Exercise 1: Consider a relation \( R(A, B, C, D, E) \) with the following dependencies:

\[
AB \rightarrow C, \ CD \rightarrow E, \ DE \rightarrow B
\]

Find all possible keys of the relation.

Exercise 2: Consider the universal relation \( R = \{A, B, C, D, E, F, G, H, I, J\} \) and the set of functional dependencies:

\[
\begin{align*}
A, B & \rightarrow C \\
A & \rightarrow D, E \\
B & \rightarrow F \\
F & \rightarrow G, H \\
D & \rightarrow I, J
\end{align*}
\]

What is the key for \( R \)? Decompose \( R \) into 2NF, then 3NF relations.

Exercise 3: Consider the universal relation \( R = \{A, B, C, D, E, F, G, H, I, J\} \) and the set of functional dependencies:

\[
\begin{align*}
A, B & \rightarrow C \\
B, D & \rightarrow E, F \\
A, D & \rightarrow G, H \\
A & \rightarrow I \\
H & \rightarrow J
\end{align*}
\]

What is the key for \( R \)? Decompose \( R \) into 2NF, then 3NF relations.

Exercise 4: Consider the relation \( R = \{\text{ShipName}, \text{ShipType}, \text{VoyageID}, \text{Cargo}, \text{Port}, \text{Date}\} \) and the set of functional dependencies:

\[
\begin{align*}
\text{ShipName} & \rightarrow \text{ShipType} \\
\text{VoyageID} & \rightarrow \text{ShipName}, \text{Cargo} \\
\text{ShipName}, \text{Date} & \rightarrow \text{VoyageID}, \text{Port}
\end{align*}
\]

What is the key for \( R \)? Decompose \( R \) into 2NF, then 3NF relations.
**Exercise 5:** Consider the relation $R$, which has attributes that hold schedules of courses and sections at a university.

$$R = \{\text{CourseNo, SecNo, OfferingDept, CreditHours, CourseLevel, InstructorSSN, Semester, Year, Days_Hours, RoomNo, NoOfStudents}\}$$

Suppose that the following functional dependencies hold on $R$:

- $\{\text{CourseNo}\} \rightarrow \{\text{OfferingDept, CreditHours, CourseLevel}\}$
- $\{\text{CourseNo, SecNo, Semester, Year}\} \rightarrow \{\text{Days_Hours, RoomNo, NoOfStudents, InstructorSSN}\}$
- $\{\text{R N D H RoomNo, Days_Hours, Semester, Year}\} \rightarrow \{\text{InstructorSSN, CourseNo, SecNo}\}$

Try to determine which sets of attributes form keys of $R$. How would you normalize this relation?

**Exercise 6:** Consider the following relation for published books:

$$BOOK (\text{Book_title, Authorname, Book type Book_type, Listprice, Author_affil, Publisher})$$

Author_affil refers to the affiliation of the author

Suppose the following dependencies exist:

- $\text{Book_title} \rightarrow \text{Publisher, Book_type}$
- $\text{Book Book_type} \rightarrow \text{Listprice}$
- $\text{Author_name} \rightarrow \text{Author-affil}$

Find keys and normalize this relation into 3NF.