Part 1: Multiple Choice (102 points - 3 points per question)

(B) 1. Which is an entity in a restaurant? (A) address (B) menu (C) rating (D) none of above

(C) 2. Which is true?
   (A) Database system is a collection of related data. (B) Metadata is the state of data.
   (C) Database instance changes every time the database is updated. (D) none of above

(C) 3. Which is not a function of a DBMS?
   (A) database definition (B) database construction (C) data abstraction (D) database manipulation

(A) 4. Which is true?
   (A) Potential for enforcing standards is an implication of using database approach. (B) Schema is also called extension.
   (C) Database schema refers to the content of a database at a moment in time. (D) none of above

(A) 5. In the three-schema architecture, which schema can have multiple view?
   (A) External schema (B) Conceptual schema (C) Internal schema (D) none of above

(C) 6. Which is in DBMS-independent design process?
   (A) transaction Implementation (B) application program design (C) requirement analysis (D) none of above

(B) 7. Which stores the presentation layer of the application?
   (A) application server (B) Web interface (C) database server (D) none of above

(A) 8. Which is usually to represent a relationship in an ER diagram? (A) verb (B) noun (C) adjective (D) proposition

(D) 9. An entity whose existence depends on another entity is called:
   (A) codependent entity (B) variant entity (C) strong entity (D) weak entity

(A) 10. The ______ of a relationship type is the number of participating entity instances.
   (A) cardinality (B) degree (C) identification (D) participation

(D) 11. Which is true?
   (A) A relationship type is the current state of a relationship. (B) A relationship cannot have more than one attribute.
   (C) A relationship instance identifies certain relationship constraints. (D) none of above

(A) 12. Which type of relationships between an auction item and a bid?
   (A) one-to-many (B) many-to-many (C) many-to-one (D) one-to-one

(C) 13. Which of the following is false?
   (A) The EER is a type of conceptual data models. (B) E. F. Codd first proposed the relation model.
   (C) An entity can exist in the database merely by being a member of a subclass. (D) none of above

(B) 14. Which rule states that an entity instance can simultaneously be a member of two (or more) subtypes
   (A) partial specialization (B) overlap (C) disjoint (D) total specialization

(B) 15. Which of the following is false?
   (A) A relation can have multiple candidate keys. (B) Key constraint means the primary key cannot have null values.
   (C) A candidate key can uniquely identify a row. (D) An enterprise key whose value is unique across all relations.

(A) 16. Which of the following is true?
   (A) A relation can have more than one candidate key. (B) A superkey is a key.
   (C) Two tuples can have the same key value. (D) none of above

(C) 17. The relational model is a type of ______ data models.
   (A) conceptual (B) physical (C) implementation (D) hierarchical

(D) 18. Which of the following is true?
   (A) C. J. Date first proposed the relation model. (B) A relation looks like a table of attributes.
   (C) In a relation each row has a row header called an attribute. (D) none of above

(D) 19. Which constraint may the delete operation violate?
   (A) Domain constraint (B) Entity constraint (C) Key integrity (D) none of above

(C) 20. To eliminate duplicate rows in a query, which can be used? (A) unique (B) index (C) distinct (D) none of above

(B) 21. Which provides a standard software API for using DBMS? (A) CASE (B) ODBC (C) OLAP (D) none of above

(C) 22. In MySQL which is used to execute a SQL script? (A) use (B) \e (C) \. (D) none of above

(D) 23. An attribute that can be broken down into smaller parts is called a(n) ______ attribute.
   (A) simple (B) associative (C) complex (D) composite

(C) 24. Which type of solutions to integrity violation does set null belong to?
   (A) Cancel the operation that causes the violation. (B) Perform the operation but inform the user of the violation.
   (C) Trigger additional updates so the violation is corrected. (D) none of above

(B) 25. How are the relationship types of degree 3 called? (A) ternary (B) primary (C) tertiary (D) binary

(A) 26. To indicate an attribute as a key, which SQL command can be used?
   (A) unique (B) index (C) distinct (D) none of above
27. In the following EER diagram, which is true?

