CSC 321 – Database Management Systems
Sample Test 1

This sample test has a few more "cascading" questions than I plan the actual test to have (problems where if you mess up one part, the following parts will likely be wrong too since they rely on earlier parts).

1. Consider a flight reservation system. The system should keep track of customers' data, flight information, and seats reserved by the customer. A reservation has a unique number and is for a single passenger. Customers can book tickets on flights on specific days. They may indicate preferred airlines and maximum amount they are willing to pay. Each customer is identified by his/her credit card number, and must give a contact phone number and address. A flight is operated by an airline, has a flight number (unique only within that airline), and operates on a given set of days of the week. The reservation must contain the row and the seat information of each passenger and the price paid for the reservation. A customer may have multiple reservations.

a. You need to build an E-R model to represent entity sets and their relationship sets of the flight reservation database, including mapping cardinalities and primary keys.

b. Transform your E-R model into relational tables, give the schemas, underline the primary keys, and mark the referential integrity (foreign key) constraints

c. Suppose you want to know the name of the passengers, the airline, the flight number, and the seat assignments of all the passengers who paid $1,000 or more for a single ticket. Give an SQL query and relational algebra statement that answer this question.

> OOPS! There is no name in the description given above. Assume it is an attribute of the Traveler (AKA Passenger) relation.

2. Describe the difference between natural join and theta-join when the condition of the theta-join is to equate the attributes appearing in the schemas of both relations.

3. Consider relation R(A, B, C) with n tuples, and relation S(C,D,E) with m tuples. Give the schema (list of attributes) and the minimum and maximum number of tuples to the following expressions:
   a. R x S
   b. $R \cup S$
   c. $\pi_{ABD} (\sigma_C (R \times S))$ for some condition C

4. Provide an example of a relation that will exhibit 'deletion anomaly' and discuss why a deletion anomaly is problematic.

5. Excited by what you are learning in CSC 321/621, you decide to create a database to track the songs your favorite band plays in its live concerts. Since you decide that E/R diagrams are for kids, you decide to create a relation schema directly for your database. After much consideration, you believe that a single schema will serve: Concerts(City, Venue, Year, Month, Date, Song, Album).

   In this relation, City (e.g., "Winston Salem") and Venue (e.g., "Ziggys") record where the concert took place and Year, Month, and Date keep track of when the concert took place. The idea is that these five attributes uniquely specify a concert. The attribute Song records the name of a song performed at a concert. You add the attribute Album to record which album the song belongs to. Perfect!

   However, after using the database for a few months, you realise that your band (and the real world) have some characteristics that you should model in your database. Convert each of the next four sentences about Concerts into a functional dependency. You can use the first letter of each attribute as an abbreviation for the attribute. Consider each of these four sentences independently. If you cannot write down a functional dependency, say so, and explain why you cannot, if possible. Do not assume any other constraints, even if they seem reasonable to you.

   a. Each song appears in at most one album. In other words, the band does not repeat the same song in different albums.

   b. A city does not have two venues with the same name. In other words, City and Venue serve to identify the location of a concert uniquely.

   c. In an effort to please its fans, the band plays at most one song from any album in a given concert.

   d. The manager books the band in any city at most once every year.

For the next two parts of this question, assume that all the functional dependencies you specified in the previous parts hold in Concerts, as do any dependencies that follow from them. However, no other dependencies hold in Concerts.

   e. What are candidate keys for Concerts?

   f. You realize it is probably better, in data sense, that you decompose Concerts into multiple relations. Here is a possible decomposition into two relations:

      Concerts1(City, Venue, Year, Month, Date)
      Concerts2(City, Year, Song, Album)

(continued on next page)

For each relation Concerts1 and Concerts2, indicate whether they are in 3NF, 2NF, or (neither 3NF or 2NF). Use the generalized definitions of 2NF and 3NF.