Branch : CSE & IT **Batch : English**

Database Management System

FD's & Normalization

DPP 04

[MCQ]

1. Consider the following two sets of functional dependencies

$X = \{P\rightarrow Q, Q\rightarrow R, R\rightarrow P, P\rightarrow R, R\rightarrow Q, Q\rightarrow P\}$

$Y = \{P\rightarrow Q, Q\rightarrow R, R\rightarrow P\}$

Which of the following is true?

(a) $X \subset Y$ (b) $Y \subset X$

(c) $X \equiv Y$ (c) $X \neq Y$

[NAT]

2. Consider a relation with schema R(P, Q, R, S, T) and FD set ($PQ\rightarrow R$, $R\rightarrow S$, $S\rightarrow P$). How many super keys in relation R contains?____.

[NAT]

3. Consider a relation R(P, Q, R, S, T) with the set of functional dependencies $\{P\rightarrow QR, RS\rightarrow T, Q\rightarrow S, T\rightarrow P\}$. How many super keys are possible in R? _____.

[MCQ]

4. Consider the relation schema R(P, Q, R, S, T, U, V, W, X, Y) and the set of functional dependencies on R are: $F = \{PQ\rightarrow R, Q\rightarrow TU, PS\rightarrow VW, V\rightarrow X, W\rightarrow Y\}$. Which of the following can be the candidate key for R?

(a) PQT (b) PQS

(c) PQSR (d) PQSVW

[NAT]

5. Let a relation R have attributes {P, Q, R, S, T} and "PQR" is the candidate key, then how many super keys are possible ________?

[MCQ]

6. Consider the following FD sets:

$S_1 = \{P\rightarrow R, PR\rightarrow S, T\rightarrow PS, T\rightarrow U\}$

$S_2 = \{P\rightarrow S, QR\rightarrow PS, R\rightarrow Q, T\rightarrow P, T\rightarrow S, T\rightarrow U\}$

$S_3 = \{P\rightarrow S, R\rightarrow P, R\rightarrow Q, T\rightarrow PU\}$

Which of the following sets is equivalent?

(a) $S_1 \equiv S_2$ (b) $S_2 \equiv S_3$

(c) $S_1 \equiv S_3$ (d) $S_1 \equiv S_2 \equiv S_3$

[NAT]

7. Consider a relation R = {P, Q, R, S, T, U, V, W} with the functional dependency sets $S = \{PR\rightarrow V, S\rightarrow TV, QR\rightarrow S, RV\rightarrow QS, PRS\rightarrow Q, RT\rightarrow PV\}$

The minimum numbers of simple functional dependency in the minimal cover of F is _________?

[NAT]

8. Consider a relation R(P, Q, R, S, T) with the following functional dependencies: $PQR\rightarrow ST$ and $S\rightarrow PQ$, then the number of super keys in R is_______?

Answer Key

1. **(c)**
2. **(7)**
3. **(27)**
4. **(b)**
5. **(4)**
6. **(b)**
7. **(6)**
8. **(10)**

Hints & Solutions

1. (c)

To check, find minimal canonical cover of both the FD sets. FD set Y is already a minimal cover. In X, $P \rightarrow Q$, $Q \rightarrow R$, So $P \rightarrow R$ is redundant FD (through transitivity), and also $Q \rightarrow R$, $R \rightarrow P$, So $Q \rightarrow P$ is also redundant FD. so, we can remove it from F, then after removing it will be $X \equiv Y$.

2. (7)

Candidate keys: PQT, QST, QRT

Super keys:

PQT: PQT, PQRT, PQST, PQRST

QST: QST, PQST, QRST, PQRST

QRT: QRT, PQRT, QRST, PQRST

Total distinct super keys are PQT, QST, QRT, PQRT, PQST, QRST, PQRST. Therefore, correct answer is 7.

3. (27)

$P \rightarrow QR$

$RS \rightarrow T$

$Q \rightarrow S$

$T \rightarrow P$

Candidate key {P, RS, QR, T}

$\{P\}^+ = \{P\ Q\ R\ S\ T\}$

$\{T\}^+ = \{P\ Q\ R\ S\ T\}$

$\{RS\}^+ = \{P\ Q\ R\ S\ T\}$

$\{QR\}^+ = \{Q\ R\ S\ T\ P\}$

So total super key on R for 5 attributes is $2^5 - 1 = 31$

Q, R, S and QS are not super keys

$31 - 4 = 27$

Hence there are 27 super keys.

