1. Yes, since $(CDE)+ \rightarrow (CDEFABGHIJ)$ which is the entire set of attributes in R.

2. No, since $CD \subseteq CDE$ determines every attribute in RHS.

3. Consider $K = ABCDEFGHIJ$,
   $(K - J)+ = R$, remove J from K
   $(K - I)+ = R$, remove I from K
   $(K - H)+ = R$, remove H from K
   $(K - G)+ = R$, remove G from K
   $(K - F)+ = R$, remove F from K
   $(K - E)+ = R$, remove E from K
   $(K - A)+ = R$, remove A from K
   $(K - B)+ = R$, remove B from K
   $(K - C)+ \neq R$, cannot remove C
   $(K - D)+ \neq R$, cannot remove D
   Hence, CD is a key.

4. Set of attributes not in RHS in G, $X = (C, D)$. Every Key of R w.r.t G constaints C and D.
   Is (CD) a key? YES. We don't need to examine other combinations.

   Observation In G, $C+$ and $D+$ determine two disjoint sets and together, they determine E, hence covering R.

   Minimal FD
   1. Singleton RHS
   $F \rightarrow A$
   $F \rightarrow B$
   $CD \rightarrow E$
   $C \rightarrow F$
   $C \rightarrow G$
   $H \rightarrow I$
   $H \rightarrow J$
   $D \rightarrow H$
   2. Extraneous LHS attributes : None, since C+ = (F,G,A,B) and D+ = (H,I,J) are disjoint sets.
   3. Remove Redundant FDs.
   $CD \rightarrow E$ (non-redundant since (CD)+ does not cover E if we remove the FD from G).
   $C \rightarrow F$
   $C \rightarrow G$
   $H \rightarrow I$
   $H \rightarrow J$
   $D \rightarrow H$
   $F \rightarrow A$
   $F \rightarrow B$

5. C, D are prime attributes of R.

6. It is not in BCNF since LHS for every F in G is not a superkey. (Eg: $H \rightarrow IJ$)

7. It is not in 3NF since LHS for every F in G is not a superkey or the RHS is not always a prime attribute. (Eg: $H \rightarrow IJ$ and IJ are not prime attributes either.)

8 Let $D1 : CDE, D2 : CFG, D3 : DH, D4 : HIJ$, and $D5 : FAB$

In D1, $CD \rightarrow E$ is preserved. Similarly, in D2 : $C \rightarrow FG$, D3: $D \rightarrow H$, D4 : $H \rightarrow IJ$ and D5: $F \rightarrow AB$ are preserved. Considering the UNION of all these preserved dependencies, we get set G. Hence, the decomposition is dependency preserving in nature.

Table 1: Lossless Decomposition Check

	A	B	C	D	E	F	G	H	I	J
D1	a	a	a	a	a	a	a	a	a	a
D2	a	a	a			a	a			
D3				a				a	a	a
D4								a	a	a
D5	a	a				a				

Using the algorithm (1) as described in class, we observe a row with all distinguished variables after iteration 1 is in red and iteration 2 is in blue. Hence, the decomposition is lossless too.

Finally,
D1 is in BCNF since CD is a superkey.
D2 is in BCNF since C is a superkey.
D3 is in BCNF since D is a superkey.
D4 is in BCNF since H is a superkey.
D5 is in BCNF since F is a superkey.