**Question 1 Solution:**

**Relational Algebra**

πename(σaname=‘Boeing0 (Aircraf t download.png Certif ied download.png Employees))

**Tuple Relational Calculus**

{E.ename | E ∈ Employees ∧ ∃C ∈ Certif ied (∃A ∈ Aircraf t(A.aid = C.aid ∧ A.aname = ‘Boeing0 ∧ E.eid = C.eid))}

**Domain Relational Calculus**

{hENi|hEid, EN, ESi ∈ Employess∧ ∃Ceid, Caid(hCeid, Caidi ∈ Certif ied∧ ∃Aid, AN, AR(hAid, AN, ARi ∈ Aircraf t∧ Aid = Caid ∧ AN = ‘Boeing0 ∧ Eid = Ceid)}

**SQL**

SELECT E.ename FROM Aircraft A, Certified C, Employees E WHERE A.aid = C.aid AND A.aname = ‘Boeing’ AND E.eid = C.eid

**Question 2 Solution:**

1. The candidate keys are

AB,BC,CD,AD

1. R is in 3NF BUT NOT IN BCNF
2. C->A and D->B. Both causes violations .So decompose into: AC,BCD but it does not preserve AB->C and AB->D and BCD is still not BCNF because D->B. So decompose further into : AC,BD,CD. We revive the lost functional dependencies by add ABC and ABD, these relations are not in BCNF form. Thus there is no BCNF decomposition

**Question 4 Solution:**

(i)

Cost is generally measured as total elapsed time for answering query

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Many factors contribute to time cost are disk accesses, CPU, or even network communication

(ii)

(a)

1. Cost of checking all conditions via a table scan + filter:B(R) = 1000blockI/Os.

2. Cost of an index-scan for condition a= 1, followed by a filter:B(R)/V(R,a) =1000/20 = 50block I/Os.

3. Cost of an index-scan for condition b= 2, followed by a filter:T(R)/V(R,b) =5000/1000 = 5block I/Os.

4. Cost of an index-scan for condition d= 3, followed by a filter:T(R)/V(R,d) =5000/500 = 10block I/Os.

Thus,we select plan 3.

(b)

1. Cost of checking all conditions via a table scan + filter:B(R) = 1000blockI/Os.

2. Cost of an index-scan for condition a= 1, followed by a filter:B(R)/V(R,a) =1000/20 = 50block I/Os.

3. Cost of an index-scan for condition b= 2, followed by a filter:T(R)/V(R,b) =5000/1000 = 5block I/Os.

4. Cost of an index-scan for condition c<3, followed by a filter:T(R)/3 =5000/3 = 1667 block I/Os.

Thus,select the plan 3.

Question 5 Solution:

(a)

(i) It is serialized, view-serialized, not conflict serializable. It is recoverable and avoid cascading aborts. It is not strict

(ii)It is serializable and view seriializable, not conflict serializable and is recoverable.