1. Each schema is a decomposition of $R = (A, B, C, D, E, F)$. For each schema and set of functional dependencies, indicate the highest normal form of the schema and whether or not it is a lossless join and/or dependency preserving by placing an X in the appropriate blanks. You may assume the domain of each attribute is integer.

(a) $\mathcal{F} = \{A \rightarrow BCDEF\}$

\[
\begin{array}{cccccccc}
\text{1NF} & \text{3NF} & \text{BCNF} & \text{4NF} & \text{5NF} & \text{LJ} & \text{DP} \\
\end{array}
\]

(b) $\mathcal{F} = \{A \rightarrow BC\}$

\[
\begin{array}{cccccccc}
\text{1NF} & \text{3NF} & \text{BCNF} & \text{4NF} & \text{5NF} & \text{LJ} & \text{DP} \\
\end{array}
\]

(c) $\mathcal{F} = \{A \rightarrow BC, D \rightarrow EF, F \rightarrow A\}$

\[
\begin{array}{cccccccc}
\text{1NF} & \text{3NF} & \text{BCNF} & \text{4NF} & \text{5NF} & \text{LJ} & \text{DP} \\
\end{array}
\]

(d) $\mathcal{F} = \{A \rightarrow BC, D \rightarrow EF, F \rightarrow A\}$

\[
\begin{array}{cccccccc}
\text{1NF} & \text{3NF} & \text{BCNF} & \text{4NF} & \text{5NF} & \text{LJ} & \text{DP} \\
\end{array}
\]

(e) $\mathcal{F} = \{A \rightarrow BC, D \rightarrow EF, F \rightarrow A\}$

\[
\begin{array}{cccccccc}
\text{1NF} & \text{3NF} & \text{BCNF} & \text{4NF} & \text{5NF} & \text{LJ} & \text{DP} \\
\end{array}
\]

(f) $\mathcal{F} = \{A \rightarrow BC, D \rightarrow EF, F \rightarrow A\}$

\[
\begin{array}{cccccccc}
\text{1NF} & \text{3NF} & \text{BCNF} & \text{4NF} & \text{5NF} & \text{LJ} & \text{DP} \\
\end{array}
\]

2. What is the definition of 1NF?

3. Using $R = (A, B, C, D, E, F)$, provide a set of functional dependencies such that the schema is in 4NF but not 5NF.
4. Decompose the relation $R = (A, B, C, D, E, F)$ with the functional dependencies $\mathcal{F} = \{AB \rightarrow CD, D \rightarrow EF, F \rightarrow A\}$ into a BCNF decomposition following the algorithm in the book.

5. Assume there exists two entities, $E_1$ and $E_2$, and a many-to-many relationship between them. Assume $E_1$ has attributes $K_1$ (the primary key), $A_1$ and $D_1$ (a derived attribute). Assume $E_2$ has $K_2$ (the primary key), $A_2$, and $M_2$ (a multivalued attribute). Show the result of aggregation applied to the relationship.
6. List all of the tables (with their attributes) that would be created to represent the aggregation of Question 5. The SQL statements to create the tables are not required.

7. Prove or disprove the Superkey decomposition theorem, which is if $S$ is a set of attributes such that $S \rightarrow R$, and $K$ is a set of attributes such that $K \subset S$ and $K \rightarrow R$, then $S - K \not\rightarrow R$.  


8. A two-layer web application architecture combines (a) web server and database (b) web server and application server (c) application server and database (d) data and server (e) all of the above (f) none of the above which are separate in three-layer architectures.

9. A cookie (a) is stored on the client (b) can be used to store session information (c) can be invalidated by the server (d) all of the above (e) exactly two of the above (f) none of the above

10. Server-side scripts can (a) be seen when the web page source is viewed (b) dynamically modify the appearance of web pages (c) access data on the server (d) all of the above (e) exactly two of the above (f) none of the above

11. Client-side scripts can (a) be seen when the web page source is viewed (b) dynamically modify the appearance of web pages (c) access data on the server (d) all of the above (e) exactly two of the above (f) none of the above

12. MVC stands for (a) Model-View-Concept (b) MetaVisual Concept (c) Model-Visual-Concept (d) Mental-View-Controller (e) none of the above

13. The data access layer connects the (a) business logic layer with the database (b) web server with the database (c) web server with the web browser (d) none of the above

14. An SQL Injection attack (a) is only possible in web-database applications (b) requires detailed knowledge about the SQL statement (c) can be severely reduced or prevented by using prepared statements (d) all of the above (e) exactly two of the above (f) none of the above

15. Cross-site scripting (a) is only possible in web-database applications (b) requires detailed knowledge about the SQL statement (c) can be severely reduced or prevented by using prepared statements (d) all of the above (e) exactly two of the above (f) none of the above

16. An audit trail (a) is a log of all changes to the data (b) identifies who carried out each operation (c) aids in fixing damage caused by erroneous updates (d) all of the above (e) exactly two of the above (f) none of the above

17. Public key encryption (a) uses the same key to encrypt and decrypt data (b) is computationally faster than AES (c) requires a secure mechanism for key transmission (d) all of the above (e) exactly two of the above (f) none of the above