National University of Computer and Emerging Sciences, Lahore
Fall Semester 2012

Course: CS204- DATABASE SYSTEMS Time Allowed: *90 min.*

Max Points: *45*

Midterm 2

Section: _____ Name: _____ Roll No: _____

Question 1 (10 points)

Consider the relation R(V, W, X, Y, Z) with FDs {Z → Y, Y → Z,X → Y,X → V, VW → X}.

a) List the possible keys for relation R based on the FDs above.

b) Show the closure for attribute X given the FDs above.

c) Suppose that relation R is decomposed into two relations, R1(V, W, X) and R2(X, Y, Z). Is this decomposition a lossless decomposition? Explain your answer.

Question 2 (5 points)

Given relation R(W, X, Y, Z) and set of FDs F = {X → W, WZ → XY, Y → WXZ}. Compute the minimal cover for F.

Question 3 (5 points)

Given relation R(W, X, Y, Z) with set of FDs F = {Z → W, Y → XZ, XW → Y }. The possible keys are {Y}, {X,Z}, {W,X}. Identify the best normal form that R satisfies (1NF, 2NF, or 3NF). Justify your answer. If the relation is not in 3NF, decompose it until it becomes 3NF.

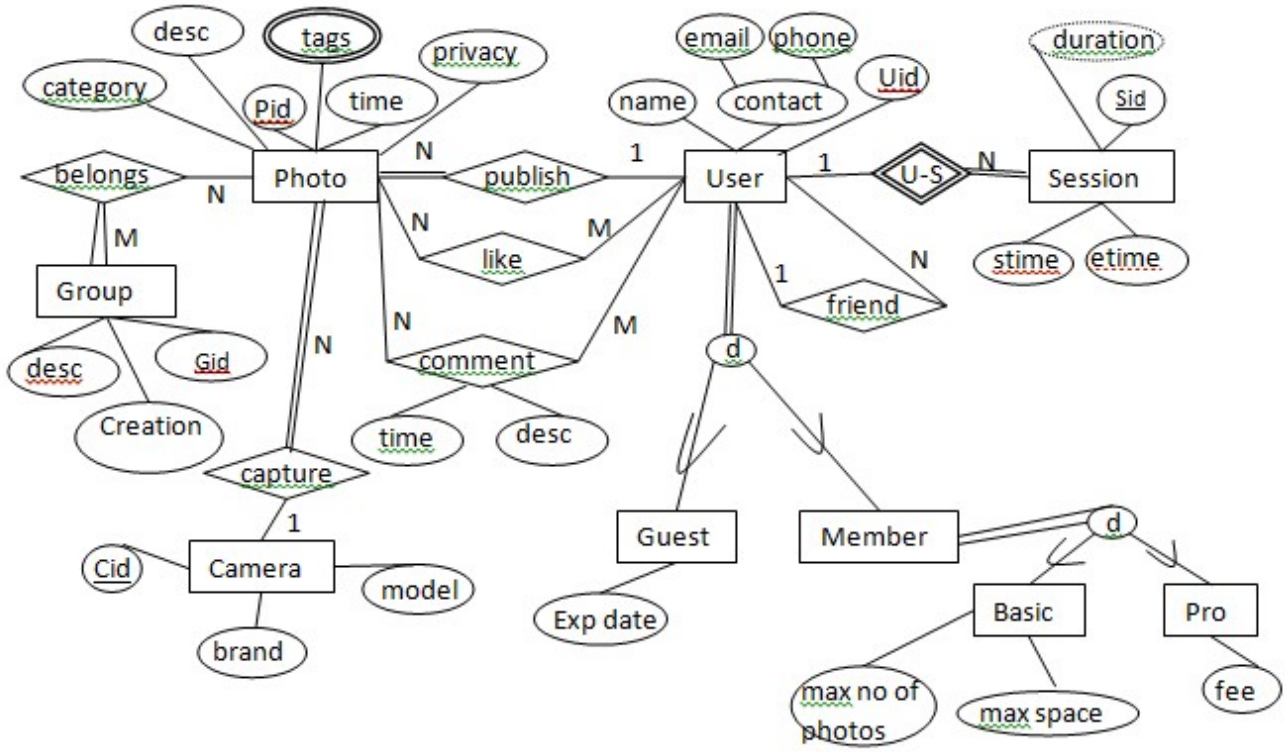
Question 4 (15 points)

