5 Databases (KM)

This question explores *Heath's Rule*, which states that if $R(X,\ Y,\ Z)$ satisfies the functional dependency $X \to Y$, where X, Y, and Z are disjoint non-empty sets of attributes, then

$$R = \pi_{X,Y}(R) \bowtie_X \pi_{X,Z}(R),$$

where $\bowtie_X$ is the natural join on the attributes of X.

(a) What is meant by the functional dependency $X \to Y$? [2 marks]

(b) Define the natural join operation $\bowtie_X$. [2 marks]

(c) Suppose that the functional dependency $X \to Y$ holds and we use Heath's rule to justify replacing the schema $R(X,\ Y,\ Z)$ with $R_1(X,\ Y)$ and $R_2(X,\ Z)$.

(i) Give two possible advantages for this schema change. [2 marks]

(ii) Give two possible disadvantages for this schema change. [2 marks]

(iii) Is X a key for R_1? Explain. [2 marks]

(iv) Is X a key for R_2? Explain. [2 marks]

(d) Prove that Heath's Rule always holds. [8 marks]