Q1.
i.
ACEF, BCEF are candidate keys.
$AD \rightarrow B$: AD does not contain a key. $C \rightarrow D$: C does not contain a key. $BC \rightarrow A$: BC does not contain a key. $B \rightarrow D$: B does not contain a key.

Decomposition:
Based on the functional dependency $AD \rightarrow B$, decompose ABCDEF into relations ACDEF, ADB;
Based on the functional dependency $C \rightarrow D$, decompose ACDEF into relations ACEF, CD;

Taken together, decompose ABCDEF into relations ACEF, CD, ABD.

ii.
AF, CF are candidate keys.
$BC \rightarrow E$: BC does not contain a key. $C \rightarrow AB$: C does not contain a key.

Decomposition:
Based on the functional dependency $C \rightarrow AB$, decompose ABCDEF into relations CDEF, ABC. This is in BCNF.

iii.
ABCF, BCDF are candidate keys.
$ABF \rightarrow D$: ABF does not contain a key. $CD \rightarrow E$: CD does not contain a key. $BD \rightarrow A$: BD does not contain a key.

Decomposition:
Based on the functional dependency $ABF \rightarrow D$, decompose ABCDEF into relations ABCEF, ABFD.
Based on the functional dependency $BD \rightarrow A$, decompose ABFD into relations BDF, ABD.

Taken together, decompose ABCDEF into relations ABCEF, BDF, ABD.

iv
AB is the candidate key.
$BCD \rightarrow EF$: BCD does not contain a key. $B \rightarrow C$: B does not contain a key.

Decomposition:
Based on the functional dependency $B \rightarrow C$, decompose ABCDEF into relations ABDEF, BC. This is in BCNF.

Q2.

Symbol legends:
π : *Projection*
σ : *Selection*
ρ : *Rename*
γ : *Aggregation* (*GroupBy*)

$\bowtie$: $Join$
R : $Relation$
Res : $Result$

i.
$Res \ = \ \pi_{name}(\sigma_{sector \ = \ 'Technology'}(Company \ \bowtie \ Category))$

ii.
$Res \ = \ \pi_{code}(\sigma_{personCount \ > \ 5}(\rho_{code,personCount}(\gamma_{code,count(Person)}(Executive)))$

iii
$Res \ = \ \pi_{person}(\sigma_{companyCount \ > \ 1}(\rho_{person,companyCount}(\gamma_{person,count(Code)}(Executive))))$

iv
$R(industry) \ = \ \pi_{industry}(\sigma_{compantCount \ = \ 1}(\rho_{industry,companyCount}(\gamma_{industry,count(Code)}(Category)))$
$Res \ = \ \pi_{code,industry}(Category \ \bowtie \ R(industry))$

Q3.
i.
$R \ \cup \ (S \ \cap \ T)$, has:
minimal r, maximal r + min(s, t) tuples.

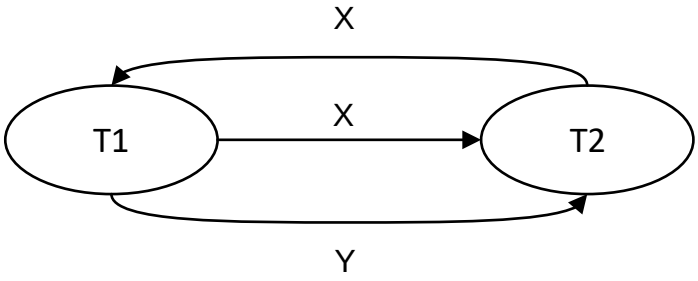
ii
$\sigma_c(R \ \times \ S)$ for some condition c, has:
minimal 0, maximal r*s tuples.

iii
$R \ - \ \pi_a(R \ \bowtie \ S)$ for some list of attributes a, has:
minimal 0, maximal r tupples.

Q4
i.

T1:	R(x)		W(x)		R(y)		W(y)
T2:		R(x)		W(x)		R(y)		W(x)

T2:R(x), T1:W(x) gives conflict $T2 \rightarrow T1$;
T1:W(x), T2(W(x) gives conflict $T1 \rightarrow T2$;
T2:R(y), T1W(y) gives conflict $T2 \rightarrow T1$.
This is not serializable due to multiple cycles, depicted as below:



ii.

T1:			W(y)			R(x)
T2:				R(y)	W(x)	
T3:	R(x)				R(d)	
T4:		W(y)	W(z)			

T3:R(x), T2:W(x) gives conflict $T3 \rightarrow T2$;
T4:W(y), T1:W(y) gives conflict $T4 \rightarrow T1$;
T1:W(y), T2:R(y) gives conflict $T1 \rightarrow T2$;
T2:W(x), T1:R(x) gives conflict $T2 \rightarrow T1$.
This is not serializable due to a cycle, depicted as below: