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Task 1

FD1: {A} → {B,C} FD2: {C} → {A,D} FD3: {D,E} → {F}

a) {C} → {B}

FD4: C -> A (Decomposition of FD2)
FD5: C -> BC (Transitivity with FD1)

a) {A,E} → {F}

FD6: A → C (Decomposition of FD1)
FD7: A → AD (Transitivity of FD6 with FD2)
FD8: A → D (Decomposition of FD7)
FD9: AE → DE (Augmentation of FD8)
FD10: AE → F (Transitivity of FD9 with FD3)

Task 2

a) X = { A }

- Initially: X + = { A }
- By using FD1: X+ = { ABC }
- By using FD2: X+ = { ABCD }

b) X = { C, E }

- Initially: X + = { CE }
- By using FD2: X+ = { CEAD }
- By using FD1: X+ = { CEADBC }
- By using FD3: X+ = { CEADBCF }

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Task 3

R(A, B, C, D, E, F)
FD1: {A,B} → {C,D,E,F} FD2: {E} → {F} FD3: {D} → {B}

a) Determine the candidate key(s) for R.

Step 1

- C is in the RHS but not in the LHS => C is not part of any candidate key.
- F is in the RHS but not in the LHS => F is not part of any candidate key.

Step 2

- A is not in the RHS, A must then be part of any candidate key.

Step 3

{A}+ = {A} - Not candidate key
{AB}+ = {ABCDEF}
{AE}+ = {AEF} - Not candidate key
{AD}+ = {ADBCEF}

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b) Note that R is not in BCNF. Which FD(s) violate the BCNF condition?

FD1

{AB} - Candidate key, therefore it is a superkey. FD1 does not violate the BCNF condition.

FD2

{E}+ = {EF} - Not a superkey. FD2 violates the BCNF condition.

- Initially: X + = { E }
- By using FD2: X+ = { EF }

FD3

{D}+ = {DB} - Not a superkey. FD3 violates the BCNF condition.

- Initially: X + = { D }
- By using FD3: X+ = { DB }
-

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R(A, B, C, D, E, F)
FD1: {A,B} → {C,D,E,F} FD2: {E} → {F} FD3: {D} → {B}

c) Decompose R into a set of BCNF relations, and describe the process step by step (don't forget to determine the FDs and the candidate key(s) for all of the relation schemas along the way).

R1(E,F) with FDs: FD2, CK: {E}
R2(ABCDE) with FD3 and a new FD4: AB → CDE (Derived from FD1 using decomposition), CK: {AB}
R1 is in BCNF, **R2** is not because of FD3. Decomposing **R2** using FD3:
R3(DB) with FD3, CK: {D}
R4(DACE) with new FD5: AD → CDE (Derived from FD3: D->B using augmentation and FD4: AB -> CDE using transitivity), CK: {AD}

The result of the decomposition of R consists of R1, R3 and R4.

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Task 4

FD1: {A,B,C} → {D,E} FD2: {B,C,D} → {A,E} FD3: {C} → {D}

a)

As B and C are not in the RHS but just in the LHS then they must be present in possible CKs. Therefore **FD3** violates the BCNF property since it only contains C in the LHS.

b)

Possible candidate keys.

{BC}+ = {BC} - Not a candidate key
{ABC}+ = {ABCDE} - A candidate key
{BCD}+ = {ABCDE} - A candidate key

CKs = {ABC}, {BCD}

FD3 violates BCNF properties. Decomposing R using **FD3.**

R1(C,D) with FDs: FD3, CK: {C}
R2(ABCE) with new FD: ABC → E (Decomposed from FD1) , CK: {ABC}

The result of the decomposition consists of R1 and R2.