①

a)

B → D
D → A
A → BCD
BC → DE

$\Rightarrow B^+ = \{B, D, A, C, E\}$

b)

I_2

A → BC D

if remove B → $B \notin A^+$ ✗
if remove C → $C \notin A^+$ ✗
if remove D → $D \subseteq A^+$ ✓

افقد است D

A → BC
BC → DE
B → D
D → A

2_1

if remov C and D ε B^+ يحرم on

A → BC
B → E
B → D
D → A

3_2

A → BC
B → E ⎤ → B → DE
B → D ⎦
D → A

c)

$R_1 = (A, B, C)$
$R_2 = (A, D)$
$R_3 = (D, E, F)$

d)

$R_1 = (A, B, C)$
$R_2 = (B, D, E)$
$R_3 = (D, A)$
$R_4 = (A, F)$

②

R = (VisitNO, VisitDate, PatNO, Pat Age, Patcity, Prov No, Prov speciality, Diagnosis)

F : PatNo → PatAge, Patcity

ProvNO → Prov speciality

VisitNo → PatNO, Visit Date, PatAge, Patcity

VisitNO, ProvNO → Diagnosis

Candidate key = Visit No, Prov No

$R_1 = (PatNO, Pat Age, Patcity)$

$R_2 = (ProvNo, Prov speciality)$

$R_3 = (visit No, Pat NO, Visit Date)$

$R_4 = (visitNO, ProvNO, Diagnosis)$

③

$R = (v, w, x, y, z)$

$z \rightarrow y$

$y \rightarrow z$

$x \rightarrow y$

$x \rightarrow v$

$v, w \rightarrow x$

a) w, v

w, x

b)

$x \rightarrow y$

$y \rightarrow z$

$x \rightarrow v$

$\Rightarrow x^+ = \{x, y, z, v\}$

c)

اگر در 2NF باشد خارج ZNF این تجزیه به فرم

$R_1 \cap R_2 = x$ ، یا

Lossless
decomposition یا $R_1 = \begin{bmatrix} x \rightarrow y \\ x \rightarrow z \\ x \rightarrow x \end{bmatrix}$

---

④ $R = (x, y, z)$

x	y	z
6	4	8
6	4	2
6	6	8

$y \rightarrow x$

$z \rightarrow y$

$xy \rightarrow z$

$y \rightarrow x$ ✓

$z \rightarrow y$ ✗

1و $8 \rightarrow 4$ زیرا

3و $8 \rightarrow 6$

$xy \rightarrow z$ ✗

1و $6, 4 \rightarrow 8$ زیرا

2و $6, 4 \rightarrow 2$

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⑤ $R = (w, x, y, z)$

$z \rightarrow w$ $y \rightarrow z$ Candidate $= y$

$y \rightarrow xz$ $\Rightarrow$ $y \rightarrow w$ key

$xw \rightarrow y$ $y \rightarrow x$

$R_1 = (z, w)$ $R_2 = (y, z)$

$R_3 = (x, y)$

BCNF فرم

a)

در 3NF اجزاء به ازای هر

$\alpha \rightarrow \beta$ هر Attribute.

در $\beta - \alpha$، عضو Candidate key

است.

b)

خیر زیرا Z بدل super key نیست

$R_1 = (z, w)$ $R_2 = (y, z)$

$R_3 = (x, y)$

BCNF