CSE2217: DSA II (Summer '25) **CT-4 Alternative Assignment** Marks: 20

1. [2 marks] How does disjoint set data structure help you to detect cycle in a graph? Explain properly with example and piece of codes if required.

2. [2 marks] How does krusKal join 2 trees and detect cycle in a graph while finding MST? Explain with an example graph.

3. [2 marks] What is primary clustering? In which open-addressing technique you can find primary clustering. What can we do to avoid primary clustering in hash table?

4. [2 marks] What is secondary clustering? In which open-addressing technique you can find secondary clustering.

5. [2 marks] Consider an open-addressing hash table as shown below (Table 3). The table already contains four data items. Assume that collisions are handled by the following hash function.

$$h(k,i) = \big(h'(k) + i\,h''(k)\big) mod\ m,$$
$$where, \quad \boldsymbol{h'(k) = (2k+7) mod\ m} \quad and$$
$$\boldsymbol{h''(k) = 1 + (3k\ mod\ m)}; \quad m = 13$$

   By showing calculations, redraw the table and show following operations
   i. Insert 52
   ii. Insert 70
   iii. Delete 98, Replace with NIL
   iv. Search 40

Index	0	1	2	3	4	5	6	7	8	9	10	11	12
Value					83	12			98	27			

Table 3: Open Addressing Table

   Do you think there is any 'primary clustering' in Table 3 after performing the operations? Justify your answer.

6. [2 marks] Draw the 11-item hash table that results from using the hash function $\boldsymbol{h(k, i) = (h'(k) + 2i^2)\ mod\ 11}$, where $\boldsymbol{h'(k) = k\ mod\ 11}$, to hash the keys 50, 3, 6, 17, and 61. Assume that collisions are handled by open addressing. What kind of clustering did you encounter?

7. [2 marks] Suppose you are using a hash table with open addressing to store elements, and the table is nearly full. While trying to insert a new element, the probing sequence keeps revisiting the same set of indices, failing to locate an available slot—even though there are still some empty positions in the table. How can this issue be resolved?

8. [2 marks] Suppose given a hash table of size 10, you are asked to insert 13 keys in the table. How can you solve this? Explain.

9. [4 marks] Consider disjoint sets of 6 elements. Perform the following operations sequentially. Show the parent array and Rank array after each operation. Also, redraw the disjoint set forest after each operation.

   a. MakeSet(0), MakeSet(1), MakeSet(2), MakeSet(3), MakeSet(4), MakeSet(5)
   b. Union(0, 2) c. Union(1, 4) d. Union(2, 4) e. Union(3, 5) f. Union(4, 5)
   g. What is the returned value of Find(1)?

Submission guideline:

- Assignment must be handwritten.
- Submit the softcopy in the eLMS.
- Deadline: 28 October 11PM.