1. Consider a relation $R = \{A, B, C, D, G, M, E, H, I, J\}$ and the set of FD's of $F = \{AB \to C,\ A \to DE,\ B \to M,\ M \to GH,\ D \to IJ\}$

a) Find F^+ b) Find A^+ c) Determine the key of R.

d) Decompose R into 2NF relations.

Ans :-

a) $F^+ = \{AB \to C, A \to DE, B \to M, M \to GH, D \to IJ, B \to GH, B \to MGH,$
$M \to G, M \to H, D \to I, D \to J, B \to G, B \to H, B \to GH, A \to D,$
$A \to E, ABD \to CD, \dots\dots\}$

b) $A^+ = \{A\} \Rightarrow \{A, D, E\} \Rightarrow \{A, D, E, I, J\}$

c) $B^+ = \{B\} \Rightarrow \{B, M\} \Rightarrow \{B, M, G, H\}$

$\Rightarrow AB^+ = \{A, B\} = \{A, B, C\} \Rightarrow \{A, B, C, M\} \Rightarrow \{A, B, C, M, G, H\}$

$\Rightarrow \{A, B, C, M, G, H, D, E\} \Rightarrow \{A, B, C, M, G, H, D, E, I, J\}$

Here AB^+ contains all the attributes of the given relation R.

$\therefore$ We can say that A & B are super key or key of the relation R.

d) The given relation has the key attributes A & B. If a relation is in 2NF, it should be in 1NF and also are non-key attributes are fully functionally dependent on the key attributes.

Here the given relation R is not in 2NF. So we have to decompose the relation in order to make the relations is 2NF.

From FD, $A \to DE$ & $B \to M$ shows partial dependency of M & DE on B & A.

$\therefore$ we can split the relation R :-

(i) $R_1\ (A, B)$

(ii) $R_2\ (A, D, E, I, J)$

(iii) $R_3\ (B, M, G, H)$

- IJ thus dependent on D from $D \to IJ$
- GH depend on M from $M \to GH$

Given a relation schema R (A, B, C, D, E, G) with a set of FD's

F = { AB → C, C → D, D → EG, G → A, D → B, E → G }.

Verify whether the decomposition (ABC, CDE, EG) of R is lossless.

$AB^+ = \{A, B, C, D, E, G\}$

Ans :- R_1(ABC), R_2(CDE), R_3(EG).

∴ AB is the super key.

	A	B	C	D	E	G
R_1(ABC)	αA	αB	αC	$β_1$D	$β_1$E	$β_1$G
R_2(CDE)	$β_2$A	$β_2$B	αC	αD	αE	$β_2$G
R_3(EG)	$β_3$A	$β_3$B	$β_3$C	$β_2$D	αE	αG

Consider the FD's :-

AB → C

C → D

D → EG

G → A

D → B

E → G

	A	B	C	D	E	G
R_1(ABC)	αA	αB	αC	αD		
R_2(CDE)	αA	αB	αC	αD	αE	αG
R_3(EG)					αE	αG

- AB → C & C → D ⇒ AB → D
- C → D & D → EG ⇒ C → EG
- G → A
- D → B
- E → G