You have to design an EER model for an online bookstore. The bookstore consists of books and magazines. Each book is described by a unique ISBN number, a title, its author(s), its publisher, price and year of publication. Each (issue of) magazine is described by a unique name, date of publication, its publisher, price and name of the editor-in-chief. The bookstore stock items in a warehouse and records the warehouse address, phone and unique code. It also records the number of particular item present in a warehouse.

Bookstore keeps track of its customer and for each customer it maintains customer's name, a phone, an address, and unique email. The customer can add bookstore items to a shopping basket and each basket has unique id. Recently, the bookstore adds music cassettes and compact disks to its collection. The same music item may be present in cassette or compact disk format, with differing prices. A shopping basket may contain any combination of books, magazines, music cassettes, or compact disks.

Question 5 (10 points)

Map the EER diagram given below, to relational schema. Clearly specify all the primary keys, foreign keys, and other constraints.



National University of Computer and Emerging Sciences, Lahore
Spring Semester 2014

Course: CS204- DATABASE SYSTEMS Time Allowed: *90 min.*
Date: *16 April, 2014*
Max Points:

SECTION(CS-A, B, C, D)
Midterm 2

Section: _____ Name: _____ Roll No: _____

Question 1*(5 points)*

Consider the relation R(*A, B, C, D, E, F, G, H*), with FDs {*BC* → *AD*, *E* → *F*, *F* → *GH*}.
a. Find all the keys for this relation R. (you don't need to list super keys that are not keys.)
b. Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer.
c. If R is not in BCNF, decompose it into a set of BCNF relations.

Question 2 *(5 points)*

Consider the relation R(*X, Y, Z, W*), with FDs { *XY* → *Z, XY* → *W, Z* → *X, W* → *Y* }.
a. Find all the keys for this relation R. (you don't need to list super keys that are not keys.)
b. Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer.
c. If R is not in BCNF, decompose it into a set of BCNF relations.

Question 3 *(points)*

Given the following relation instance.

```
-------
X  Y  Z
-------
1  4  2
1  5  3
1  6  3
3  2  2
-------
```

Which of the following functional dependencies are satisfied by the instance?
(a) XY -> Z and Z -> Y (b) YZ -> X and Y -> Z
(c) YZ -> X and X -> Z (d) XZ -> Y and Y -> X

Question 4 *(points)*

Consider a relation scheme R = (A, B, C, D, E, H) on which the following functional dependencies hold: {A–>B, BC–>D, E–>C, D–>A}. What are the candidate keys of R?

Question 5 *(points)*

Consider two sets of functional dependencies for a given Relation R = (A, B, C, D, E, F)

F = { A → C, AC → D, E → AD, E → F }
G = { A → CD, E → AF }

Is F equivalent to G?

Question 6 *(points)*

Find a minimal cover for the following set of functional dependencies:
Relation R = (A, B, C, D, E, F)

F = { A → C, AC → D, E → AD, E → F }

Question 7 *(points)*

Consider the following (incomplete) schedule *S*:
R1(X), R1(Y), W1(X), R2(Y), W3(Y), W1(X), R2(Y)

Can you determine the serializability graph for this schedule? Assuming that all three transactions eventually commit, show the serializability graph.

Question 8 *(points)*

Determine whether each schedule is strict, cascadeless, recoverable, or nonrecoverable. Determine the strictest recoverability condition that each schedule satisfies and show your working.

