



RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

Bachelor of Science in Information Technology
First Year - Semester II Examination – Jan/Feb 2023

ICT 1407 –DATABASE SYSTEMS

three (03)

Time: ~~Two (02)~~ hours

-
- Answer ALL the questions.
-

1. a) What is a subclass? When is a subclass needed in data modeling? (04 marks)
- b) State and discuss the two main types of constraints on specializations and generalizations. (06 marks)
- c) Consider a database system for a baseball organization such as the major leagues. The data requirements are summarized as follows:
 - The personnel involved in the league include players, coaches, managers, and umpires. Each is identified by a unique personnel id. They are also described by their first and last names along with the date and place of birth.
 - Players are further described by other attributes such as their batting orientation (left, right, or switch) and have a lifetime batting average (BA).
 - Within the players group is a subset of players called pitchers. Pitchers have a lifetime ERA (earned run average) associated with them.
 - Teams are uniquely identified by their names. Teams are also described by the city in which they are located and the division and league in which they play (such as Central division of the American League).
 - Teams have one manager, a number of coaches, and a number of players.
 - Games are played between two teams, with one designated as the home team and the other the visiting team on a particular date. The score (runs, hits, and errors) is recorded for each team. The team with the most runs is declared the winner of the game.

- With each finished game, a winning pitcher and a losing pitcher are recorded. In case there is a save awarded, the save pitcher is also recorded.
- With each finished game, the number of hits (singles, doubles, triples, and home runs) obtained by each player is also recorded.

i. Design an enhanced entity–relationship diagram for the BASEBALL database. (15 marks)

ii. Map the above designed diagram into relational data model. (15 marks)

(Total 40 marks)

2. a) Briefly describe the six clauses in the syntax of an SQL retrieval query stating whether they are required or optional. Show what type of constructs can be specified in each of the six clauses. (08 marks)

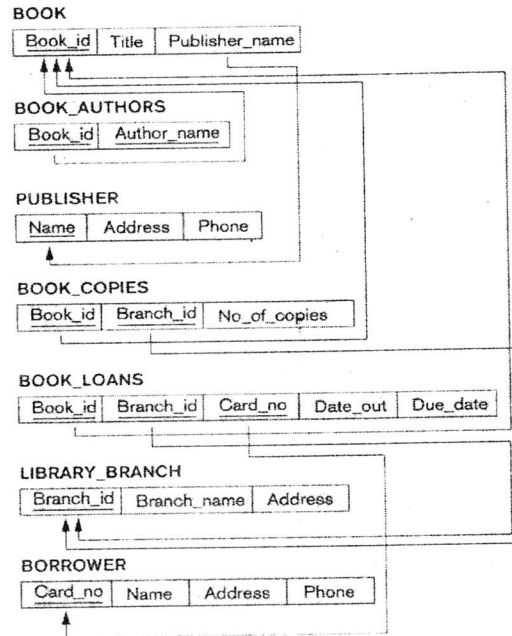
b) Describe how an SQL retrieval query will be executed by specifying the conceptual order of execution of each of the six clauses. (05 marks)

c) What is union compatibility? Why do the UNION, INTERSECTION, and DIFFERENCE operations require the relations on which they are applied to be union compatible?

(03 marks)

d) Consider the LIBRARY relational database schema, which is used to keep track of books, borrowers, and book loans shown in the figure given below. Referential integrity constraints are shown as directed arcs in the figure. Write down SQL queries for the following:

- Retrieve how many copies of the book titled *The Lost Tribe* are owned by the library branch whose name is 'Sharpstown'.
- Retrieve how many copies of the book titled *The Lost Tribe* are owned by each library branch.
- Retrieve the names of all borrowers who do not have any books checked out.
- For each book that is loaned out from the Sharpstown branch and of which Due_date is today, retrieve the book title, the borrower's name, and the borrower's address.



- v. Retrieve the branch name and the total number of books loaned out from each branch.
- vi. Retrieve the names, addresses, and number of books checked out for all borrowers who have more than five books checked out
- vii. For each book authored (or coauthored) by Stephen King, retrieve the title and the number of copies owned by the library branch whose name is Central.

(7 x 02 marks)

(Total 30 marks)

3. a) Discuss the entity integrity and referential integrity constraints. Explain why each of them is considered important? (06 marks)
- b) Explain insertion, deletion, and modification anomalies. Why are they considered bad? Illustrate with examples. (06 marks)
- c) What undesirable dependencies are avoided when a relation is in 2NF? (03 marks)
- d) What undesirable dependencies are avoided when a relation is in 3NF? (03 marks)

- e) Consider the following relation:

R (Doctor#, Patient#, Date, Diagnosis, Treat_code, Charge)

In the above relation, a tuple describes a visit of a patient to a doctor along with a treatment code and daily charge. Assume that diagnosis is determined (uniquely) for each patient by a doctor. Assume that each treatment code has a fixed charge (regardless of patient).

Is this relation in 2NF? Justify your answer and decompose if necessary. Then argue whether further normalization to 3NF is necessary, and if so, perform it. (06 marks)

- f) Consider the following relation:

CAR_SALE (Car_id, Option_type, Option_listprice, Sale_date, Option_discountedprice)

This relation refers to options installed in cars (e.g., cruise control) that were sold at a dealership, the list price and the discounted prices of the options. Assume that the relation holds following functional dependencies.

$CarID \rightarrow Sale_date$
 $Option_type \rightarrow Option_listprice$ and $CarID$
 $Option_type \rightarrow Option_discountedprice$

Using the generalized definition of the 3NF prove that "this relation is not in 3NF". Then with the knowledge of 2NF, discuss why "it is not even in 2NF". (06 marks)

(Total 30 marks)

--- END ---