Part I
A. Draw the complete ER-diagram for a library database specified in each of the following step.
   You don't have to use EER, but you may add-in more entities where you think appropriate.
   Preferably using a free diagram drawing tool.

1. The library keeps each book's information like ISBN number, book title, authors, publisher, and
dition. Each book has a number of copies available to be borrowed. It also contains a history of
borrowers.

2. Each Member is identified by an assigned card number. The library also tracks member's full name,
phone number, member since date, borrow history and composite mailing address which include street,
zipcode, city, and state. As well as which region does this customer belong to; it depends on the mailing
address. Each member may borrow a maximum of 5 books at a time.

3. Each Region is also identified by an assigned region_ID. It contains the zipcode, city, state, country,
and region name. More than one zipcode and city may belong to one region. One region can include up
to 5 different zipcode.

4. The books belong to various Categories. Each book might belong to one or more Categories, for
instance, "Database System" are under both Tech and College Courses.

5. Each Category has a name, a brief description, and number of books in this category.

6. There's information on which member has borrowed which book, on which date, return date, due
date.

B. Translate the diagram to Relational Model in 3NF.

C. Give one reasonable example of a recursive relationship, and draw the ER diagram for this situation.
   Explain briefly.

D. Give one reasonable example of a relationship with a cardinality ratio *:* (many to many), and draw
   the ER diagram for this situation. Explain briefly.

E. Give one reasonable example of an entity set that has two disjoint subclasses with optional
   participation. Explain briefly.
Part II
Consider the relational schema $R = ABCDEGHJ$ has following functional dependencies set $F$,

1. $D \rightarrow CG$
2. $C \rightarrow G$
3. $AB \rightarrow E$
4. $AC \rightarrow E$
5. $GE \rightarrow H$
6. $AH \rightarrow J$
7. $B \rightarrow DC$

F. Does following dependencies belong to $F^+$? Show work to prove your answer.
   $AD \rightarrow J$

G. Find two attributes of $R$ that do not functionally depend on $B$. Show work to prove your answer.

H. Is it possible for two tuples of the relation $R$ have the same value of attributes $A$ and $D$, but different value of $H$?

I. Find all candidate keys for $R$. Prove they’re candidate keys and there’s no more.