S1: R1(X), R1(Y), W1(X), R2(Y), W3(Y), a3,W1(X), R2(Y), c1, c2
S2: R1(X), R1(Y), W1(X), R2(Y), W3(Y), a3,W1(X), R2(Y), c1, a2
S3: R1(X), R1(Y), W1(X), R2(Y), W3(Y), c3,W1(X), R2(Y), c1, a2
S4: R1(X), R1(Y), W1(X), R2(Y), W3(Y), W1(X), R2(Y), c1, c3,a2

FAST – National University of Computer and Emerging Sciences, Lahore
Fundamentals of Database Systems CS213 – Spring 2015
Midterm 2 Solution

Time allowed: 1 hour
Date: 2-May-2015 **Total Marks: 22**

Question 1: [Marks : 4+5=9]

a) Consider the following database state and discuss all integrity constraints violated by each operation, if any

Department(Name is the key)

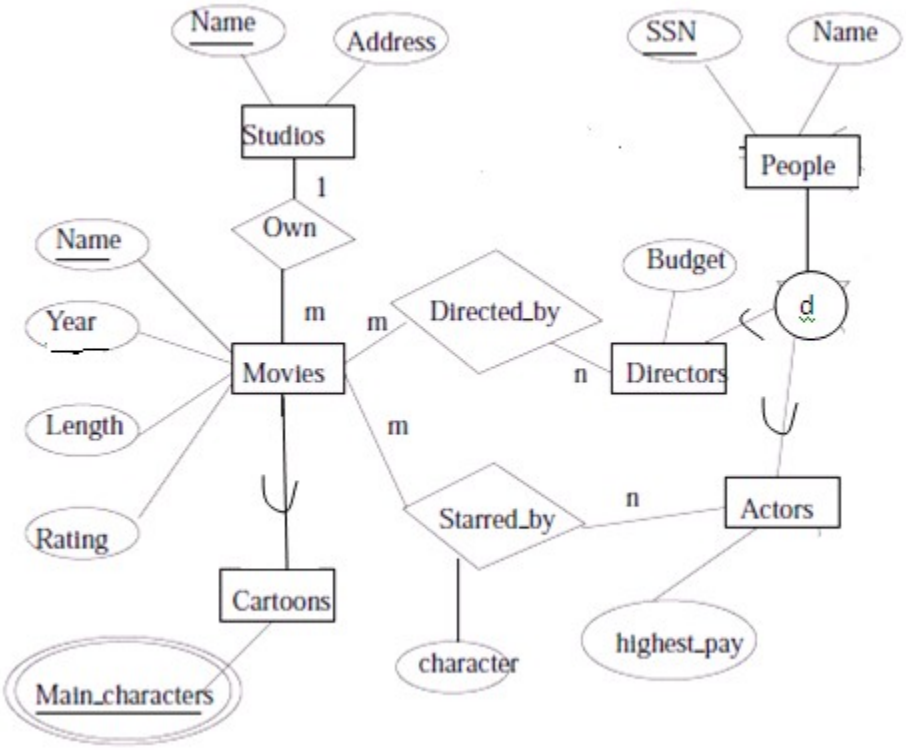
Name	**Block**
CS	A-1
Management	A-2
Engineering	A-3

Student(RollNum is the key) Department_Name is foreign key

FirstName	**LastName**	**RollNum**	**Department_Name**
Imtiaz	Umar	20	CS
Aftab	Ahmad	21	Engineering

I. Insert <Mechnical,A-4> into Department
Successful
II. Insert <Aftab, Ahmad, null, Civil> into Student
Entity Integrity Constraint violated
III. Update RollNum to 21 where FirstName is Imtiaz in Student
Key constraint violated
IV. Delete row where Department is Engineering
Refrential integrity constraint violated.

b) Give the relational model corresponding to the following EER diagram



Question 2: [Marks: 2+2+3+3+3=13]

Consider the following relational model and write SQL queries to answer the following questions:

Supplier

Supplier_id	sname	status	city

Part

Part_id	pname	color	city

Shipment

Supplier_id	Project_id	Part_id	quantity

Project

Project_id	projname	city

a) Give a unique and ordered list of names of suppliers who supply some red colored part to project "projX'.

```
Select distinct s.sname
From supplier s inner join shipment sh on sh.supplier_id=s.supplier_id inner join part p
on sh.part_id=p.part_id inner join project pr on pr.project_id=sh.project_id
Where p.color='red' and pr.prohname='projX'
Order by s.sname
```

b) Get the ids of suppliers who supply both part with part_id 6 and part with part_id 11.

```
Select supplier_id
From shipment where part_id=6
Intersect
Select supplier_id
From shipment where part_id=11
```

c) Get names of suppliers who have supplied the same total quantity of part_id 7 as the supplier with supplier id 36 but have a status lower than that of supplier with id 36.

```
Select s.sname
From supplier s, shipment sh
Where s.supplier_id=sh.supplier_id and sh.part_id=7
and s.status<(select status from supplier where supplier_id=36)
Group by s.sname
Having sum(sh.quantity) =(select sum(quantity) from shipment where supplier_id=36
and part_id=7)
```

```
Select s.sname, s.status
From supplier s, shipment sh
Where s.supplier_id=sh.supplier_id and sh.part_id=7
Group by s.sname, s.status
Having sum(sh.quantity) =(select sum(shi.quantity) from shipment shi, supplier si where
shi.supplier_id=si.supplier_id and shi.supplier_id=36 and shi.part_id=7 and
si.status>s.status)
```

d) Get project_ids of projects supplied entirely by supplier with id 88.

```
Select project_id
From shipment where supplier_id=88
minus
Select project_id
From shipment where supplier_id<>88
```

e) The following query gets the part_id and part name of parts supplied to all projects in London. Please fill in the blanks:

```
select p.part_id, p.pname
from part p
where _not exists
 (
  select * from project_
   where city='London' and project_id not in
     ( select sh.project_id_ from shipment sh
       where p.part_id=sh.part_id_
      )
)
```

Roll No. _____Name _____ Section ___

National University of Computer and Emerging Sciences, Lahore Campus

Course:	Database Systems	Course Code:	CS203
Program:	BS(Computer Science)	Semester:	Spring 2018
Duration:	60 Minutes	Total Marks:	40
Paper Date:	12-Apr-18	Weight	15%
Section:	ALL	Page(s):	5
Exam:	Midterm-2		

Instruction/Notes: Scratch sheet can be used for rough work however, all the questions and steps are to be shown on question paper. No extra/rough sheets should be submitted with question paper.
You will not get any credit if you do not show proper working, reasoning and steps as asked in question statements.

Q1. *(10 points)* Consider a relation with schema *R(A, B,C,D)*, with FDs *F = {BC → A, AD → B, CD → B, AC → D}*.
Assume possible keys of this relation are *{BC}, {CD},* and *{AC}*. 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.

ANSWER:
Highest NF= 3NF; due to violation of FD2: AD → B
BCNF relations schemas are R1(A, C, D) & R2(A, D, B); but FD1: *BC → A* & FD3: *CD → B* are lost.

Roll No. _____Name _____ Section ___

Q2. *(4+6= 10 points)* Consider the relation schema $R(A, B, C, D)$, with FDs $F = \{AC \rightarrow B, B \rightarrow A, BD \rightarrow C, D \rightarrow A\}$.

a) Which of the following FDs may or may not hold over schema R? Justify your answer.

i) $CD \rightarrow B$ **ii)** $AC \rightarrow D$ **iii)** $BD \rightarrow B$ **iv)** $A \rightarrow B$

b) Find all the candidate keys for this relation R (You do not need to list superkeys that are not keys). Provide proper reason.

ANSWER:
a) i. Hold ii. Not Hold iii. Hold iv. Not Hold.
b) Candidate keys are {BD} and {CD}.

Roll No. _____Name _____ Section ___

Q3. *(10 points)* Consider the relation schema *R(A, B, C, D),* with FDs *F = {AB →CD, C →A, AD→C, CD →AB, D →B}*. Find a minimal cover of *F* (i.e. F_c).

