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0144-BSCS-17
"C"

(a)
(Q1) ——————?

Q1)(a) **Functional Dependencies:-**

As D has unique attributes. So,

FD1 : D → A
FD2 : D → B
FD3 : D → C

D defines the primary key. So, it can define all attributes.

D → ABC

A & C combine & make unique.

i.e

AC → B & AC → D
AB → C & AB → D
AD → B & AD → C

Combination with D makes any attribute unique.

Q1)(b)(A) **Minimal cover:-**

A → B
A → C
AB → CDGH
C → GD
D → G
E → F

A → B
ABE ≈ AE
→ Replace

(B) As we can see in FDs E & F are not functionaly define by single or group of attributes So, they remain with every L.H.S element.

AE+ = { B, C, G, D, H, F }

Minimal ⇒ G { A → BC, AE → CDGH, E → F }

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(Q1) (a)

FD

1 → AB → C
2 → AC → D
3 → D → A
4 → B → C
5 → C → B
6 → D → B
7 → D → C
8 → AC → B
9 → AC → D
10 → AD → B
11 → AD → C
12 → BD → A
13 → CD → B
14 → CD → A

$A \not\to B$
$B \not\to A$ (Not Dependent Functionly)
$A \not\to C$
$C \not\to A$
$A \not\to D$
$B \not\to D$
$C \not\to D$
$BC \not\to A$
$BC \not\to D$

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Q2) ——————?

(a) ——————?

(a) RA:-

$\pi_{sname}(\pi_{sid}((\pi_{pid}\,\sigma_{color='red'}\,Parts) \bowtie Catalog) \bowtie Suppliers)$

TRC:-

$\{T \mid \exists T_1 \in Suppliers(\exists X \in Parts(X.color='red' \wedge \exists Y \in Catalog$
$\{Y.pid = X.pid \wedge Y.sid = T1.sid)) \wedge T.sname = T1.sname)\}$

DRC:-

$\{(Y) \mid (X,Y,Z) \in Suppliers \wedge \exists P,Q,R((P,Q,R) \in Parts$
$\wedge R='red' \wedge \exists I,J,K((I,J,K) \in catalog \wedge J=P \wedge I=X))\}$

SQL:-

```
Select  S.sname
From    Suppliers S, Parts P, Catalog C
Where   P.color='red' AND C.pid=P.pid AND C.sid=S.sid
```

(Q2)(b) ——————?

(b) RA:-

$\pi_{sid}(\pi_{pid}(\sigma_{color='red' \vee color='green'}\,Parts) \bowtie Catalog)$

TRC:-

$\{T \mid \exists T1 \in Catalog(\exists X \in Parts((X.color='red' \vee X.color='green')$
$\wedge X.pid = T1.pid) \wedge T.sid = T1.sid)\}$

DRC:-

$\{(X) \mid (X,Y,Z) \in Catalog \wedge \exists A,B,C((A,B,C) \in Parts$
$\wedge (C='red' \vee C='green') \wedge A = Y)\}$

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SQL:-

```
Select  C.sid
From    Catalog C, Parts P
Where   (P.color = 'red' OR P.color = 'green')
AND     P.pid = C.pid
```

(Q2)(c) ——————?

(1) Consider the set of FD: $AB \rightarrow CD$ and $B \rightarrow C$. AB is obviously a key for this relation since $AB \rightarrow CD$ implies $AB \rightarrow ABCD$. It is a primary key since there are no smaller subsets of keys that hold over $R(A,B,C,D)$. The FD: $B \rightarrow C$ violates 2NF since;

- $C \in B$ is false, that is, it is not a trivial FD.
- B is not a superkey.
- C is not a part of some key.
- B is a proper subset of the key AB. (transitive dependency).

(2) Consider the set FD: $AB \rightarrow CD$ and $C \rightarrow D$. AB is obviously a key for this relation since $AB \rightarrow CD$ implies $AB \rightarrow ABCD$. It is a primary key since there are no smaller subsets of keys that hold over $R(A,B,C,D)$. The FD: $C \rightarrow D$ violates 3NF but not 2NF since:

- $D \in C$ is false, that is it is not a trivial FD.
- C is not a superkey.
- D is not a part of some key for R.

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(Q2)(3) The only way R would be in BCNF if B includes a key.
i.e. B is a key for R

(Q2)(4) It means that the relation is one-to-one. That is, each a entity corresponds to at most one B entity & vice versa.
(In addition, we have the dependency $AB \rightarrow C$ from the semantics of a relationship set).

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Q3) (a) _____ ?

(A) $\pi_{sname}((\sigma_{bid!=103}\ Reserves) \bowtie Sailors)$

(B) $\pi_{sname}((\sigma_{color='blue'}\ boat) \bowtie Sailors \bowtie Reserves)$

(C) $\rho(TempRed, \pi_{sid}((\sigma_{color='red'}\ Boats) \bowtie Reserves))$
$\rho(TempGreen, \pi_{sid}((\sigma_{color='green'}\ Boats) \bowtie Reserves))$
$\pi_{sname}((TempRed \cap TempGreen) \bowtie Sailors)$

(D) $\pi_{sname}((\sigma_{ratings>'1'} \cup rating='1'\ Sailors) \bowtie Reserves \bowtie Boat))$

(E) $\pi_{color}((\sigma_{sname='lubber'}\ Sailors) \bowtie Reserves \bowtie Boats))$

(b)

(Q3) _____ ?

(Q3) (b) $A \rightarrow B$, $A \rightarrow A$

if $BC \rightarrow DE$

then $ABC \rightarrow DE$

$AEF \rightarrow G$ & $ABC \rightarrow DE$

So, ACF can determine DG

(c) _____ ?

