Part 1: Multiple Choice (75 points - 3 points per question)

(A) 1. Which is used to store and analyze maps, weather data, and satellite images?
   (A) GIS (B) GPS (C) OLAP (D) none of above

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

(C) 3. Which is the main phase of designing a database?
   (A) Cost analysis (B) Performance evaluation (C) Requirements specification and analysis (D) none of above

(B) 4. Which is a DBMS? (A) Apache (B) Microsoft Access (C) PHP (D) none of above

(A) 5. Who determines requirements of end users?
   (A) System analysts (B) Application programmers (C) Tool developers (D) none of above

(D) 6. Which is not an advantage of using the database approach?
   (A) Controlling redundancy (B) Providing Storage Structures
   (C) Providing backup and recovery (D) Reducing integrity constraints

(A) 7. Which represents a real-world object or concept? (A) Entity (B) Attribute (C) Relationship (D) none of above

(C) 8. Which is the description of a database?
   (A) database instance (B) database construction (C) database schema (D) database query

(D) 9. Which schema describes physical storage structure of the database?
   (A) conceptual (B) external (C) implementation (D) internal

(B) 10. Which data model describes how data is stored as files in the computer?
   (A) conceptual (B) physical (C) representational (D) none of above

(C) 11. Which are used to specify restrictions on the actual values in a database state?
   (A) structures (B) operations (C) constraints (D) entities

(D) 12. Which of the following is true?
   (A) Relational model represents data as a collection of objects. (B) Degree is the total number of values in domain.
   (C) Cardinality is the number of attributes n of its relation schema (D) None of the above

(C) 13. Which is not a meaning for null values?
   (A) Attribute does not apply to this tuple. (B) Attribute value is unknown.
   (C) The value is beyond the domain range. (D) Value exists but is not available.

(C) 14. Which is true?
   (A) A superkey is a key. (B) Two tuples can have the same key value.
   (C) A relation can have more than one candidate key. (D) None of the above

(B) 15. Which constraint involves two relations?
   (A) Key constraint (B) Referential integrity (C) Entity integrity (D) Domain constraint

(B) 16. Which constraint may delete violate?
   (A) Domain constraint (B) Referential integrity (C) Key constraint (D) All of the above

(A) 17. Which specifies alternate (secondary) keys? (A) unique (B) index (C) distinct (D) none of above

(A) 18. Which can be used to specify referential triggered action? (A) set null (B) set rule (C) set default (D) set value

(D) 19. Which integrity constraints can trigger a sequence of operations? (A) restrict (B) set default (C) set null (D) cascade

(C) 20. Which is a join condition in the following SQL commands?
   select name from employee, department
   where department_name = 'Research' and employee.department_no = department.department_no;
   (A) select name from employee, department (B) department_name = 'Research'
   (C) employee.department_no = department.department_no (D) None of the above

(C) 21. What does the following SQL statement do? select name from customer where city = 'Hsinchu';
   (A) Retrieves all customers whose name is Hsinchu from the customer table.
   (B) Retrieves all cities whose name is Hsinchu from the customer table.
   (C) Retrieves the name of all customers who live in Hsinchu.
   (D) none of above

(A) 22. To eliminate duplicate rows in a query, which qualifier can be used in the SQL Select command?
   (A) distinct (B) check (C) specific (D) unique

(B) 23. In MySQL which is used to execute a SQL script? (A) use (B) \. (C) \
   (D) none of the above

(B) 24. Which is used for string pattern matching in SQL? (A) as (B) like (C) between (D) none of above

(D) 25. When you log into your Facebook account, which SQL command will be used?
   (A)insert (B) update (C) delete (D) select
Part 2: Questions and Answers (85 points)

1. (24 points) Briefly explain these terminologies. If they are acronyms, also write what they stand for.
   (a) data independence  (b) XML  (c) DBMS  (d) ERP  (e) persistent object  (f) JDBC
   Ans:
   (a) Data independence is the capacity to change the lower-level schema without having to change the higher level schema.
   (b) EXtensible Markup Language (XML) is a language used to specify the data content.
   (c) Database management system (DBMS) is software used to create, maintain, and provide controlled access to databases.
   (d) Enterprise resource planning (ERP) is an information technology term referring to an integrated system that serves all departments within an enterprise.
   (e) Persistent object is a data item which exist after the application is terminated.
   (f) Java Database Connectivity (JDBC) is an application Program Interface (API) to access server databases for Java.

