Problem 1. [40pts]

Consider a healthcare database. For every person, we need to record, the person’s SSN, birthdate, gender, height and weight. For male records, the users also want to know the percent of body muscle mass, while for female records they want to know the testosterone level. Moreover, our database should be able to store or deduce the biological mother, father and children of each person. Finally, there are different tests (with unique names, like ‘red-blood-cell-count’, ‘cholesterol-level’), which may be administered zero or more times on each person. For each administered test, our users need to know the name of the test, the date, the person and the result (assuming this is always numerical) of the test.

Complete the following tasks:

1. (20 pts) create the E-R diagram, indicate keys and weak entities (if any).
2. (20 pts) turn the E-R diagram into tables (relational model schema), and then write the SQL statement to create these relations (with primary key and foreign key constraint).

Problem 2. [40pts]

Suppose that you need to design a database for an auto-repair mechanical shop. The relevant information that must be stored is:

- Every car has a vehicle identification number (VIN), and each car is of specific model.
- The shop accommodates a number of car models, and each model is identified by a model tag (e.g. Fusion) and has a type (e.g. sedan, suv) and a make (e.g. Ford).
- A number of technicians and accountants work at the shop. You need to store the name, SSN, address, phone number, and salary of each technician and accountant.
- Each technician is an expert on one or more car model(s), and his or her experience may overlap with that of other technicians. This information must also be recorded. We also want to record the skill level of a technician (a single integer value for his/her overall skill rating over all models he/she is an expert of).
- The shop’s accountants must have an annual accounting policy training. For each account, you must store the date of the most recent training he/she has attended.
- All employees (including technicians and accountants) purchase healthcare insurance from one insurance provider. You must store the healthcare policy number of each employee.
- The shop has a number of tests that are used to ensure that vehicles are in good condition. Each test has a test number, a name, and a maximum possible score.
- The shop keeps track of each time a given vehicle is tested by a given technician using a particular test. For each testing event, the information needed is the date, the number of hours the technician spent doing the test, and the score the car received on the test.

1. (20 pts) Give an E/R diagram for this database. Very briefly explain the intuitive meaning of any entity and relationship sets. Make sure to list the keys and weak entities (if any).
2. (20 pts) Turn the E-R diagram into tables (relational model schema). Indicate primary and candidate keys. Give the SQL statements to create the corresponding relations in a relational
DBMS. The primary key and foreign key (if any) must be specified.

**Problem 3.** [20 points]

a) (10 points) Draw a (simple) E-R diagram that results in a primary key/foreign key constraint to be created between tables. Show the SQL statements that create the tables including the foreign key and primary key indications.

b) (5 points) For the relational tables you generated in question 1(a), Describe which insert and delete operations in this database must be checked to ensure that referential integrity is not violated for that foreign key. Please state specifically which operations on which relations can cause problems.

c) (5 points) Consider a database of employees in which we need to record information about employee’s address. Name one condition which would make you consider “address” an entity set of its own rather than an attribute of the employee entity set.