National University of Computer and Emerging Sciences, Lahore Campus

Course:	**Database Systems**	**Course Code:**	**CS2005**
Program:	**BS (Computer Science)**	**Semester:**	**Spring 2024**
Out Date:	**18-Mar-2024**	**Total Marks:**	
Due Date:	**Wed 27-Mar-2024** ***(start of class)***	**Weight:**	
Section	**BCS-4A, BCS-4B**	**Page(s):**	**1**
Assignment:	**4 (FDs & NFs)**		

Instructions:

- This assignment is an individual assignment.
- Clearly mention any assumption you have made.
- You are required to submit the hard copy of your assignment at the start of your class.
- For any query, please contact your TA.

TOPIC: Functional Dependencies and Normal Forms

Q1. Consider a relation R (A, B, C, D, E, F, G) with FDs= {AB →C, D→ E, C→ A, B→G, C→DF, C→ BD, E→AB, A→DE, D→ E}. Which of the following FDs may or may not hold over schema R? Give valid reason.

i. A →G **ii.** C → E **iii.** CG → E **iv.** B→A **v.** CGE → A

Q2. Consider two sets of FDs, F and G. F = {A→B, B→C, AC→D} and G = {A→B, B→C, A→D}. Check whether they are equivalent. Show all steps.

Q3. Consider the relation R (A, B, C, D, E, F, G, H, I) and a set of FDs F = {AB→CD, A→E, B→FH, C→G, D→B, G→C, H→I}. Compute the minimal cover for *F* (i.e., *Fc*). Also find all possible Keys (i.e., minimal of super keys) of R.

Q4. Consider the relation R (A, B, C, D) and a set of FDs F = {AB→D, BC→A, D→C}. Find all possible Keys of R.

Q5. Consider a relation schema *R (A, B, C, D, E)* with FDs *F = {A → E, E → BD}*.

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.

Q6. Consider the relation R *(A, B, C, D, E, H)*, with FDs F= {A→BC, B→CE, A→E, AC→H, D→B}. Key of this relation is {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.

Q7. Use your knowledge and intuition to determine FDs. Address (street_address, city, state, zip).

Q8. consider the following relation schema. DISK_DRIVE (Serial_number, Manufacturer, Model, Batch, Capacity, Retailer)
Example: Disk_drive ('1978619', 'WesternDigital', 'A2235X', '765234', 500, 'CompUSA')
Write each of the following dependencies as an FD:

a. The manufacturer and serial number uniquely identifies the drive.
b. A model number is registered by a manufacturer and therefore can't be used by another manufacturer.
c. All disk drives in a particular batch are the same model.
d. All disk drives of a certain model of a particular manufacturer have exactly the same capacity