BITS ID NO - 2019ht13096

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COURSE TITLE - SSZG518

COURSE NAME - DATABASE DESIGN AND APPLICATIONS

Q.1

1.1

$$R_1 = \rho_{l_1}(lives)$$

$$R_2 = \rho_{l_2}(lives \bowtie manages)$$

$$R_3 = R_1 \bowtie_{(R_1.manager\_name = R_2.person\_name \wedge R_1.street = R_2.street \wedge R_1.city = R_2.city)} (R_2)$$

$$\boxed{Result = \Pi_{person\_name}(R_3)}$$

1.2.

$$R_1 = \sigma_{company\_name = \text{"CITY BANK"}}(works)$$

$$\boxed{Result = \Pi_{person\_name, city}(lives \bowtie R_1)}$$

1.3.

$$R_1 = \sigma_{(company\_name = \text{"CITY BANK"} \wedge salary > 52000)}(works)$$

$$\boxed{Result = \Pi_{person\_name, street, city}(lives \bowtie R_1)}$$

Q.1

1.4.

Result =

$$\Pi_{person\_name}(lives \bowtie works \bowtie located\_in)$$

1.5:

→ Assuming all person works in a company.

$$\Pi_{person\_name}(\sigma_{company\_name \neq \text{"CITY BANK"}}(works))$$

→ If some person does not work:

$$R_1 = \Pi_{person\_name}(\sigma_{company\_name = \text{"CITY BANK"}}(works))$$

$$\boxed{Result = \Pi_{person\_name}(lives) - R_1}$$

Q.2

2.1)

```
SELECT company_name
FROM works GROUP BY company_name
HAVING SUM(salary) <=
        ALL( SELECT SUM(salary)
             FROM works
             GROUP BY company-name);
```

2.2)

```
SELECT C1. company-name FROM located-in C1
 WHERE NOT EXISTS
 ((SELECT city FROM located-in
   WHERE company-name = 'CITYBANK')
   EXCEPT
   (SELECT CITY FROM located-in C2
    WHERE C1. company-name = C2. company-
                                     name));
```

Q2

2.3) Assuming all person work:

```
SELECT Person-name FROM works
    WHERE company-nome <> 'CITY BANK';
```

However,
if not all person work for a company
then query would be

```
SELECT person-name FROM lives LEFT OUTER JOIN
    works ON lives.person-name = works.person-nam
    WHERE works.company-name <> 'CITY BANK';
```

2.4)

```
SELECT person-name FROM works
WHERE salary > (SELECT MAX(salary)
                FROM works WHERE
                company-name = 'CITY BANK');
```

Q.2

2.5)

```
SELECT person-name FROM works W1
WHERE salary >( SELECT Avg (salary)
                FROM works W2
                WHERE W1. company-name
                      = W2. company_name);
```

Q.3

3.1 Relation R :

$P \to Q$

$R \to Q$

$S \to PQR$

$PR \to S$.

Step 1 ÷ Breaking RHS

(i) $P \to Q$ (ii) $R \to Q$ (iii) $S \to P$ (iv) $S \to Q$

(v) $S \to R$ (vi) $PR \to S$

Step 2 ÷ check essential dependency

(i) $P \to Q$, $(P)^+ = \{P, Q\}$

$\therefore (P)^+_Q = \{P\}$.

$\therefore$ essential

(ii) $R \to Q$; $(R)^+ = \{R, Q\}$

$\therefore (R)^+_Q = \{R\}$. → different than above

$\therefore$ essential

(iii) $S \to P$; $(S)^+ = \{P, Q, R, S\}$.

$(S)^+_P = \{Q, R, S\}$ → different.

$\therefore$ essential

Q.3

3.1 (continued)

(iv) $S \to Q$: $(S)^+ = \{P, Q, R, S\}$

$(S)^+_Q = \{P, Q, R, S\}$. → Redundant.

∴ Redundant.

(v) $S \to R$ ∴ $(S)^+ = \{P, Q, R, S\}$.