2. (a) (4 points) What is data model?
   (b) (3 points) What is database schema?
   (c) (3 points) What is database state?
   Ans:
   (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) The database schema is the description of a database.
   (c) The database state is data in database at a particular moment in time.

3. (a) (4 points) Illustrate the three-tier client-server architecture.
   (b) (6 points) Explain the functions for each tier in the three-tier architecture.
   Ans:
   (a)

   ![Diagram of three-tier architecture]

   (b) • The first tier has the Web browser, which provides the user interface.
   • The middle tier has Web server and the applications that require database access.
   • The third tier has the database system and the database itself.

4. (8 points) Consider the following relations for a database that keeps track of business trips and sales of salespersons. Underline the primary key and draw the schema diagram.
   salesperson(employee_id, name, position, department_no)
   trip(employee_id, trip_id, from_city, departure_date, return_date)
   expense(trip_id, account_no, fee)
   sales(sale_id, employee_id, amount)
   sales: [sale_id, employee_id, amount]
   salesperson: [employee_id, name, position, department_no]
   trip: [employee_id, trip_id, from_city, departure_date, return_date]
   expense: [trip_id, account_no, fee]
5. (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?

Ans:

(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.

6. (23 points) Consider the following library database:

<table>
<thead>
<tr>
<th>card_no</th>
<th>name</th>
<th>phone_no</th>
</tr>
</thead>
<tbody>
<tr>
<td>B97022</td>
<td>Taylor Swift</td>
<td>03-5123456</td>
</tr>
<tr>
<td>B97145</td>
<td>Katy Perry</td>
<td>0912-123456</td>
</tr>
<tr>
<td>B97262</td>
<td>Lady Gaga</td>
<td>0928-342512</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>card_no</th>
<th>book_id</th>
<th>date_out</th>
<th>due_date</th>
</tr>
</thead>
<tbody>
<tr>
<td>B97022</td>
<td>123688</td>
<td>2010-06-06</td>
<td>2010-07-06</td>
</tr>
<tr>
<td>B97145</td>
<td>111332</td>
<td>2010-05-28</td>
<td>2010-06-28</td>
</tr>
<tr>
<td>B97262</td>
<td>168168</td>
<td>2010-05-20</td>
<td>2010-06-20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>book_id</th>
<th>title</th>
</tr>
</thead>
<tbody>
<tr>
<td>123688</td>
<td>Java</td>
</tr>
<tr>
<td>111332</td>
<td>Database</td>
</tr>
<tr>
<td>168168</td>
<td>UNIX</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', 'Katy Perry', '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) Insert ('B07168', 'Justin Bieber', '03-5186417') into the borrower table.
iii. (2 points) Change 'Database' to 'Database Design' in the book table.
iv. (3 points) Remove all books borrowed by 'Lady Gaga' from the book table.
v. (3 points) List all book title that are borrowed on June 6, 2010.

Ans:

(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 primay key in the borrower table to reference to.
iii. It violates the referential integrity because the foreign key, book_id '123688' in the book_loan table will have no primay key in the book table to reference to.
iv. It violates the referential integrity because the foreign key, card_no 'B97262' in the book_loan table will have no primay 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. insert into borrower values ('B07168', 'Justin Bieber', '03-5186417')  
iii. update book set title = 'Database Design' where title = 'Database'  