# Assignment 4 (Normalization)

Ans 1) a) $\Pi_{address}\left[\sigma_{emp.dno=dept.dno}(dept \times emp)\right]$

b) $\sigma_{name=dept.name}\left[\Pi_{dept.name}(dept) \times \Pi_{name}(emp)\right]$

c) Cannot be expressed using given operators.

d) $\Pi_{name}\left[\sigma_{deptno='x'}(emp)\right]$

Ans 2) b) $YZ \rightarrow X$ and $Y \rightarrow Z$

Ans 3) a) r has no duplicates and s is non-empty.

Ans 4) $R=(A,B,C,D,E)$, $R_1=(A,B,C)$ & $R_2=(A,D,E)$

$R_1 \bowtie R_2 = R \Rightarrow$ It is lossless decomposition

Ans 5) $CD \rightarrow E$ does not hold for the relations b/c C and D, E are not in the relation after decomposition. Similarly $B \rightarrow D$ does not hold.

Ans 6) a) Since there is no common attribute between $R_1$ and $R_2$. Natural Form cannot be performed, hence it is lossy decomposition

b) In $R_1$: $A \rightarrow B$ holds

In $R_2$: $C \rightarrow D$ holds

Hence, it is dependency preserving.

Ans 7) $C \rightarrow B$, $t_1[C] = t_2[C] \Rightarrow t_1[B] = t_2[B]$
For any two tuples $t_1$ and $t_2$ in column C and B.

Ans 8) $F = \{A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A\}$

$F^+ = \{A \rightarrow BC$
$CD \rightarrow E$
$B \rightarrow D$
$E \rightarrow A$
$CD \rightarrow A$
$CD \rightarrow BC$
$D \rightarrow B$
$A \rightarrow D$
$A \rightarrow E\}$

Ans 9) $F^C = A \rightarrow BC$
$CD \rightarrow E$
$B \rightarrow D$
$E \rightarrow A$

Ans 10) i) Considering both attributes are atomic, it is 1NF.

ii) Since only 2 attributes are present other one is non prime and fully functionally dependent on the candidate key or if both attributes from candidate key then it is trivial functional dependency, hence, it is in 2NF.

iii) For any $\alpha \subseteq R$ and $\beta \subseteq R$
$\alpha \rightarrow \beta$ is either trivial [from (ii)]
$\alpha$ is a superkey for R (where $\alpha$ is the candidate key among the two attributes)
Hence it is BCNF.