$(S)^+_R = \{P, Q, S\}$ → different

∴ Essential

(vi) $PR \to S$ ∴ $(PR)^+ = \{P, Q, R, S\}$

∴ $(PR)^+_S = \{P, Q, R\}$ → different

∴ Essential.

So we get following.

$P \to Q$
$R \to Q$
$S \to P$
$S \to R$
$PR \to S$

$S \to P$, $S \to R$ > $S \to PR$

Step. 3 ÷ Break LHS to single attribute

$PR \to S$; $(PR)^+ = \{P, Q, R, S\}$.

$(P)^+ = \{P, Q\}$, $(R)^+ = \{R, Q\}$.

Q.3

Since $(P)^+$ & $(R)^+$ is different;

final canonical cover is same as step 2

$\therefore$ final =
$P \to Q$
$R \to Q$
$S \to PR$
$PR \to S$

3.2

$R = (P, Q, R, S, T)$

$P \to Q$

$PQ \to R$

$S \to PQT$.

Step (1)

$P \to Q$
$PQ \to R$
$S \to P$
$S \to Q$
$S \to T$

(Q.3)

Q.2) continued

Step (2)

$P \to Q$; $(P)^+ = \{P, Q, R\}$; $(P)^+_Q = \{P\}$

$PQ \to R$; $(PQ)^+ = \{P, Q, R\}$; $(PQ)^+_R = \{P, Q\}$

$S \to P$; $(S)^+ = \{P, Q, R, S, T\}$; $(S)^+_P = \{S, Q, T\}$

$S \to Q$; $(S)^+ = \{P, Q, R, S, T\}$; $\underbrace{(S)^+_Q = \{P, Q, R, S, T\}}_{\text{Redundant}}$

$S \to T$; $(S)^+ = \{P, Q, R, S, T\}$; $(S)^+_T = \{P, Q, R, S\}$

So we get,
(I) $P \to Q$ (II) $PQ \to R$, (III) $S \to P$ (IV) $S \to T$.

Step (3) for $PQ \to R$

$(PQ)^+ = \{P, Q, R\}$
$(P)^+ = \{P, Q, R\}$] Redundant
$(Q)^+ = \{Q\}$.

Q.3

P.2) continued

So, we get

(i) $P \rightarrow Q$ (ii) $P \rightarrow R$ (iii) $S \rightarrow P$ (iv) $S \rightarrow T$

∴ final canonical cover

$= P \rightarrow QR$

$S \rightarrow PT$

P.3) Given $R = Q \rightarrow P$

$PS \rightarrow QR$

$R \rightarrow PQS$.

Step (1)

(i) $Q \rightarrow P$ (ii) $PS \rightarrow Q$ (iii) $PS \rightarrow R$

(iv) $R \rightarrow P$ (v) $R \rightarrow Q$ (vi) $R \rightarrow S$

Q.3

3.3 - Continued

Step (II)

(I) $Q \to P$; $(Q)^+ = \{P, Q,\}$; $(Q)^+_P = \{Q\}$.

(II) $PS \to Q$; $(PS)^+ = \{P, S, Q, R\}$; $(PS)^+_Q = \{P, S, Q, R\}$

Redundant, So Remove

(III) $PS \to R$; $(PS)^+ = \{P, S, Q, R\}$; $(PS)^+_R = \{P, S, \}$.

(IV) $R \to P$; $(R)^+ = \{P, Q, R, S\}$; $(R)^+_P = \{P, Q, R, S\}$.

Redundant, So Remove

(V) $R \to Q$; $(R)^+ = \{P, Q, R, S\}$; $(R)^+_Q = \{R, S\}$.

(VI) $R \to S$; $(R)^+ = \{P, Q, R, S\}$. $(R)^+_S = \{P, Q, R\}$.

So after Removing

(I) $Q \to P$ (II) $PS \to R$ (III) $R \to Q$ (VI) $R \to S$

Q.3

3.3 → continued

Step (iii)

Remove LHS Redundancy

$PS \rightarrow R$

$(PS)^+ = \{P, Q, R, S\}$

$(P)^+ = \{P\}$

$(S)^+ = \{S\}$.

∴ No redundancy so cannot be Removed.

