Databases

(a) Define the concept of a functional dependency. [2 marks]

(b) Let $R(A, B, C, D, E, F)$ be a database schema with functional dependencies

\[ A, B \rightarrow C \]
\[ B, C \rightarrow A, D \]
\[ D \rightarrow E \]
\[ C, F \rightarrow B \]

(i) Compute the closure of \{A, B\}. [3 marks]

(ii) Is $A, B \rightarrow D, F$ a functional dependency over $R$? Justify your answer. [1 mark]

(c) Define the concept of a multivalued dependency. [2 marks]

(d) Suppose the functional dependency $X \rightarrow Y$ holds on a relational schema. Does this mean that the multivalued dependency $X \rightarrow Y$ holds? Justify your answer. [3 marks]

(e) Define the concept of a lossless-join decomposition. [3 marks]

(f) Let $R(X)$ be a database schema, where $X$ is a set of attributes. Show that $S(Y \cup Z)$ and $T(Y \cup (X - Z))$ is a lossless-join decomposition of $R(X)$ if and only if the multivalued dependency $Y \rightarrow Z$ holds over $R$. [6 marks]