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| **National University of Computer and Emerging Sciences, Lahore Campus** | | | | |
| C:\Users\saif\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Word\final design.jpg | **Course Name:** | **Database Systems** | **Course Code:** | **CS2005** |
| **Degree Program:** | **BS(Computer Science)** | **Semester:** | **Spring 2023** |
| **Deadline:** | **6th April,2023 in Class &GC** | **Total Marks:** | **TBD** |
| **Section:** | **BCS-6J** | **Type:** | **Assignment** |
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**Important Instructions:**

* **Submit the assignment in handwritten form.**
* **Use assignment sheets for solving questions.**
* **You have to submit both hardcopy and softcopy. Submit softcopy on Google classroom and hardcopy in class.**
* **Late submission is not allowed.**
* **You are not allowed to copy the solution of your peers. If any sort of cheating is found, negative marks will be given to all students involved.**

**1- List all FDs.**

|  |  |  |  |
| --- | --- | --- | --- |
| A | B | C | D |
| a1 | b1 | c1 | d1 |
| a1 | b1 | c1 | d2 |
| a1 | b2 | c2 | d3 |
| a2 | b1 | c2 | d4 |
| a2 | b2 | c2 | d5 |

**2- a) Which of the following FDs may or may not hold over schema R?Give reasons.**

a) AB → C, b) CD → E, c) E → A, d) F → G, e) GH → F

R(A, B, C, D, E, F, G, H)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 | 3 | 3 | 4 | 5 | 6 | 7 | 8 |
| 2 | 2 | 4 | 4 | 5 | 6 | 7 | 8 |

**b) Which of the following FDs may or may not hold over schema R?Give reasons.**

a) A → B, b)BC → A, c)B → C, d)DE → F, e)FG → H

R(A, B, C, D, E, F, G, H)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 2 | 2 | 3 | 4 | 6 | 7 | 7 | 9 |
| 3 | 3 | 4 | 5 | 5 | 7 | 8 | 9 |

**3- Prove the following inference rules for functional dependencies by using inference rules.**

1. {A →B} and C subset-of B |= {A →C}
2. {AC →D, C →B} = {AB →D}

**4- Consider the following relation and provide the closure of {A}, {B}, {C}, {D} and {CD}.**

|  |  |  |  |
| --- | --- | --- | --- |
| **A** | **B** | **C** | **D** |
| 1 | 2 | 3 | 4 |
| 2 | 3 | 3 | 4 |
| 3 | 3 | 4 | 4 |

**5**- Consider the relation ORDERS (order\_id, customer\_id, order\_date, ship\_date, item\_id, item\_qty, item\_price) and the set F = {{order\_id, item\_id} → {item\_qty, item\_price}, {customer\_id} → {order\_id, order\_date, ship\_date}}.

**What is the KEY of this relation? Prove it.**

**6**- Consider the relation R (A, B, C, D, E, F, G, H, I) and the set F = {A→BC, CD→Η, CG→ΑE, H→G, B→D, F→G}. Find the closure of A and BC (i.e. A+ and {BC}+). **What is the KEY of this relation? Prove it.**

**7- Find the minimal cover for the following set of FDs for a relation**

1. Consider the relation R (A, B, C, D, E, G, H) and a set of FDs F = {AB → C, DEG → H, A → C, DE → G}.
2. Consider the relation R (A, B, C, D, E, H) and a set of FDs F = {A→BC, B→CE, A→E, AC→H, D→B}.

**8- Consider the following two sets of FDs. Check whether they are equivalent. Show with steps.**

1. F= (A → C, AC → DE → AD), G= (A → CD, E → AH)
2. F = {A->C, AC->D, E->AD, E->H}, G= { A->CD, E->AH}

**9**- Consider a relation with schema R(A, B,C,D), with FDs F = {BC→A, AD→B, CD→B, AC→D}. Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer. If R is not in BCNF, decompose it into a set of BCNF relations and show your steps. Indicate which dependencies if any are not preserved by the BCNF decomposition.

**10**- Consider a relation with schema R(A, B, C, D, E), with FDs F = {AB→C, DE→C, B→D}. Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer. If R is not in BCNF, decompose it into a set of BCNF relations and show your steps. Indicate which dependencies if any are not preserved by the BCNF decomposition.

**11**- Consider a relation schema R (A, B, C, D), with FDs F = {AB→C, C→D, D→A}. Suppose {AB}, {BC}, and {CD} are the three possible keys of this relation. State which of the following decompositions of R relation are lossless decomposition. Prove it.

a. R1(A, B), R2(C, D), and R3(D, A)

b. R1(B, C), R2(C, D), and R3(D, A)

**12**- Consider the relation R (A, B. C, D, E), with FDs {AC→B, DE→B, C→E}. Key is {ACD}. State which of the following decompositions of R relation are lossless decomposition. Prove it.

a. R1(A, C, B), R2(A, C, D), and R3(C, E).

b. R1(A, C, B), R2(B, D, E), and R3(C, E).