Name:
CWID:

Final Exam Fall 2023
CS425: Database Organization, IIT.edu

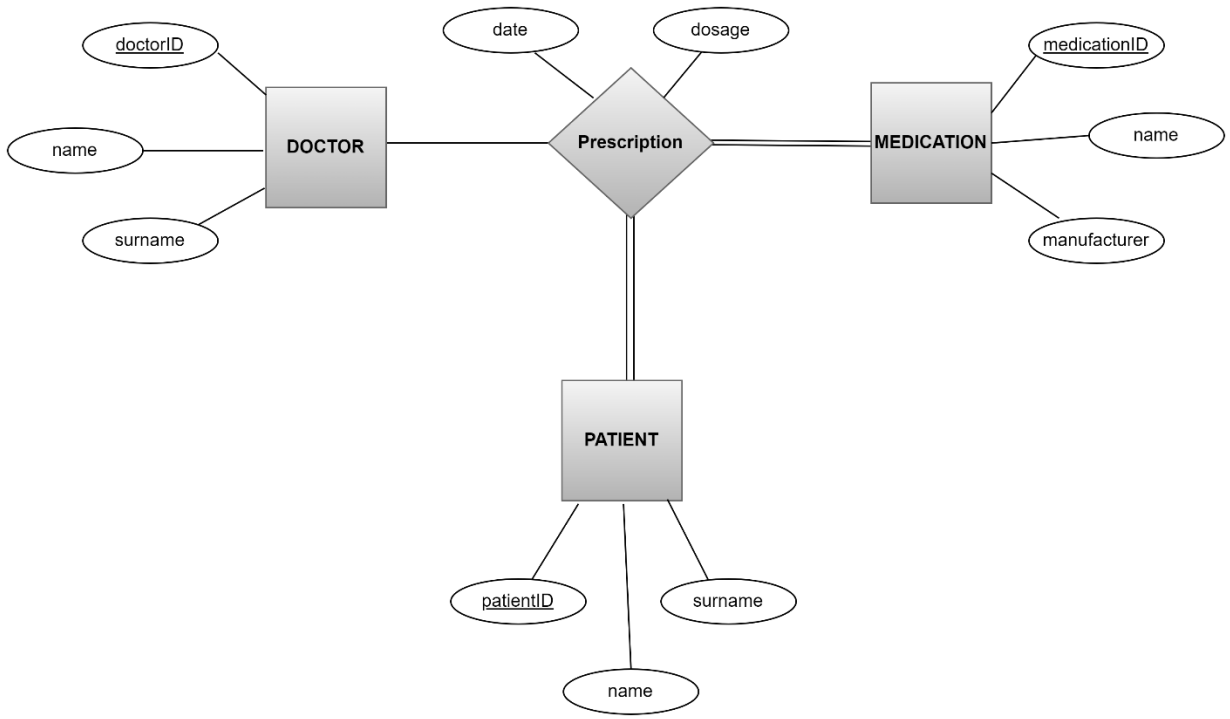
EXAM INSTRUCTIONS

Answer ALL questions.

Time allowed: 2 hours.

Part I (20 points)

1. Explain the relationship in the Entity-Relationship Diagram (ERD) in your own words [4 pts].



2. Write down all business rules that are represented in the above ERD [6 pts].

3. Which normal form does the ERD satisfies? Provide an explanation [4 pts].

4. What is the different between the third normal form (3NF) and Boyce-Codd normal form (BCNF)? [4 pts].

Part II (30 points)

5. Create an Entity Relationship Diagram (ERD) using CHENs notation after studying the Carbon Accounting Database (ACME Technologies) business rules below. ACME Technologies is a group of companies manufacturing body virtual reality suits, communicators, movie projectors and many other consumer gadgets. Also, you are required to present the relation schemas including primary keys (PKs) and foreign keys (FKs) that fully represent the database at a logical level.

   Carbon Accounting Database (ACME Technologies) business rules include:

   a. A single database will be created that will track the carbon footprints of all the companies registered with the ACME Technologies group.
   b. Each company has a name and consists of one or more departments.
   c. Each company has one employee that is the CEO of the company. That employee may only be the CEO of one company, and not all employees are CEOs.
   d. Each department must have exactly one employee who is the Green Champion – the person responsible for any initiatives related to the carbon footprint of the department. That employee may only be the Green Champion for a single department, and not all employees are Green Champions.
   e. The following data must be recorded for each employee: name and surname.
   f. Some departments have products that they are responsible for. Each product must be allocated to exactly one department and must have a description.
   g. The main purpose of the database is to record carbon transactions. Each carbon transaction is accounted for by exactly one department. Optionally, the single product that the carbon transaction relates to can also be recorded.
   h. The following data must be recorded for each carbon transaction: date and value.

Rubric	**pts**
Entities	5
Relationships with correct participation and cardinalities	12
Relation schemas showing PKs and correct FK postings	12
Correct CHEN notation	1
Total	**30**

[Draw Entity Relationship Diagram (ERD) here]

[Write the relation schemas here, in the format below]

Student (<u>StudentID</u>, Name, BirthDate, etc.)

<u>Part III (25 points)</u>

6. Normalize the data given in the table below to the third normal form (3NF). Show all the steps in your normalization (i.e., 1NF, 2NF and 3NF) and the resulting tables (must show data in each table). Clearly label each normal form so that marks can be awarded at each stage of your normalization.

UnitID	StudentID	Date	Tutor	Topic	Venue	Grade	Book	Email
Unit1	S001	24/09	T1	ALG	124	20	Donnah	tut1@tech.net
Unit2	S001	10/10	T3	FDs	131	10	Stonebraker	tut3@tech.net
Unit1	S004	24/09	T1	ALG	124	70	Donnah	tut1@tech.net
Unit3	S002	20/10	T3	NFs	132	40	Codd	tut3@tech.net
Unit4	S002	13/12	T4	SQL	301	70	Cengage	Tut4@tech.net

Part IV (25 points)

7. Given the following relation R(A, B, C, D, E, F) and the set of functional dependencies . F = {DF → C, BC → F, E → A, ABC → E} that hold on R.

    a. Is R in 1NF/2NF/3NF/BCNF? Provide an explanation [4 pts].

    b. Find all valid candidate key(s) for R [6 pts].

8. Consider the relation schema R(A, B, C, D, E, F) with set F of functional dependencies as follows:

F = {
A → B
B → C
CD → E
BCD → F
C → AD
}

Which of the following functional dependencies will NOT HOLD in the above relation (**Tick or circle all that apply**) [5 pts]

a. A -> E

b. CD -> EF

c. A -> ABCDEF

d. AD -> F

e. B -> CD

f. None

9. Consider the relation R (A, B, C, D, E) and a set of functional dependencies F = {A → C, AB → C, C → DI, CD → I, EC → AB, EI → C}.
Compute the canonical (minimal) cover of F [10 pts].

END