

**Bangladesh University of Professionals (BUP)**  
**Department of Information and Communication Technology (ICT)**  
**Program: B.Sc. in ICE**  
**Final Examination**  
**Course Title: Data Structure Lab**  
**Course Code: ICE 2202**

**Date: 27.05.24**  
**Time: 1.5 Hours**

**Full Marks: 40**

*(Answer all the questions.)*

**Q1.** Create a linked list of  $n$  ( $\leq 10^6$ ) random integer numbers that can perform the following operations: [18]

- i. Insert a new element at the end of the list and print it.
- ii. Insert a new element after a specific node of the list and print it.
- iii. You are given  $Q$  ( $\leq 10$ ) queries. Each query will contain a number  $k$ . You have to print the position of the number  $k$  if present in the list. Otherwise print “-1” as the output.

**Q2.** Implement a queue (circular) that can perform the following operations. [17]

- i. *Push()*
- ii. *empty()*

Using STL queue, implement BFS algorithm and output the following:

- i. The ordered of the vertices in which they are visited.
- ii. The level of every vertex in the graph.

**Q3.** Using DFS, solve the following problem. [5]

**K** people are having a picnic. They are initially in **N** cities, conveniently numbered from **1** to **N**. The roads between cities are connected by **M** one-way roads (no road connects a city to itself).

Now they want to gather in the same city for their picnic, but (because of the one-way roads) some people may only be able to get to some cities. Help them by figuring out how many cities are reachable by all of them, and hence are possible picnic locations.

**Input Format:**

Input starts with an integer **T** ( $\leq 10$ ), denoting the number of test cases.

Each case starts with three integers **K** ( $1 \leq K \leq 100$ ), **N** ( $1 \leq N \leq 1000$ ), **M** ( $1 \leq M \leq 10000$ ). Each of the next **K** lines will contain an integer (**1 to N**) denoting the city where the  $i^{\text{th}}$  person lives. Each of the next **M** lines will contain two integers **u v** ( $1 \leq u, v \leq N$ ,  $u \neq v$ ) denoting there is a road from **u** to **v**.

**Output Format:**

For each case, print the case number and the number of cities that are reachable by all of them via the one-way roads.

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Input	Output
1 2 4 4 2 3 1 2 1 4 2 3 3 4	Case 1: 2