# The Open University of Sri Lanka
# Faculty of Natural Sciences
# B.Sc. Degree Programme

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|---|---|
| **Department** | : Computer Science |
| **Level** | : 3/4 |
| **Name of the Examination** | : Final Examination |
| **Course Title and – Code** | : CSU3301 - Database Design and Implementation<br>CSU4315 - Database Management Systems |
| **Academic Year** | : 2024/2025 |
| **Date** | : 25.04.2025 |
| **Time** | : 09.30 a.m. -11.30 a.m. |
| **Duration** | : 02 Hours |

**General Instructions**

1. Read all the instructions carefully before answering the questions.
2. This question paper consists of **SIX (06) main** questions in eight (08) pages. Each main question has sub questions.
3. Answer **FOUR (04)** questions ONLY.
4. Answer for each main question should commence from a new page.
5. Draw clear diagrams where necessary.
6. Involvement in any activity that is considered as an exam offense will lead to punishment.
7. Use blue or black ink to answer the questions.
8. Clearly state your index number in your answer script.

## QUESTION 01

1) Briefly describe the difference between Data and Information.

2) What is Data Management?

3) What is meant by the term Redundant Data?

4) What is a Database?

5) Mention two disadvantages of a File Processing System.

6) Describe the following with respect to databases.
   a) Field
   b) Record
   c) File

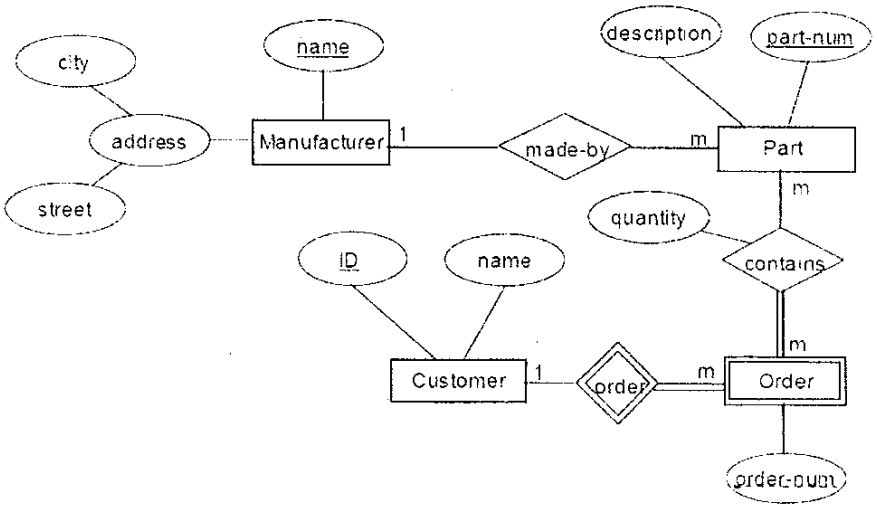
7) What is a Database Management System (DBMS)?

8) Is the following table in the First Normal Form (1NF)? If not, explain why. If it is not in 1NF, convert it to 1NF. Then, explain what further changes are needed to bring the table to Second Normal Form (2NF). Briefly justify your answer.

| Order ID | Customer Name | Product Name | Quantity |
|---|---|---|---|
| 101 | Kasuni | Pen, Notebook | 2, 1 |
| 102 | Saman | Pencil | 5 |

9) Write an SQL query to display the names of all students from a table called STUDENT who are from the city 'Colombo'.

10) Draw the appropriate Relational Schema for the following ER diagram.



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## QUESTION 02

1) List and describe five (5) different categories of users in a Database System.

2) Fill in the blanks with appropriate terms.

**(Information, Data, Single-user Database, Logical Data Model, Data Loss, Operating System, Normalization, Integrity, Backup and Recovery, Primary Key)**

a) Raw facts and figures are processed to generate .....