∴ final Canonical cover =

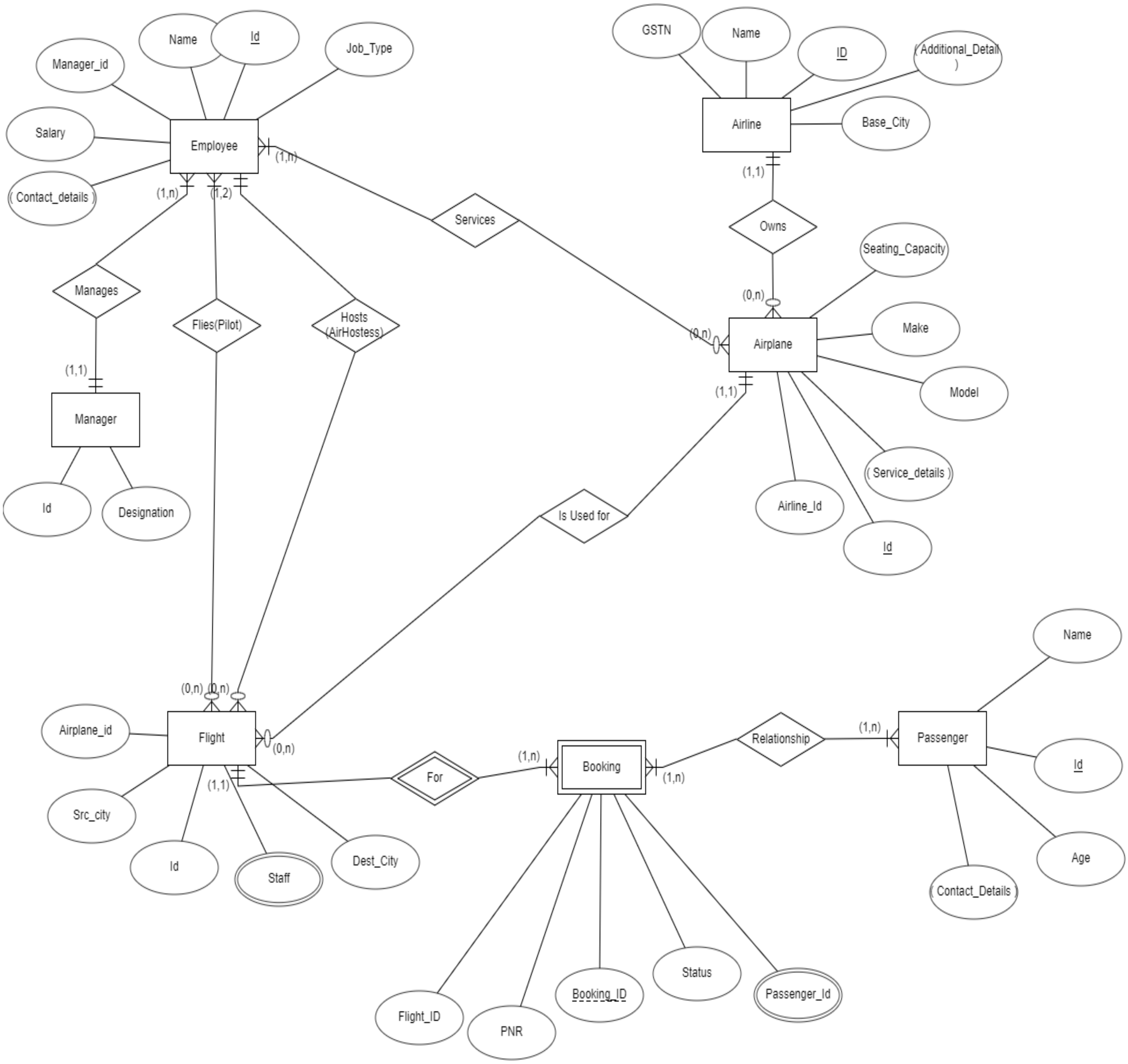
$Q \rightarrow P$

$PS \rightarrow R$

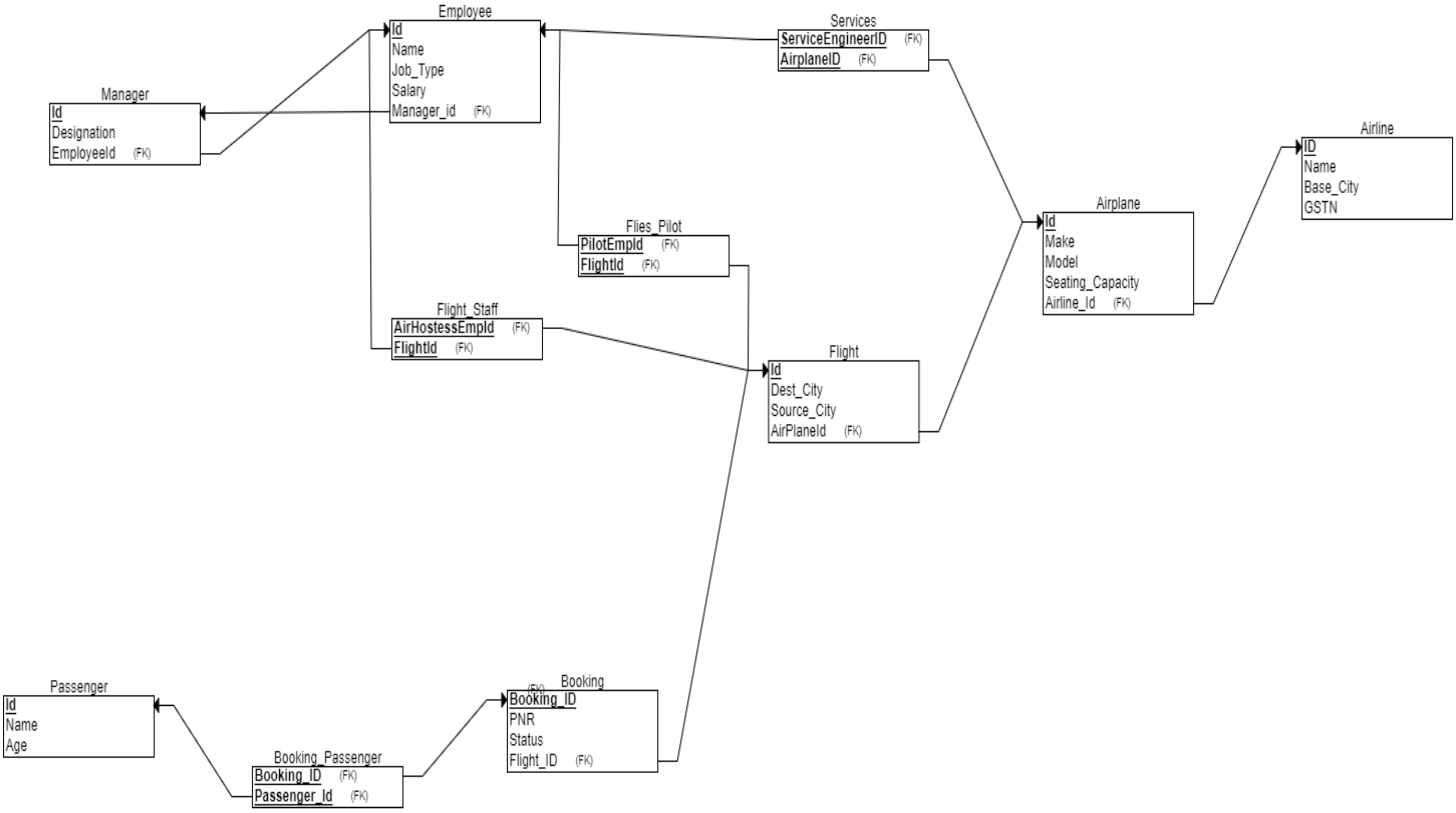
$R \rightarrow SQ$

Q4

ER Diagram for the Airline: I have used a tool to draw this diagram to ensure clarity**.**



Relational Model for the diagram:



THE END