Database Design

1. An Internet store sends emails to customers and would like to use a database to keep track of which messages are sent to which customers. A message has a message id (mid), a subject (subject), and a body (body). A customer is uniquely identified by the email address (email), and customer's data includes the attributes name, gender, householdSize, and phone-number. A person can have more than one phone-number. When an email is sent, the date (sendDate) is recorded. A message can be sent to many customers, and customers receive many messages.

   i) Give an E-R diagram that completely describes the entities and relationships for this scenario.
   ii) Reduce the E-R diagram that you obtained to a relational schema. In the schema, make sure you show primary keys and referential integrities (foreign keys).

2. A university registrar's office maintains data about the following entities:
   1. courses, including number, title, credits, syllabus, and prerequisites;
   2. course offerings, including course number, year, semester, section number, instructor(s), timings, and classroom;
   3. students, including student-id, name, and program;
   4. instructors, including identification number, name, department, and title.

   Further, the enrollment of students in courses and grades awarded to students in each course they are enrolled for must be appropriately modeled.

   i) Construct an E-R diagram for the registrar's office. Document all assumptions that you make about the mapping constraints.
   ii) Reduce the E-R diagram that you obtained to a relational schema. In the schema, make sure you show primary keys, and referential integrities (foreign keys).

3. The Prescriptions-R-X chain of pharmacies has offered to give you a free lifetime supply of medicine if you design its database. Given the rising cost of health care, you agree. Here's the information that you gather:
   1. Patients are identified by an SSN, and their names, addresses, and ages must be recorded.
   2. Doctors are identified by an SSN. For each doctor, the name, specialty, and years of experience must be recorded.
   3. Each pharmaceutical company is identified by name and has a phone number.
   4. For each drug, the trade name and formula must be recorded. Each drug is sold by a given pharmaceutical company, and the trade name identifies a drug uniquely from among the products of that company. If a pharmaceutical company is deleted, you need not keep track of its products any longer.

5. Each pharmacy has a name, address, and phone number.
6. Every patient has a primary physician. Every doctor has at least one patient.
7. Each pharmacy sells several drugs and has a price for each. A drug could be sold at several pharmacies, and the price could vary from one pharmacy to another.
8. Doctors prescribe drugs for patients. A doctor could prescribe one or more drugs for several patients, and a patient could obtain prescriptions from several doctors. Each prescription has a date and a quantity associated with it. You can assume that, if a doctor prescribes the same drug for the same patient more than once, only the last such prescription needs to be stored.
9. Pharmaceutical companies have long-term contracts with pharmacies. A pharmaceutical company can contract with several pharmacies, and a pharmacy can contract with several pharmaceutical companies. For each contract, you have to store a start date, an end date, and the text of the contract.
10. Pharmacies appoint a supervisor for each contract. There must always be a supervisor for each contract, but the contract supervisor can change over the lifetime of the contract.

i) Draw an ER diagram that captures the preceding information.
ii) Reduce the E-R diagram that you obtained to a relational schema. In the schema, make sure you show primary keys, and referential integrities (foreign keys)