CT2 Question

(checking 3NF & converting if not)

5. Consider the relation PLAYER with relational schema PLAYER (Player-no, Player-name, Team, Team-color, Coach-no, Coach-name, Player-position, Team-captain) and set of functional dependencies as follows;   (4)
F = {Player-no → Player-name, Player-no → Player-position, Player-no → Team, Coach-no → Coach-name, Team → Team-color, Team → Coach-no, Team → Team-captain}
Answer the question: Is PLAYER in 3NF? If not, convert into 3NF.

(labels above schema: C D E F G H A B)

$R(ABC\ DEFGH)$

$FD: \{ A \to B,\ A \to G,\ A \to C,\ E \to F,$
$\quad\quad C \to D,\ C \to E,\ C \to H \}$

core attributes = A

$(A)^+ = ABGCDEFH$

$\hookrightarrow$ only candidate key

Prime attributes = $\{A\}$

Non Prime attributes = $\{B, C, D, E, F, G, H\}$

1NF : ✓

$\hookrightarrow$ given relation is assumed to be in 1NF automatically.

2NF : ✓

$\hookrightarrow$ As there is only one candidate key, with a singular attribute, no subsets are possible.

$\hookrightarrow$ so no partial dependency in the form of _____ non prime.

↳ so no ...

subset of candidate key → non prime attributes

3NF :

transitive dependencies are in the form of

non-prime attributes → non-prime attributes

↳ transitive dependencies exist ✓

$E \to F$ $\quad$ $C \to DEH$

$E^+ = EF$ $\quad$ $C^+ = CDEHF$

$R_1 (EF)$ $\quad\quad$ $R_2 (CDEHF)$ $\quad\quad$ $R_3 (ABGEC)$
$CK = E$ $\quad\quad\quad$ $CK = C$ $\quad\quad\quad\quad$ $CK = A$

$E^+ = EF$ $\quad\quad$ $C^+ = CDEFH$ $\quad\quad$ $A^+ = ABGEC$

$F^+ = F$ $\quad\quad$ $D^+ = D$ $\quad\quad\quad$ $B^+ = B$

$\quad\quad\quad\quad$ $E^+ = EF$ $\quad\quad\quad$ $G^+ = G$

$E \to F$ $\quad\quad$ $F^+ = F$ $\quad\quad\quad$ $E^+ = EF$

↓ $\quad\quad\quad\quad$ $H^+ = H$ $\quad\quad\quad$ $C^+ = CDEHF$

3NF ✓

BCNF ✓ $\quad\quad$ $C \to DEFH$ $\quad\quad$ $A \to BCEG$

$\quad\quad\quad\quad\quad$ $E \to F$ ↴ $\quad\quad$ $C \to E$

$\quad\quad\quad\quad\quad$ transitive dependency

Decomposing $R_2 (CDEFH)$

$FD : \{ C \to DEFH , E \to F \}$

$$FD: \{ \quad C \rightarrow DEFH, \quad E \rightarrow F \}$$

$$E \rightarrow F$$
$$E^+ = EF$$

$R_{21} (EF)$
$CK = E$
$$E^+ = \cancel{E} F$$
$$F^+ = \cancel{F}$$

$E \rightarrow F$
3NF ✓ BCNF ✓

$R_{22} (CDHE)$ $CK = C$
$$C^+ = \cancel{C} D E \cancel{F} H$$
$$D^+ = \cancel{D}$$
$$E^+ = \cancel{E} \cancel{F}$$
$$H^+ = \cancel{H}$$

$C \rightarrow DEH$ 3NF ✓
BCNF ✓

Decomposing $R_3 (ABCEG)$

$$FD: \{ \quad A \rightarrow BCEG, \quad C \rightarrow E \}$$

$$C \rightarrow E$$
$$C^+ = CE$$

$R_{31} (CE)$
$CK = C$
$$C^+ = \cancel{C} \cancel{E}$$
$$E^+ = \cancel{E}$$

$C \rightarrow E$
3NF ✓
BCNF ✓

$R_{32} (CABG)$ $CK = A$
$$A^+ = A BC\cancel{E}G$$
$$B^+ = \cancel{B}$$
$$G^+ = \cancel{G}$$
$$C^+ = \cancel{C}\cancel{G}$$

$A \rightarrow BCG$ 3NF ✓
BCNF ✓

Final decompositions :

R(A BC DEFGH) :

D : { EF, CDEH, CE, ABCG }
      R1   R2   R3   R4   (renamed)

FD of R1 : { E → F }

FD of R2 : { C → DEH }

FD of R3 : { C → E }

FD of R4 : { A → BCG }