ANSWER:
F_c = *{AB →CD, C →A, ~~AD→C~~, ~~CD →AB~~, D →B}*
i.e. F_c = *{AB →CD, C →A, D →B}*

Roll No. _____Name _____ Section ___

Q4. ONLY FOR SECTION (A, B, E, F) *(3+3+4= 10 points)*

a) Given these transactions, find a cascade-free but not strict schedule, if possible (your schedule must be non-serial).
T1: r1(A), r1(B), w1(B), w1(A), c1. **T2:** r2(B), w2(B), c2. **T3:** w3(B), c3.

b) Consider the following schedule of three transactions T1, T2, and T3.
S: w3(X), r2(X), w1(Y), r2(Y), r2(Z), r1(Z), c3, c2, c1.

Draw the serializability (precedence) graph for this schedule. State whether this schedule is (conflict) serializable or not. If the schedule is serializable, write down the equivalent serial schedule(s) otherwise explain why it is not.

c) What are checkpoints, and why are they important? What are transaction commit points, and why are they important?

ANSWER:
a) r1(A), r1(B), r2(B), w3(B), w1(B), w2(B), w1(A), c1, c2, c3.
b) It is conflict-serializable; Two equivalent serial schedules are T1→T3→T2 and T3→T1→T2.
Edges in graph: T3--^{X}-->T2 & T1--^{Y}-->T2.
c) See text book (transaction processing chapter).

Roll No. _____Name _____ Section ___

Q4. ONLY FOR SECTION (C, D) *(10 points)*

Represent the following requirements as ER model also specify the constraints using **min-max notation**.

Each bank can have multiple branches, and *each branch* have multiple *types of accounts* and offers diverse types of l*oans*. A bank is registered with its name and have a unique nine-digit code. The different branches of a bank have branch number that is unique within a bank. Most of the branches are recognized by their location (i.e. town, city, state). To open an account a customer must provide name, CNIC, mobile number and home phone, resident and permanent address and birthdate. A customer must know the unique account number issued by the bank to perform the basic transactions. For each account bank record the account type and balance. The account number consists of 3-digit bank code followed by 7-digit number. Same is the case with loan number. The bank also records the loan type and amount.

Every customer must have at least one account but is restricted to at most two loans at a time, and a bank branch cannot have more than 5000 loans. The customer can access the details of their accounts and loans online. The bank keeps track of the date when the customer last access their account.

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National University of Computer and Emerging Sciences, Lahore Campus

Course Name:	Database Systems	Course Code:	CS2005
Degree Program:	BS(Computer Science)	Semester:	Spring 2022
Exam Duration:	60 Minutes	Total Marks:	25
Paper Date:	Mon 09-May-2022	Weight	15%
Section:	ALL	Page(s):	5
Exam Type:	Midterm-2	Total Questions:	5

Name: Nabeeha Mudassar Roll No: 20L-1080 Section: BSSE 4A

Instruction/Notes: Scratch sheet can be used for rough work however, all the questions and steps are to be shown on question paper. *No extra/rough sheets should be submitted with question paper.* You will not get any credit if you do not show proper working, reasoning and steps as asked in question statements.

Q1. *(5 points)* Consider a relation R (A, B, C, D, E, H, K, L), with the set of FDs F= {A → BL, B → CE, D → BK, K→ D}. What are the keys of this relation? Prove it.

$A \to B \quad A \to L \quad B \to C \quad B \to E \quad D \to B \quad D \to K \quad K \to D$

essential attributes = A, H

maybe = B, D, K

non essential = L, C, E

5

$AH^+ = \{A, H, B, L, C, E\}$ not key

$AHD^+ = \{A, H, D, B, L, C, E, K\}$ → candidate key

$AHK^+ = \{A, H, K, B, L, C, E, D\}$ → candidate key

$AHB^+ = \{A, H, B, L, C, E\}$ → not candidate key

candidate keys = ~~{(A,H,D), (A,H,K), (A,H,B)}~~

= {(AHD), (AHK), ~~(AHB)~~}

Roll No: 20L-1080

Q2. *(5 points)* Consider the relation schema R (A, B, C, D, E, H), with FDs F= {A → BC, B → CE, A → E, AC → H, D → B}. Find a minimal cover of F (i.e. F_c).

