Convert the following relation to 3NF

$R(A, B, C, D, E)$

FD: $\{AB \rightarrow C,\ B \rightarrow D,\ E \rightarrow D\}$

1) Find the Candidate key first

Here ABE is the Key $\qquad AB\cancel{C}\cancel{D}E$

$ABE^+ = \{ABCDE\}$ and also

Non of the Subsets of ABE are Superkeys.

2) Identify whether given table is in 2NF

∴ check ~~for~~ the table R, and find any partial dependency is there or not.

Here $AB \rightarrow C$ is a partial dependency.

$B \rightarrow D$ is a partial dependency.

$E \rightarrow D$ is a partial dependency.

3) create new table for each partial dependency by taking the closure of the left hand side of each P.D

∴ $AB^+ = ABCD \qquad B^+ = BD \qquad E^+ = ED$

∴ $R_1(ABCD) \qquad R_2(BD) \qquad R_3(ED)$

4) ~~First~~ add one more table ~~by~~ which has the attributes from the original table ~~that~~ ~~are~~ excluding the right hand Side of each P.D

∴ The right hand side of F.D's are C, D

∴ AB~~C~~~~D~~E ∴ So remaining is ABE

This in one sense helps us to have a table with the primary key of the table.

∴ we have now total four tables

$R_1(\underline{AB}CD)$ $R_2(\underline{B}D)$ $R_3(\underline{E}D)$ $R_4(\underline{ABE})$

Here in R_1 AB is the key or primary key

in R_2 B " " " "

in R_3 E " " " "

in R_4 ABE " " " "

5) Now find the FD's for each individual subrelation

$R_1(\underline{AB}CD)$

$A^+ = A$ (trivial)
$B^+ = BD$ $B \to D$
$C^+ = C$ (trivial)
$D^+ = D$ (")
$AB^+ = ABCD$ $AB \to CD$
$AC^+ = AC$ ∝ (trivial)
$AD^+ = AD$ ∝
$BC^+ = BCD$ $BC \to D$ ∝ (redundant)
$BD^+ = BD$ ∝
$CD^+ = CD$ ∝
$ABC^+ = ABCD$ $ABC \to D$ (redundant) ∝
$ABD^+ = ABCD$ $ABD \to C$ (redundant)
$BCD^+ = BCD$ ∝
$ACD^+ = ACD$ ∝

F_1: $AB \to CD$
$B \to D$

$R_2(\underline{BD})$

$B^+ = BD$ ∴ $B \to D$
$D^+ = D$ (trivial)
$BD^+ = BD$ (trivial)

∴ F_2: $B \to D$

$R_3(\underline{ED})$

$E^+ = ED$ ∴ $E \to D$
$D^+ = D$ (trivial)
$ED^+ = ED$ (trivial)

∴ F_3: $E \to D$

$R_4(\underline{ABE})$

$A^+ = A$ (trivial)
$B^+ = B\cancel{D}$ (trivial)
$E^+ = E\cancel{D}$ (trivial)
$AB^+ = AB\cancel{C}\cancel{D}$ (trivial)
$BE^+ = BE\cancel{D}$ (trivial)
$AE^+ = AE\cancel{D}$ (trivial)

∴ F_4: Nothing

In the 5th step we are verifying whether there is anymore F.D in the subtables.

6) Now each table you verify whether any more P.D is there

$R_1(ABCD)$	$R_2(BD)$	$R_3(ED)$	$R_4(ABE)$
F_1: $AB \to CD$, $B \to D$	F_2: $B \to D$	F_3: $E \to D$	F_4: Nothing
Not in 2NF form because $B \to D$ is a P.D	in 2NF form	in 2NF form	in 2NF form

∴ Split the $R_1(ABCD)$ further

the P.D is $B \to D$

∴ take left hand side of P.D and take closure

$B^+ = BD$

∴ $R_5(\underline{B}D)$ and remaining attributes excluding the right hand side of P.D as one table

∴ $R_6(\underline{AB}C)$

Here in $R_5(\underline{B}, D)$ there is no P.D ∴ it is in 2NF

also $R_6(\underline{AB}C)$ has only one FD $AB \to C$

∴ in 2NF form

∴ Since $R_3(BD)$ and $R_5(BD)$ are redundant discard one table

∴ we get

$\boxed{R_5(BD),\ R_6(ABC),\ R_3(ED),\ R_4(ABE)}$

in 2NF form

7) Now Check whether the tables have Transitive dependency if its there Split that Subtable further

R_5(<u>B</u>D)	R_6(<u>AB</u>C)	R_3(<u>E</u>D)	R_4(<u>ABE</u>)
FD: $B \to D$	FD: $AB \to C$	FD: $E \to D$	FD: Nothing
in 3NF form	in 3NF form	in 3NF form	(so already in 3NF)

Since there is no transitive dependency in any of the Subtables we have that relations is now in 3NF form