

**DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION SYSTEMS**  
**DATABASE SYSTEMS (CS F212)**  
**MID-SEMESTER EXAMINATION (REGULAR)**

MAX MARKS: 90

**Ques 1:** Draw ER diagram of the following:

- a) Draw an ER diagram for a hospital management system that tracks patients, doctors, medical procedures, and appointments. A Patient can have many Appointments. A Doctor can have many Appointments. An Appointment involves one Patient and one Doctor. A Medical Procedure can be performed on many Patients.
  
- b) A university wants to develop a database system to manage student enrollments and courses. The university offers multiple courses across various departments and has many students enrolled in each course. Each course has a unique course code, name, department, and professor who teaches the course. Each student has a unique student ID, name, and address. Students can enroll in multiple courses, and each course can have many students enrolled. The university also wants to keep track of grades and attendance for each enrolled student.
  
- c) A company wants to develop a database system to manage its inventory and sales. The company sells multiple products, each with a unique product ID, name, price, and quantity in stock. Customers can place orders for one or more products, and each order has a unique order ID, date, and time. The company also wants to track customer information, including name, address, and phone number. Each order can have multiple products, and each product can be part of a single order. The system should also track the sales made by each employee, including their name and employee ID.

**(5 X 3 = 15 Marks)**

Note: Only Completely correct answers for each part will fetch marks. Sub parts don't have partial marking.

**Ques 2:** For the following relational schema given. Write the **SQL** solution for the queries.  
(The relational schema is not complete and is hypothetical one)

Table: books

- id (integer, primary key)
- title (text)
- author (text)
- price (decimal)
- genre (text)

Table: customers

- id (integer, primary key)

- name (text)
- email (text)
- password (text)

Table: orders

- id (integer, primary key)
- customer\_id (integer, foreign key references customers.id)
- order\_date (date)
- total\_price (decimal)

Table: order\_items

- id (integer, primary key)
- order\_id (integer, foreign key references orders.id)
- book\_id (integer, foreign key references books.id)
- quantity (integer)
- price (decimal)

- a) The bookstore manager wants to find out the top 5 bestselling books in the past month.
- b) A customer wants to see their order history, including the date, total price, and a list of books they ordered.
- c) Find out the total revenue from book sales in the past year.
- d) Find out the customers who have made at least one purchase but have not purchased anything in the past month.
- e) Find out the customers who have spent the most money.
- f) Find out the number of books sold by genre.
- g) The bookstore wants to find out the average price of books sold.

**(6 x 3 + 2 = 20 Marks)**

Note: You can specify your assumptions, if its absolutely necessary to answer the questions.

**Ques 3:** Assume the following schema:

Customers (id: integer, name: string, email: string, phone: string)

Orders (id: integer, customer\_id: integer, order\_date: date, total\_price: decimal)

Order\_items (id: integer, order\_id: integer, book\_id: integer, price: decimal, quantity: integer)

Books (id: integer, title: string, author: string, publisher: string, genre: string, price: decimal)

Write the **Relational Algebra** solution for the queries.

(The relational schema is not complete and is hypothetical one)

- a) List the names of all customers who have placed at least one order.
- b) List the titles of all books that have been ordered more than 10 times.
- c) List the customer names and total amount spent by each customer in descending order of total amount spent.

- d) List the titles of all books that have never been ordered.
  - e) List the customer names and total number of orders for each customer who has placed at least one order.
- (5 X 3 = 15 Marks)**

**Ques 4:** Consider a relation R, R(A, B, C, D, E), with the following set of functional dependencies:

$A \rightarrow B, C, D, E$

$B \rightarrow A, C, D, E$

$C \rightarrow D, E$

$B, C \rightarrow D$

$B, C \rightarrow E$

- a) Determine all the candidate keys for R.
- b) Identify all the functional dependencies that violate 3NF., and Decompose R into 3NF.
- c) Show that the decomposition done by you is lossless join and dependency preserving.
- d) Identify all the functional dependencies that violate BCNF, Decompose R into BCNF based on the identified functional dependencies.
- e) Show that the decomposition done by you is lossless join and dependency preserving.

**(5X3 = 15 Marks)**

[In this question, " $A \rightarrow B, C, D, E$ " is same as " $A \rightarrow BCDE$ "]

**Ques 5:** Consider a relation R(A, B, C, D, E, F) with the following functional dependencies:

$A \rightarrow B$

$A \rightarrow C$

$B \rightarrow D$

$C \rightarrow D$

$D \rightarrow E$

$C \rightarrow F$

$F \rightarrow A$

Find the minimal set of functional dependencies that is equivalent to the original set. Show all calculations.

**(5 Marks)**

**Ques 6:** Construct a B+-tree for the following set of key values:

(2, 3, 5, 7, 11, 17, 19, 23, 29, 31)

Assume that the tree is initially empty and values are added in ascending order. Construct B+-trees for the cases where the number of pointers that will fit in one node is

- a) Three
- b) Four
- c) Five

**(5x3 = 15 Marks)**

- d) For the case where the number of pointers that will fit in one node is Four. Do the following
- I. Insert 9.
  - II. Insert 10.
  - III. Insert 8.
  - IV. Delete 23.
  - V. Delete 19.

**(5 Marks)**

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