Step 1 $A \to BC, A \to C, B \to C, B \to E, A \to E, AC \to H, D \to B$

Step 2 Remove redundancies on LHS.

$AC \to H$ $\quad C^+ = \{C,\}$

$A^+ = \{A, B, C, E, H\}$ ∴ C, A both necessary.

No redundancies on left

Step 3 Remove redundancies on right.

$A \to B$, $A^+ = \{A, C, E, H\}$ not redundant

$A \to C$, $A^+ = \{A, B, C, E, H\} \to$ redundant

$B \to C$, $B^+ = \{B; E,\}$ not redundant

$B \to E$, $B^+ = \{B, C,\}$ not redundant

$A \to E$, $A^+ = \{A, B, C, E, H\} \to$ redundant

$AC \to H$, $AC^+ = \{A, C, B, E,\}$ not redundant

$D \to B$, $D^+ = \{D, B\}$ not redundant

4

redundant depencies = $A \to C, A \to E$

F_c=minimal cover: $(A \to B, B \to C, B \to E, AC \to H, D \to B)$

Roll No: 20L-1080

Q3. *(5 points)* Consider a relation R (A, B, C, D), with the set of FDs F = {A → B, B → C, C → D, D → A}. Show the relation state that must hold all these FDs.

A	B	C	D
1	4	5	2
2	3	6	1
2	3	6	1

5

Q4. *(5 points)* 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).

(a) $(R_1 \underset{AC}{\bowtie} R_2) \underset{C}{\bowtie} R_3$

R_1 and R_2 can be joined using AC which is the candidate key for R_1. Then this table can be joined with R_3 based on C.
So this is lossless decomposition.

5

(b) $(R_1 \underset{C}{\bowtie} R_3) \underset{?}{\bowtie} R_2$

This is not lossless decomposition.
There is no common (candidate) key between $(R_1 \bowtie R_3)$ and R_2. to join them

Roll No: 20L-1080

Q5. *(5 points)* Consider the relation schema R (A, B, C, D, E, H), with FDs F= {AB → C, CD → AE, E → H}. Keys are {ABD} and {BCD}. 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.

AB → C CD → AE E → H

AB → C CD → A CD → E E → H

Prime attributes = A, B, D, C

Non Prime = E, H

Highest NF = 1NF.

→ check 1NF = yes (no multivalued attributes)

→ check 2NF = no.
Partial dependency exists: CD → A, CD → E
(hence cannot be in 2NF, so 1NF).

• Removing Partial dependencies:

R1(A,B,C), R2(A,C,D) R3(C,D,E,H)

Now it is in 2NF.

→ check 3NF = no. Transitive dependency exists in R3 (CD → E, E → H)

• Removing Transitive dependency:

R1(A,B,C) R2(A,C,D) R3(C,D,E) R4(E,H)

~~(ABD) (BCD) (ACD) (C,D,E) (E,H)~~

→ check BCNF = yes. Left sides are super keys.

Final BCNF = R1(A,B,C) R2(A,C,D) R3(C,D,E) R4(E,H)

Lost dependency = None

Roll No. _____ Name _____ Section ____

National University of Computer and Emerging Sciences, Lahore Campus

Course:	Database Systems	Course Code:	CS2005
Program:	BS (CS, DS, SE)	Semester:	Spring 2023
Duration:	60 Minutes	Total Marks:	25
Paper Date:	Mon 10-Apr-2023	Weight	15%
Section:	ALL	Page(s):	1
Exam:	Midterm-II		

Instruction/Notes: **Solve the questions in the given order.**
You will not get any credit if you do not show proper working, reasoning, and steps as asked in the question statements.

Q1. *(5 points)* Consider a relation R (A, B, C, D, E, F), with the set of FDs $F = \{A \rightarrow BC, B \rightarrow D, CF \rightarrow E, E \rightarrow F\}$. Find all possible keys of this relation? Prove it.

