# LAB 2

## RELATIONAL DATABASE

Fullname:

Student ID:

ID Group:

## Answer sheet:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Q1 (2 marks) | Q2 (2 marks) | Q3 (2 marks) | Q4 (4 marks) |
| Minimal cover: | {AB → C, BD → E, |  |  | R1(AI): 3NF (BCNF), Key: A R3(HG): 3NF (BCNF), Key: H R4(ABCDEH): 3NF (BCNF), Key: ABD |
| Candidate keys: |  | ABD |  |  |
| Best normal form: |  |  | 1NF |  |
| Final decomposition: |  |  |  | R3(HG): 3NF (BCNF), Key: H R4(ABCDEH): 3NF (BCNF), Key: ABD |

Date and Time: 05:59 AM +07, Thursday, May 29, 2025

Consider relation: R (A, B, C, D, E, G, H, I)  
with the set of functional dependencies: F = {AB → C, BD → EG, AD → GH, A → I, H → G}  
  
1. Find the minimal cover  
2. Find all candidate keys.  
3. Identify the best normal form that R satisfies  
4. If the relation is not in 3NF, decompose it until it becomes 3NF (or BCNF).  
 At each step, identify a new relation, decompose and re-compute the keys and the normal forms they satisfy.

## SOLUTIONS:

1. Find the minimal cover:  
 Step 1: Simplify the right-hand side of each functional dependency.  
 - AB → C: Already single attribute, no change.  
 - BD → EG: Split into BD → E and BD → G.  
 - AD → GH: Split into AD → G and AD → H.  
 - A → I: Already single attribute, no change.  
 - H → G: Already single attribute, no change.  
 New set: F' = {AB → C, BD → E, BD → G, AD → G, AD → H, A → I, H → G}.  
  
 Step 2: Eliminate redundant functional dependencies.  
 - AD → G is redundant due to AD → H and H → G. Remove it.  
 Updated F' = {AB → C, BD → E, BD → G, AD → H, A → I, H → G}.  
  
 Step 3: Eliminate redundant attributes in left-hand side.  
 All FDs are already minimal.  
 Minimal cover: Fmin = {AB → C, BD → E, BD → G, AD → H, A → I, H → G}.  
  
2. Find all candidate keys:  
 - Try (ABD)+:  
 AB → C ⇒ ABC  
 AD → H ⇒ ABCDH  
 H → G ⇒ ABCDHG  
 BD → E ⇒ ABCDHGE  
 A → I ⇒ ABCDHGEI  
 ⇒ ABD+ = ABCDEFGHI  
 - Check minimality:  
 - Remove A: BD+ = BDE ⇒ missing C, H, I ⇒ Not a key  
 - Remove B: AD+ = ADH ⇒ missing C, E, I ⇒ Not a key  
 - Remove D: AB+ = ABC ⇒ missing H, G, E, I ⇒ Not a key  
 Candidate key: ABD  
  
3. Identify the best normal form that R satisfies:  
 - 1NF: Assumed satisfied.  
 - 2NF: A → I is a partial dependency ⇒ violates 2NF.  
 - 3NF: Violated due to 2NF.  
 - BCNF: Violated due to A → I and H → G (A and H are not superkeys).  
 Best normal form: 1NF  
  
4. Decomposition into 3NF (or BCNF):  
 Step 1: Decompose based on A → I ⇒ R1(AI)  
 Remaining attributes: R2(ABCDEFGH) with FDs: {AB → C, BD → E, BD → G, AD → H, H → G}  
 - R1(AI): A is key ⇒ 3NF, BCNF  
 - R2: H → G violates BCNF  
  
 Step 2: Decompose R2 based on H → G ⇒  
 - R3(HG): H is key ⇒ 3NF, BCNF  
 - R4(ABCDEH) with FDs: {AB → C, BD → E, AD → H}  
 - ABD is key ⇒ all LHS of FDs are superkeys or RHS are prime ⇒ satisfies 3NF, BCNF  
  
 Final decomposition:  
 - R1(AI): 3NF (BCNF), Key: A  
 - R3(HG): 3NF (BCNF), Key: H  
 - R4(ABCDEH): 3NF (BCNF), Key: ABD