(A) A person can be a camper and a runner.
(B) A person must be a camper, a biker, and a runner.
(C) A person must be a camper, a biker, or a runner.
(D) none of above

28. Which is an approach to map a n-ary relationship type in the ER diagram to the relational schema?

(A) Merged relation (B) A relationship relation and n foreign keys
(C) A relation set of simple component attributes (D) none of above

29. The relational data model consists of which components?

(A) Data structure (B) Data manipulation (C) Data integrity (D) All of the above

30. Which constraint may the delete operation violate?

(A) Referential constraint (B) Entity constraint (C) Key integrity (D) none of above

31. Which of the following finds those groups meeting stated conditions?

(A) group by (B) having (C) using by (D) none of above

32. Which integrity constraints can trigger a sequence of operations?

(A) restrict (B) set default (C) set null (D) cascade

33. Which is a join condition in the following SQL commands?

```sql
select name from employee, department
where department.name = 'Research' and employee.department = department.department;
```

(A) department.name = 'Research' (B) employee.department = department.department
(C) select name from employee, department (D) none of above

34. The UNION clause is used to:

(A) join two tables together to form one table. (B) find all rows that do not match in two tables.
(C) combine the output from multiple queries into a single result table. (D) none of above.

### Part 2: Questions and Answers (122 points)

1. (15 points) Briefly explain these terminologies. If they are acronyms, also write what they stand for.

   (a) data mining (b) functional dependency (c) identifying relationship (d) ontology (e) XML

   (a) The data mining can be defined in either one as shown in below:
   
   - The discovery of new information in terms of patterns or rules from vast amounts of data.
   - The process of finding interesting structure in data.
   - The process of employing one or more computer learning techniques to automatically analyze and extract knowledge from data.

   (b) Functional dependency specifies that the value of one attribute (the determinant) determines the value of another attribute in the same table.

   (c) An identifying relationship is the relationship between a weak entity type and its owner.

   (d) Ontology means using conceptual modeling and other tools to develop "a specification of a conceptualization".

   (e) EXtensible Markup Language (XML) is a language used to specify the data content.

2. (a) (4 points) What is data model?

   (b) (6 points) Describe the three-schema architecture of databases.

   (c) (4 points) Explain the differences between an entity (instance) and an entity type.

   (a) A set of concepts to describe the structure of a database, the operations for manipulating these structures, and certain constraints that the database should obey.

   (b) In the three-schema architecture, schemas can be defined at three levels: internal schema, conceptual schema, and external schemas.

   (c) An entity (instance) is a specific object or thing in the mini-world that are represented in the database. An entity type is a collection of entities that share common properties or characteristics.
3. (8 points) Explain the key constraint, domain constraint, entity integrity constraint, and referential constraint.
   - The key constraint means there is no duplicate key in any relation.
   - The domain constraint indicates every value in a tuple must be from the domain of its attribute.
   - The entity integrity indicates the values of primary key attributes in a relation cannot be null.
   - The referential integrity constraints indicate any attribute of a foreign key in a table can contain only either values from the corresponding parent table’s primary key or the null value.

4. (a) (4 points) What does SQL stand for? Explain it.
   - (b) (6 points) Based on the functions how can SQL be classified into three categories?
     (a) Structured Query Language (SQL) is a standard language used to retrieve, update and delete data from relational database management systems (DBMS).
     (b) Data Definition Language (DDL) is used to define databases.
     Data Manipulation Language (DML) is used to manipulate databases.
     Data Control Language (DCL) is used to control databases.

5. (a) (3 points) Explain normalization for a relational database.
    (b) (9 points) Explain the 1NF, 2NF, and 3NF.
    (a) The process of structuring relations by decomposing their attributes into smaller relations.
    (b) i. 1NF is the relation that has no composite attributes, multivalued attributes, and nested relations.
         ii. In 2NF, every non-prime attribute is fully functionally dependent on the primary key in the relation.
             Other possible answers:
             There are no two keys in the relation.
             There is no partial functional dependency in the relation.
         iii. Third normal form (3NF) is a normal form in which there is no transitive functional dependency in the relation.

6. (8 points) A customer relation has 4 attributes: customer_id, name, email, and address. No two customers have the same customer_id and email.
   (a) (6 points) List keys, 3 superkeys, and primary key for the customer relation.
   (b) (2 points) Explain the reason of choosing the primary key.
   (a) keys: customer_id, email
   (b) The customer_id is chosen because it can uniquely identify each tuple in the relation and the email might have the null value.

