

Student ID:

Student Name:

Part A: Hash Table Definitions (Conceptual Understanding)

Q1. Define “collision” in the context of hash tables.

A1:

Two keys hashing to same index.

Q2. What is a “bucket” in a hash table?

A2:

A container holding one or more records at a table index.

Q3. Define “load factor (α)” and explain why it affects performance.

A3:

$\alpha = n/m$; n = number of elements; m = table size;

higher $\alpha \rightarrow$ more collisions \rightarrow longer probe chains.

Q4. What is “primary clustering,” and which probing method suffers from it?

A4:

Linear probing; long consecutive filled slots form.

Q5. What is “secondary clustering,” and how is it different from primary clustering?

A5:

Keys with same hash follow identical probe sequences; not consecutive but identical pattern.

Q6. Briefly explain the difference between:

- Open addressing
- Separate chaining

A6:

Open addressing stores all entries in table; chaining stores lists in buckets.

Part B: Hash Function Calculation (Collision & Pattern Observation)

Show your steps clearly.

Hash Function 1 — Division Method

$$h_1(k) = k \bmod 10$$

Hash Function 2 — Folding Method

Split key into two-digit chunks and sum the chunks.

$$h_2(k) = (\text{sum of 2-digit groups}) \bmod 11$$

Example:

Key = 8429 → groups: 84 + 29 → 113 → 113 mod 11 = 3

Q7. (Compute using Hash Function 1)

Given keys: 27, 37, 47, 57, 67

Compute their hash values using:

$$h_1(k) = k \bmod 10$$

A7:

$$27 \rightarrow 7, 37 \rightarrow 7, 47 \rightarrow 7, 57 \rightarrow 7, 67 \rightarrow 7$$

Q8. (Identify collision pattern)

From your results in Q1:

- What pattern do you observe?
- Explain why these keys collide.

A8:

All keys end in digit 7 → same remainder mod 10 → collide at index 7.

Q9. (Compute using Hash Function 2)

Compute $h_2(k)$ for: 1234, 9217, 4519, 9902

A9:

$$\begin{aligned} 1234 &\rightarrow 12+34=46 \rightarrow 46 \bmod 11=2 \\ 9217 &\rightarrow 92+17=109 \rightarrow 109 \bmod 11=10 \\ 4519 &\rightarrow 45+19=64 \rightarrow 64 \bmod 11=9 \\ 9902 &\rightarrow 99+02=101 \rightarrow 101 \bmod 11=2 \end{aligned}$$

Q10. (Compare distribution)

- Which hash function (h_1 or h_2) produced more collisions for the input set?
- Which seems to spread keys more evenly?
- Provide 1–2 sentences of explanation.

A10:

h_1 produces more collisions; h_2 spreads values better because folding disrupts simple patterns in the input.