vi) State whether this statement is correct - "Insertion sort has a best-case time complexity of $O(n)$ ". Explain your answer.

✓ Q2. Write a C program or pseudo-code to reverse a singly linked list. Assume, the head of the linked list has been provided. Time taken for the algorithm should not exceed $O(n)$ and extra space (other than the storage of the linked list) should be $O(1)$. **{5 Marks}**

✓ Q3. Explain how interpolation search can turn into linear search. Write a C program/ pseudo-code to explain it with an example. **{5 Marks}**

✓ Q4. Write a C function/pseudo-code to delete a node from a non-empty singly linked list located after a node with a key value, which has been provided as an input to the function. NB: Assume that the main function exists, and the nodes have unique values. **{5 Marks}**

Q5. Write the enqueue/insert and dequeue/delete functions for a 1-D array implementation of a circular queue. Input for insert would be indices front and rear, base address of the array, queue size, and element to be inserted. Input for delete would be indices front and rear, base address of the array, and queue size. **{5 Marks}**

Q6. Explain with diagram how a combination of two stacks can be used as a queue (FIFO), i.e., it would adhere to the first-in-first-out policy in terms of the insert() and delete() functions. Explain the worst-case time complexity of insert() and delete() for your implementation. **{5 Marks}**