(c) $A \rightarrow BC$

if $B \rightarrow E$

then $A \rightarrow BCE$

$CD \rightarrow EF$

A can determine C

$ACD \rightarrow EF$ by $AD \rightarrow F$

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(D) ——— ?

(D) $AB \rightarrow C$ closure of ABD

$BD \rightarrow EF$ (D, B, A, I, C, E, F, G, H, I)

$AD \rightarrow GH$

$A \rightarrow I$

$H \rightarrow AJ$

ABD is a key of Relation

(e) ——— ?

(e) (1) $X \rightarrow YZ$ (Given

(2) $Y \rightarrow Y$ (Decomp)

(3) $X \rightarrow Z$ (Decomp)

(4) $Z \rightarrow W$ (Given)

(5) If $X \rightarrow Z$, $Z \rightarrow W$ then $X \rightarrow W$ (Transitivity Rule)

Thus

(6) $X \rightarrow YZW$ (2, 3, 4, union)

(f) ——— ?

(f) Algorithm for closure of FD's

① Add the attributes which are present on L.H.S in the original FD.

② Now, add the attributes present on the R.H.S of FD

③ With the help of attributes present on R.H.S, check the other attributes that can be derived from the other given functional dependencies. Repeat, this process untill all the possible attributes which can be derived are added in the closure.

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(Q4)(A)

Base Entity	Unique Identifier
FLIGHT	(_Flight_ID) which is in the form composite attributes (Flight#, Date)
AIRCRAFT	Tail #
RESERVATION	Reserv_no
TECHNICIAN	SSN
TRUCK	Vehicle_ID, License_Plate #

Weak entity and its unique identifier

Base Entity	Unique identifier
SERVICE	Data_code (The weak key attribute has composite attributes Date, work code, Tail#).

Q4 (B)

Tail# in SERVICE is the partial key which is part of its composite attributes based weak

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primary key attribute, referencing the primary key of parent strong entity AIRCRAFT for service.

Q4(c)

Attributus which are not colored black circles are optional.

Entity	Optional Attributes	Multi valued attributes
SERVICE	1. Start time	1. No
	2. End time	2. No
	3. Hours	3. Yes
TECHNICIAN	1. Speciality	1. Yes
	2. Hiredate	2. No
	3. Tenure	
TRUCK	1. Condition	1. No.

Q4(D)

- **HOURS** in SERVICE entity is derived attributes whose value is calculated from other attributes.

- **Tenure** in TRUCK entity is derived attribute whose value is calculated using other attribute Hire Date which can be deducted from the current date.

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- A derived attribute can either be stored in the entity or need not to be stored in the entity.

Q4(e)

(a) 1:1 cardinality ratio will mean one to one relationship between two entity at a time. For example, one technician will be assigned to one truck as 1:1 cardinality ratio.

(b) 1:1 cardinality ratio will mean one to many relationships between two entities at a time. For example, one aircraft may involve in many flights as 1:n cardinality ratio.

(c) m:n cardinality ratio will mean many to many relationships between two entities at a time. For example, many m number of flights have many n numbers of reservations as m:n cardinality ratio. Many "m" numbers of technicians will perform "n" number of services as m:n cardinality ratio.

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Q4(f)

The strong entity aircraft has a relationship with the weak entity "SERVICE" through an identifying relationship "Goes for" using a double diamond. The relationship between a ~~relationship~~ strong entity Technician and the weak entity service will be using a single diamond relationship through an associative entity "performs" as it is present in m.n relationship btw the two entities.

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(Q5)(A) ———— ?

(Q5)(A) Flights(flno, connected(flights), departs) : assembly(flno, connected, flights, departs)

(Q5)(C) Flights(flno, departs(Madison)) : assembly(flno, departs, Madison)

(Q5)(B) Flights(flno, depart(Madison)) : assembly(flno, departs, Madison)

(Q5)(D) **Atomocity:**

It means that either the entire transaction takes place at once or doesn't happen at all. There is no midway. means transactions do not execute partially. It has 2 operations:-

① Abort ② Commit

i.e:- $x = 300$ $Y = 200$

T_1	Transaction T	T_2
Read (x)		Read (Y)
x : x − 100		Y : = Y + 100
write (x)		write (Y)
After: x : 200		After : Y : 400

Consistency:-

This means integrity constraints must be maintained so that the database is consistent before & after the transaction.

i.e:- 300 − 100 = 200 (Before T)

100 + 100 = 200 (After T)

∴ DB is consistent. Inconsistency occurs in case T1 completes but T2 fails.

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(Q5)(D) **Isolation:-**

This property ensures that multiple transactions can occur concurrently without leading to the inconsistency of database state. Transactions occur independently without interference

i.e

T'	T''
Read(X)	Read(X)
X := X*100	Read(Y)
Write(X)	Z := X+Y
Read(Y)	Write(Z)
Y := Y-50	
Write	

Durability:-

This property ensures that once the transaction has completed execution, the updates & modifications to the database are stored in & written to disk & they persist even if a system failure occurs. These updates now become permanent & are stored in non-volatile memory.

Schedule:-

When multiple transactions are running concurrently then there needs to be a sequence in which the operations are performed because at a time only one operation can be performed on the DB. This sequence of operations is called Schedule.

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Blind Write:-

Blind Write is simply when a transaction writes without reading. i.e; a transaction have WRITE(Q), but no READ(Q) before it. So, the transaction is writing to DB "Blindly" without reading ~~per~~ previous value.

Dirty Read:-

A dirty read occurs when one transaction is permitted to read data that is being modified by another transaction which is running concurrently but which has not yet committed itself. If the transaction that modifies the data commits itself, the dirty read problem occur.

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