2022 Database System Qualifying Exam

1. (12%) What are the three languages that SQL provides?

2. (20%) The tuples in the relations must meet certain restrictions. If the tuples in all relations meet these constraints, we call the database "consistent". What are the five constraints in the relational model? Please explain them in detail. (20%)

3. (25%) Draw an ER diagram to design a medical system, which needs to satisfy all the following descriptions and constraints:
   - ✓ There are four entity types: Doctor, InPatient, TestItem, Room.
   - ✓ The Doctor entity has three attributes: dId, dName, gender. The attribute value of dId is unique.
   - ✓ The InPatient entity has three attributes: pId, pName, contact. There can be multiple contacts for a patient, and the name and phone of the contact must be recorded. The attribute value of pId is unique. Each patient must have an attending doctor.
   - ✓ The TestItem entity has two attributes: tId, tName. The attribute of tId is unique. An inpatient can have multiple test items, and the test date must be recorded.
   - ✓ The Room entity has two attributes: rNo, level. The attribute value of rNo is unique.
   - ✓ There are usually several beds in a room, and one inpatient occupies one bed.
   - ✓ Some doctors have mentors, but only one.

4. (15%) Referring to the database schema in Figure 1 (on the last page), please express the following query in SQL: (1.) List the names of the members who have bought "Jolin Album". (2.) List the transaction number and membership number of the 2004 online transaction (that is, the transaction method is 'cart'). (3.) List the transaction number, product name, product unit price, transaction amount, and sale price of the transaction with a total sale price of more than NTD$ 400.

5. (16%) Please explain the definitions of the 1NF, 2NF, 3NF and BCNF.

6. (12%) Consider the following relation schema for car sales: CarSale (state, plateNo, customer, salesperson, taxRate, model, dateSold, discount). There are the following function dependencies: {salesperson, model, dateSold}→ {discount}; state→taxRate; {state, plateNo}→{customer, salesperson, model, dateSold}. I would like to ask (1.) Which attributes make up the key? (2.) Please decompose CarSale into relation schema that satisfy 2NF (but not 3NF). (3.) Please decompose CarSale into relation schema that satisfy 3NF. (12%)

```
CREATE TABLE Member
    (mId            CHAR(8)             NOT NULL,
    pId             CHAR(10),           NOT NULL,
    name            VARCHAR(8)          NOT NULL,
    birthday        DATE,
    phone           VARCHAR(10),
    address         VARCHAR(40),
    email           VARCHAR(20),
    introducer      CHAR(8),
    PRIMARY KEY (mId),
    UNIQUE (pId),
    FOREIGN KEY(introducer)   REFERENCES Member(mId)
            ON DELETE SET NULL ON UPDATE CASCADE);

CREATE TABLE Transaction
    (tNo            CHAR(5)             NOT NULL,
    transMid        CHAR(8)             NOT NULL,
    transTime       DATETIME            NOT NULL,
    method          VARCHAR(5)          NOT NULL,
    bankId          VARCHAR(14),
    bankName        VARCHAR(20),
    cardType        VARCHAR(10),
    cartId          VARCHAR(10),
    dueDate         DATE,
    PRIMARY KEY (tNo),
    FOREIGN KEY (transMid) REFERENCES Member(mId));

CREATE TABLE Product
    (pNo            CHAR(6)             NOT NULL,
    pName           VARCHAR(30),
    unitPrice       DECIMAL(10, 2),
    category        VARCHAR(20),
    PRIMARY KEY (pNo),
    CONSTRAINT UnitPrice_Check
            CHECK (unitPrice>100));

CREATE TABLE Author
    (pNo            CHAR(6)             NOT NULL,
    name            VARCHAR(8)          NOT NULL,
    PRIMARY KEY (pNo, name),
    FOREIGN KEY (pNo) REFERENCES Product(pNo));

CREATE TABLE Browse
    (mId    CHAR(8)    NOT NULL DEFAULT 'a0910001',
    pNo     CHAR(6)             NOT NULL,
    browseTime   DATETIME       NOT NULL,
    PRIMARY KEY (mId, pNo, browseTime),
    FOREIGN KEY (mId) REFERENCES Member(mId)
        ON DELETE SET DEFAULT ON UPDATE CASCADE,
    FOREIGN KEY (pNo) REFERENCES Product(pNo));

CREATE TABLE Cart
    (mId            CHAR(8)             NOT NULL,
    cartTime        DATETIME            NOT NULL,
    tNo             CHAR(5),
    PRIMARY KEY (mId, cartTime),
    FOREIGN KEY (tNo) REFERENCES Transaction(tNo)
            ON UPDATE CASCADE,
    FOREIGN KEY (mId) REFERENCES Member(mId)
            ON DELETE CASCADE ON UPDATE CASCADE);

CREATE TABLE Order
    (pNo            CHAR(6)             NOT NULL,
    mId             CHAR(8)             NOT NULL,
    cartTime        DATETIME            NOT NULL,
    amount          INT         NOT NULL DEFAULT   1,
    PRIMARY KEY (pNo, mId, cartTime),
    FOREIGN KEY (pNo) REFERENCES Product(pNo),
    FOREIGN KEY (mId, cartTime) REFERENCES Cart(mId, cartTime));

CREATE TABLE Record
    (tNo            CHAR(5)             NOT NULL,
    pNo             CHAR(6)             NOT NULL,
    salePrice       DECIMAL(10, 2)      NOT NULL,
    amount          INT                 NOT NULL,
    PRIMARY KEY (tNo, pNo),
    FOREIGN KEY (tNo) REFERENCES Transaction(tNo),
    FOREIGN KEY (pNo) REFERENCES Product(pNo));
```

Fig. 1. Database schema of the online bookstore