Q2. *(5 points)* Consider two sets of FDs, F and G, $F = \{A \rightarrow BC, B \rightarrow CD, C \rightarrow DE\}$ and $G = \{A \rightarrow B, B \rightarrow C, C \rightarrow D, D \rightarrow E\}$. Are F and G equivalent? Prove it.

Q3. *(5 points)* Find a minimal cover of $F = \{A \rightarrow BCD, BC \rightarrow DE, D \rightarrow E\}$. Show all steps.

Q4. *(5 points)* Consider the relation schema R (A, B, C, D), with FDs $F = \{AB \rightarrow C, BC \rightarrow D, AD \rightarrow B\}$. Keys of this relation R are {AB} and {AD}.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.

Q5. *(5 points)* Consider the relation **R (A, B, C, D, E), with** FDs $F = \{A \rightarrow BC, B \rightarrow CD, C \rightarrow DE, D \rightarrow E\}$. Identify the best normal form that R satisfies **(1NF, 2NF, 3NF, or BCNF). Justify** your answer. If R is not in 3NF, decompose it into a set of 3NF relations and show **your steps.**

National University of Computer and Emerging Sciences

Lahore Campus

Database Systems (CS2005)

Sessional-II Exam

Date: Fri, 05 April 2024

Course Instructor(s)

Total Time (Hrs.): 1

Total Marks: 25

Total Questions: 5

Roll No _____ Section _____ Student Signature _____

Do not write below this line.

Note: Please ensure that you attempt all questions and their respective parts in the given order.

CLO # 3

Q. No 1: Consider a relation R (A, B, C, D, E, F), with the set of FDs F= {AB→C, CD→E, EF→A, BC→ D, DE→F}. Find all possible keys (i.e. candidate keys) of this relation? Prove it. [5]

Solution CK = { AB, BC, BDE, BEF }

CLO # 3

Q. No 2: Consider the relation schema R (A, B, C, D, E), with FDs F= {A→BC, BCD→E, BC→D, A→D}. Find a minimal cover of *F* (i.e. F_c). [5]

CLO # 3

Q. No 3: Consider two sets of FDs, F and G, F = {A→BC, B→D, C→E, D→E} and G = {A→BC, B→D, C→E, BD→E, A→D}. Are F and G equivalent? Prove it. [5]

CLO # 3 Not Equivalent, F covers G, but G doesn't covers F

Q. No 4: Consider the relation R (A, B. C, D, E), with FDs {AC→B, D→E}. State which of the following decompositions of R relation are lossless decomposition. Prove it. [5]

Lossless

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

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

Key = {ACD}

$R \leftarrow R_1 \bowtie R_2$ via AC, $R \bowtie R_3$ via D

Lossy

CLO # 3

Q. No 5: Consider the relation schema R (A, B, C, D, E), with FDs F= {AB → C, BC → D, D → E, AE → B}. Keys of this relation are AB, AD, and AE. 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. [5]

3NF

$R_1(ABC), R_2(BCD), R_3(DE)$

R(ABCDE)

$R_1(BCDE)$

$R_1(BCDE)$ {BC→D, D→E}

$R_2(ABC)$ {AB→C}

$R_1(BCD)$ {BC→D} BCNF

$R_2(DE)$ {D→E} BCNF

0099

$A \to BC,\ BCD \to E,\ BC \to D,\ A \to D$

Step 1: $A \to B,\ A \to C,\ BCD \to E,\ BC \to D,\ A \to D$

Step 2: $A \to B,\ A \to C,\ BC \to E,\ BC \to D,\ A \to D$ ~~$A \to D$~~

$A^+ = \{A\}$ ✗

$A^+ = \{ABD\}$ ✗

$BC^+ = \{BCD\}$ ✗

$BC^+ = \{BCE\}$ ✗

$A^+ = \{ABCED\}$ ✓

$A \to B,\ A \to C,\ BC \to E,\ BC \to D$ ✓

$A \to BC,\ BC \to DE$ ✓