7. (27 points) Consider the following library database:

<table>
<thead>
<tr>
<th>borrower table</th>
<th>book_loan table</th>
<th>book table</th>
</tr>
</thead>
<tbody>
<tr>
<td>card_no</td>
<td>name</td>
<td>birthdate</td>
</tr>
<tr>
<td>B97022</td>
<td>Taylor Swift</td>
<td>03-5123456</td>
</tr>
<tr>
<td>B97145</td>
<td>Lily Allen</td>
<td>0912-123456</td>
</tr>
<tr>
<td>B97262</td>
<td>Lady Gaga</td>
<td>0928-342512</td>
</tr>
</tbody>
</table>

where primary keys are underlined. card_no and book_id in the book_loan table are foreign keys referencing to the borrower and book table respectively.

(a) If the following operations are taken, check if domain constraints, key constraints, entity integrity, or referential integrity is violated. If there is any violation, explain it.
   i. (2 points) Insert ('B97145', 'Wu Bai', '03-5168168') into the borrower table.
   ii. (2 points) Remove the row ('B97145', 'Lily Allen', '0912-123456') from the borrower table.
   iii. (2 points) Change the book_id of 'Java' in the book table from '123688' to '123123'.
   iv. (2 points) Change the card_no in the borrower table from 'B97262' to 'B97623'.
   v. (2 points) Change the title value in the book table from 'Java' to 'Java Programming'.

(b) Use SQL to answer the following questions.
   i. (3 points) Create the borrower table.
   ii. (2 points) Add a attribute publisher into the book table.
   iii. (2 points) Insert ('B07168', 'Justin Bieber', '03-5186417') into the borrower table.
iv. (2 points) Change 'Database' to 'Database Design' in the book table.
v. (2 points) Remove all books borrowed by 'Lady Gaga' from the book table.
vi. (3 points) List all book title that are borrowed on June 6, 2010.
vii. (3 points) Count the number of books borrowed by each borrower.

(a)  i. It violates the key constraint because the card_no 'B97145' already existed.
    ii. It violates the referential integrity because the foreign key, card_no 'B97145' in the book_loan table will have no primary key in the borrower table to reference to.
    iii. It violates the referential integrity because the foreign key, book_id '123688' in the book table will have no primary key in the book table to reference to.
    iv. It violates the referential integrity because the foreign key, card_no 'B97145' in the book table will have no primary key in the borrower table to reference to.
v.  It violates no constraint.

(b) i. create table borrower (  
    card_no char(6) primary key not null,
    name varchar(30),
    birthdate date)
    ii. alter table book add publisher varchar(30);
    iii. insert into borrower values ('B07168', 'Justin Bieber', '03-5186417')
    iv. update book set title = 'Database Design' where title = 'Database'
    v. delete from book where book_id in (select book_id from borrower, book_loan where borrower.card_no = book_loan.card_no and name = 'Lady Gaga')
    vii. select name, count(*) from borrower, book_loan where borrower.card_no = book_loan.card_no group by book_id

8. (14 points) Consider the world cup. There are teams, player, and matches. Each entity should have a least 3 attributes.
   (a) (7 points) Add the necessary relationships to draw a ER/EER diagram to represent the relationships among teams, players, and matches.
   (b) (7 points) Transform the above ER/EER diagrams to 3NF relations and show the 3NF relation schema.

(a)  ![ER Diagram]

(b) player: player_no | country | name | birthday | position  
    team: country | coach | group  
    match: country | date | match_country | time | location

9. (14 points) Consider the following schema for the movie information. Normalize it to 3NF relations.
   movie(movie_id, title, year, star_id, star_name, gender, birthdate, director_id, director_name)
where primary keys are underlined.
   (a) (7 points) Draw the ER diagram.
   (b) (7 points) Show the relation schema.
(a) 

(b) star: \( \begin{array}{c}
\text{star}_\text{id} & \text{star}_\text{name} & \text{gender} & \text{birthday} \\
\end{array} \) 

movie: \( \begin{array}{c}
\text{star}_\text{id} & \text{director}_\text{id} & \text{movie}_\text{id} & \text{title} & \text{year} \\
\end{array} \) 

director: \( \begin{array}{c}
\text{director}_\text{id} & \text{director}_\text{name} \\
\end{array} \)