ABV- Indian Institute of Engineering Technology &
Management Gwalior
Minor Examination - Even Semester
(Subject Code: BCCS/ITIT-1201)

Class: BCS/IMG
(II Sem)

Subject: Data Structures   Max. Marks: 30
Time: 2 hrs   Date: May 4, 2023

Note: Attempt all questions. Assume missing data, if any. No doubts will be cleared during exam.

Q.1) A square matrix is called lower triangular if all the entries above the main diagonal are zero. Consider the two dimensional lower triangular matrix, M, of order $n \times n$ of order. Obtain the formula for address calculation in the address of row major and column major order for location $M[j][k]$, if base address is α and space occupied by each element is β byte.   [2.5+2.

Q.2) Consider the pseudo code of the algorithm given in right hand side:

(a) What is the loop invariant condition for algorithm.

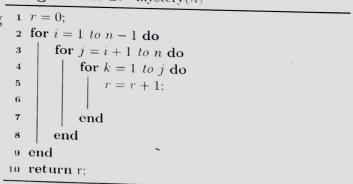(b) Prove the correctness of the algorithm using loop invariant condition defined in (a).

Algorithm 1: Array Reversal

```
1  i ← 0;
2  j ← n − 1;
3  while i ≤ j do
4  |    temp ← A[i];
5  |    A[i] ← A[j];
6  |    A[j] ← temp;
7  |    i = i + 1;
8  |    j = j − 1;
9  |
10 end
```

[5]

Q.3) Consider the following recurrence relation: where $a \geq 1, b > 1, d \geq 0$. If $a = b^d$, then show that $T(n) = O(n^d \log n)$.

$$T(n) = \begin{cases} c & \text{if } n = 1 \\ aT(n/b) + O(n^d) & \text{otherwise} \end{cases}$$

Q.4) Evaluate the following postfix expression using stack. $239 * +23 \uparrow -62/+$, show the contents of each and every steps, also find the equivalent prefix form of above expression. Where $\uparrow$ is an exponent operator.

Q.5) What value is returned by the Function written in Algorithm 2? Express your answer as a function of n. Give the worst-case running time using Big Oh notation.

Algorithm 2: mystery(n)

```
1  r = 0;
2  for i = 1 to n − 1 do
3  |    for j = i + 1 to n do
4  |    |    for k = 1 to j do
5  |    |    |    r = r + 1;
6  |    |    |
7  |    |    end
8  |    end
9  end
10 return r;
```

[5]

Q.6) (a) Write a function to insert a node at k^{th} position in single linked list.   [2.5+2.
(b) In what scenarios would you choose a linked list over an array, and vice versa? What are the key advantages and disadvantages of each data structure, and how do they impact the performance of different algorithms and operations?

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