

National University of Computer and Emerging Sciences, Lahore Campus



Course Name:	Database Systems	Course Code:	CS2005
Type	Assignment 04	Semester:	Spring 2023
Deadline	6 -NOV -2023 (11:59) sharp(online submission) Hard copy in class	Total Marks:80 section :5C	

INSTRUCTIONS :

1. **Handwritten Submissions:** All assignments should be submitted in handwritten form. This means that you should physically write out your answers, rather than typing or printing them. Make sure your handwriting is clear and legible to ensure that your work can be properly assessed.
2. **No Plagiarism:** Plagiarism is strictly prohibited and will result in severe penalties. Ensure that your work is entirely your own . Any form of academic dishonesty, including copying from classmates or using online resources without proper attribution, will not be tolerated.
3. **Submission Deadline:** Assignments must be submitted on or before the specified deadline. Late submissions will not be accepted, and a score of zero will be awarded for assignments submitted after the due date .***Submit online on specified date and hard copies to your teacher on 7th of the November TUESDAY CLASS .***

QUESTION 1 KEY FINDING (5*3)

Qa. Consider the relation R (A, B, C, D) and a set of FDs $F = \{AB \rightarrow C, CD \rightarrow B, AD \rightarrow B, AC \rightarrow D\}$. Find all possible Keys of R.

Qb. Consider the relation R (A, B, C, D, E) and a set of FDs $F = \{A \rightarrow C, C \rightarrow BD, D \rightarrow A\}$. Find all possible Keys of R.

Qc. Consider the relation R (A, B, C, D, E) and a set of FDs $F = \{C \rightarrow AB, A \rightarrow E, D \rightarrow E, BD \rightarrow C, CD \rightarrow B\}$. Find all possible Keys of R.

QUESTION NO 2 (5*3)

COMPUTE MINIMAL COVERS

Qa. Consider the relation R (A, B, C, D, E, G) and a set of FDs $F = \{D \rightarrow E, ABC \rightarrow BDE, B \rightarrow G, A \rightarrow C, ABC \rightarrow G\}$. Compute the minimal cover for F (i.e. F_c). Also find all possible Keys (i.e. minimal of super keys) of R.

Qb. Consider the relation R (A, B, C, D, E, I) and a set of FDs $F = \{A \rightarrow C, AB \rightarrow C, C \rightarrow DI, CD \rightarrow I, EC \rightarrow AB, EI \rightarrow C\}$. Compute the minimal cover for F (i.e. F_c). Also find all possible Keys (minimal of super keys i.e. candidate keys) of R.

Qc. Consider the relation R (A, B, C, D, E, G) and a set of FDs $F = \{ABC \rightarrow CDEG, C \rightarrow E, A \rightarrow B, D \rightarrow G\}$. Compute the minimal cover for F (i.e. F_c). Also find all possible Keys (i.e. minimal of super keys) of R.

QUESTION NO 3 (5*2)

EQUIVALENT AND NON EQUIVALENT FDS

Qa. Find out whether the following set of functional dependencies for the relation R (A, B, C, D, E, G) are equivalent or not. Show all the steps. $F_1 = \{A \rightarrow C, AB \rightarrow C, C \rightarrow DG, CD \rightarrow G, EC \rightarrow AB, EG \rightarrow C\}$ and $F_2 = \{A \rightarrow C, C \rightarrow D, C \rightarrow G, EC \rightarrow A, EC \rightarrow B, EG \rightarrow C\}$

Qb. Find out whether the following set of FDs are equivalent or not. Show all the steps.
points)

$F_1 = \{A \rightarrow C, AB \rightarrow C, C \rightarrow DI, CD \rightarrow I, EC \rightarrow AB, EI \rightarrow C\}$

$F_2 = \{A \rightarrow C, C \rightarrow D, C \rightarrow I, EC \rightarrow A, EC \rightarrow B, EI \rightarrow C\}$

QUESTION NO 4

LOSSY AND LOSSLESS DECOMPOSITION (5*4)

Q. Consider the relation R (A, B, C, D, E), with FDs $F = \{A \rightarrow BC, C \rightarrow D, E \rightarrow D, BE \rightarrow A\}$.

a. Is the decomposition $R_1(A, E)$, $R_2(A, B, C)$, and $R_3(D, E)$ a lossless decomposition? Prove it.

b. Is the decomposition $R_1(A, E)$, $R_2(A, B, C)$, and $R_3(C, D)$ a lossless decomposition? Prove it.

Q. Consider a relation schema R (A, B, C, D, E), with FDs $F = \{CD \rightarrow A, BE \rightarrow A, D \rightarrow B\}$. Suppose {CDE} is the possible key of this relation R. Prove or disprove the following decompositions are lossless decompositions. Provide valid reasons.

a. $R_1(A, C, D)$, $R_2(C, D, E)$, and $R_3(B, D)$

b. $R_1(A, C, D)$, $R_2(A, B, E)$, and $R_3(B, D)$

QUESTION NO 5(7*3)

NORMALIZATION AND DESIGN ANOMALIES .

Q4(a). Given the relation $R(A, B, C, D)$, find the highest normal form with respect to the following FDs and Keys

(each part is separate). If R is not in BCNF, decompose it into a set of BCNF relations. Indicate which dependencies if any are not preserved by the decomposition.

a. $F = \{AB \rightarrow C, C \rightarrow D, \text{ and } D \rightarrow A\}$. Suppose keys are $\{AB\}$, $\{BC\}$, and $\{BD\}$.

b. $F = \{A \rightarrow B, B \rightarrow C, C \rightarrow D, D \rightarrow A\}$. Suppose keys are $\{A\}$, $\{B\}$, $\{C\}$, and $\{D\}$.

Q4(B). Consider a relation schema $R(A, B, C, D, E, F)$, with FDs $G = \{CD \rightarrow A, BD \rightarrow C, AC \rightarrow B, D \rightarrow E, E \rightarrow F\}$.
Suppose

$\{BD\}$ and $\{CD\}$ are the two possible keys of this relation. Show all steps, working, and reasoning to answer the following questions.

a. Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer.

b. Decompose the relation R into a 2NF schema, if it is not in 2NF. (Remove 2NF violations only, in this part)

c. Check whether your answer to part (b) is in 3NF. If not, decompose it into a 3NF schema.

d. Check whether your answer to part (c) is in BCNF. If not, decompose it into a BCNF schema. List clearly complete set of BCNF

schema relations with all keys and FDs and also indicate which dependencies if any are not preserved.

Q4(c). Consider a relation schema $R(A, B, C, D)$, with FDs $F = \{B \rightarrow D, D \rightarrow A\}$. Show all steps, working, and

reasoning to answer the following questions.

a. Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer.

b. Decompose the relation R into a 2NF schema, if it is not in 2NF. (Remove 2NF violations only, in this part)

c. Check whether your answer to part (b) is in 3NF. If not, decompose it into a 3NF schema.

d. Check whether your answer to part (c) is in BCNF. If not, decompose it into a BCNF schema.

