

## GATE Questions on Normalization

1. Which normal form is considered adequate for normal relational database design?  
(a) 2NF      (b) 5NF      (c) 4NF      (d) 3NF

Ans: option (d)

Explanation:

A relational database table is often described as "normalized" if it is in the Third Normal Form because most of the 3NF tables are free of insertion, update, and deletion anomalies.

2. Consider a schema  $R(A, B, C, D)$  and functional dependencies  $A \rightarrow B$  and  $C \rightarrow D$ . Then the decomposition of  $R$  into  $R_1(A, B)$  and  $R_2(C, D)$  is  
(a) dependency preserving and lossless join  
(b) lossless join but not dependency preserving  
(c) dependency preserving but not lossless join  
(d) not dependency preserving and not lossless join

Ans: option (c)

Explanation:

While decomposing a relational table we must verify the following properties:

i) Dependency Preserving Property: A decomposition is said to be dependency preserving if  $F^+ = (F_1 \cup F_2 \cup \dots \cup F_n)^+$ , Where  $F^+$  = total functional dependencies (FDs) on universal relation  $R$ ,  $F_1$  = set of FDs of  $R_1$ , and  $F_2$  = set of FDs of  $R_2$ .

For the above question  $R_1$  preserves  $A \rightarrow B$  and  $R_2$  preserves  $C \rightarrow D$ . Since the FDs of universal relation  $R$  is preserved by  $R_1$  and  $R_2$ , the decomposition is dependency preserving.

ii) Lossless-Join Property:

The decomposition is a lossless-join decomposition of  $R$  if at least one of the following functional dependencies are in  $F^+$ :-

a)  $R_1 \cap R_2 \rightarrow R_1$

b)  $R_1 \cap R_2 \rightarrow R_2$

It ensures that the attributes involved in the natural join ( ) are a candidate key for at least one of the two relations. In the above question schema  $R$  is decomposed into  $R_1(A, B)$  and  $R_2(C, D)$ , and  $R_1 \cap R_2$  is empty. So, the decomposition is not lossless.

4. Which one of the following statements about normal forms is FALSE?  
(a) BCNF is stricter than 3NF  
(b) Lossless, dependency-preserving decomposition into 3NF is always possible  
(c) Lossless, dependency-preserving decomposition into BCNF is always possible  
(d) Any relation with two attributes is in BCNF

Ans: option (c)

Explanation:

Achieving Lossless and dependency-preserving decomposition property into BCNF is difficult. For details:

5. Which of the following is TRUE?  
(a) Every relation in 2NF is also in BCNF

- (b) A relation R is in 3NF if every non-prime attribute of R is fully functionally dependent on every key of R
- (c) Every relation in BCNF is also in 3NF
- (d) No relation can be in both BCNF and 3NF

Ans: option (c)

6. Which of the following is TRUE?

- (a) Every relation in 2NF is also in BCNF
- (b) A relation R is in 3NF if every non-prime attribute of R is fully functionally dependent on every key of R
- (c) Every relation in BCNF is also in 3NF
- (d) No relation can be in both BCNF and 3NF

Ans: option (c)

7. Consider the following functional dependencies in a database.

Date\_of\_Birth->Age                      Age->Eligibility  
Name->Roll\_number                      Roll\_number->Name  
Course\_number->Course\_name          Course\_number->Instructor  
(Roll\_number, Course\_number) ->Grade

The relation (Roll\_number, Name, Date\_of\_birth, Age) is

- (a) in second normal form but not in third normal form
- (b) in third normal form but not in BCNF
- (c) in BCNF
- (d) in none of the above

Ans: option (d)

Explanation:

For the given relation only some of the above FDs are applicable. The applicable FDs are given below:

Date\_of\_Birth->Age  
Name->Roll\_number  
Roll\_number->Name

Finding the closure set of attributes we get the candidate keys:(Roll\_number, Date\_of\_Birth), and (Name, Date\_of\_Birth)