4. (b)

firstly, find the closure of all the options given above. As we can see that P, Q, and S cannot be derived from any of the above functional dependencies given which states that P, Q and S should be present in the key. Therefore, we need to check only the closure set of option b, c and d which contains these three. Since PQS^+ derives all the attributes in the relation R, So clearly, it's a candidate key.

Point to be noted that, option (c) & (d) are the super keys, since adding zero or more attributes to candidate key generates super key.

5. (4)

PQR is candidate key, remaining attributes $\rightarrow$ S, T with S, T four possibilities hence 4 super keys are possible.

6. (b)

Candidate key for S_1 = T, closure of $T^+ = \{P, Q, R, S, T, U\}$

Candidate key for S_2 = RT closure of $RT^+ = \{P, Q, R, S, T, U\}$

Candidate key for S_3 = RT closure of $RT^+ = \{P, Q, R, S, T, U\}$

So, S_2 as S_3 are equivalent.

7. (6)

A FD $A \rightarrow B$ is a simple FD if B is a single attribute:

Step 1:

Simplify all the given FD's

$PR \rightarrow V$

$S \rightarrow T$

$S \rightarrow V$

$QR \rightarrow S$

$RV \rightarrow S$

$RV \rightarrow Q$

$PRS \rightarrow Q$

$RT \rightarrow P$

$RT \rightarrow V$

Step 2:

Find out extraneous attributes present in FD.

$PRS \rightarrow Q$: $(PR)^+ \rightarrow PRVQ$, So we get Q, S is extraneous and can be safely removed, rewriting the new FD as $PR \rightarrow Q$.

$PR \rightarrow V$: $P^+ \rightarrow P$, so can't get V; R is not extraneous,

$R^+ \rightarrow R$, so, count set V; P is not extraneous. Hence, keep this FD as it is.

QR→S: $Q^+ \to Q$, so can't get S R is not extraneous $R^+ \to R$, so can't set S, Q is not extraneous keep this FD as it is.

RV → Q: $R^+ \to$ R, so can't get Q; V is not extraneous

$V^+ \to$ V, so, can't get Q; R is not extraneous keep this FD as it is.

RV→S; $R^+ \to R$, so can't get S; V is not extraneous V+→V so can't get S; R is not extraneous so keep this FD as it is.

If we continue the step 2, we will not find any extraneous attribute on LHS of any FD. So, we are done with step 2.

Step 3:

Find Redundant FD's

$(PR)^+ \to$ PRQSTV; so, we got V from other FDs remove the entire FD from list.

$(RV)^+ \to$RVSTPQ; So, we get Q from other FD's remove the entire FD from the list.

(RT)+ →RTVS; so, we did not get P from other FDs, so keep this FD in the lists.

(RT)+ →RTPQSV; so we got V from other FDs, hence, remove this FD from the list.

Step 4:

1) S→T
2) S→V
3) QR→S
4) RV→Q
5) PR→Q
6) RT→P

The minimum number of simple FDs in the minimal cover of F is 6.

8. (10)

Consider a relation R have attributes $\{x_1, x_2, x_3....x_n\}$ and the candidates' keys are "x_1x_2", "x_1x_3" then possible number of super keys = super keys of (x_1, x_2) + super keys of (x_1, x_3) – super keys of (x_1, x_2, x_3)

$\Rightarrow 2^{(n-2)} + 2^{(n-2)} - 2^{(n-3)}$

The candidate keys of relation are PQR and SR.

The number of super keys of (PQR) = $2^{(5-3)} = 4$

The number of super keys of (RS) = $2^{(5-2)} = 8$

The number of super keys of (PQRS) = $2^{(5-4)} = 2$

Then possible number of super keys = 4 + 8 – 2 = 10

ie, PQR, PQRS, PQRT, PQRST, RS, PRS, QRS, RST, PRST, QRST.