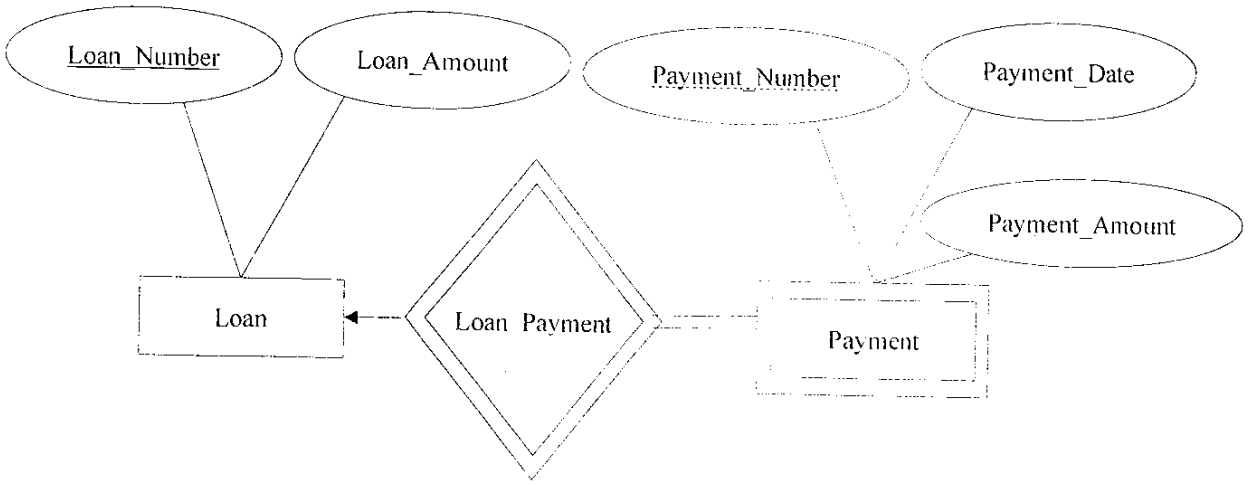
b) ..... refers to the accidental removal of data caused by deleting related or unrelated files.

c) The ..... is responsible for controlling hardware and providing an environment for software to operate.

d) A database that operates on a single personal computer for one user is known as a .....

e) The ..... deals with how data is logically organized and perceived by users.

3) Draw the appropriate Relational Schema for the following ER diagram. What are the key features that show an entity is Weak?



4) An engineering consultancy firm supplies temporary specialized staff to outside companies to work on their projects for certain amount of time. The table below lists the time spent by each of the company's employees at other companies to carry out projects.

| NIN | Contract No | Time Spent | Employee Name | Company ID | Company Location |
|---|---|---|---|---|---|
| 616681B | SC1025 | 72 | P. Ranathunga | SC115 | Colombo |
| 674315A | SC1025 | 48 | R. Perera | SC115 | Colombo |
| 323113B | SC1026 | 24 | P. Gunasena | SC23 | Kandy |
| 616681A | SC1026 | 24 | P. Dias | SC23 | Kandy |

a) What is Normalization?

b) Define the term Functional Dependency.

c) Explain in which Normal Form the above table is.

d) Suggest a suitable Primary Key for this Relation and explain your choice.

e) Find the Fully Functional Dependencies on the Primary Key and the Partial Dependencies on the Primary Key.

f) Normalize the table to 2NF.

g) What is Third Normal Form (3NF)? How do you convert a table from Second Normal Form (2NF) to Third Normal Form (3NF)? Explain briefly.

**QUESTION 03**

1) Suppose you are given the following requirements for a simple database for the National Hockey League (NHL):

- The NHL has many teams
- Each team has a name, a city, a coach, a captain, and a set of players
- Each player belongs to only one team
- Each player has a name, a position (such as left wing or goalie), a skill level, and a set of injury records
- A team captain is also a player
- A game is played between two teams (referred to as host team and guest team) and has a date (such as May 11th, 2024) and a score (such as 4 to 2)

a) Draw the complete ER diagram (Use Chen Notation)

b) Show the proper Connectivity of the relationships.

c) Clearly state any assumptions you make.



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2) By looking at the two tables (LECTURER and SUBJECT) in the "UNIVERSITY" database, write the outputs of the following SQL queries.

**LECTURER**

| LEC_ID | LEC_NAME | LEC_AGE | LEC_SAL | SUB_ID |
|---|---|---|---|---|
| 100 | Sunil Perera | 45 | 450000 | 2 |
| 101 | Nuwan Silva | 34 | 350000 | 1 |
| 102 | Saman Soyza | 38 | 375000 | 3 |
| 103 | Ravin Perera | 48 | 480000 | 4 |
| 104 | Sarath Kure | 56 | 360000 | 3 |
| 105 | Nalaka Kostha | 30 | 420000 | 1 |

**SUBJECT**

| SUB_ID | SUB_NAME | NO_OF_STUDENTS |
|---|---|---|
| 1 | Web development | 80 |
| 2 | Data structures | 110 |
| 3 | Data communication | 130 |
| 4 | Artificial intelligence | 70 |

a) Find lecturer names where the second letter is 'a'.

b) List the names of all subjects that have more than 100 students.

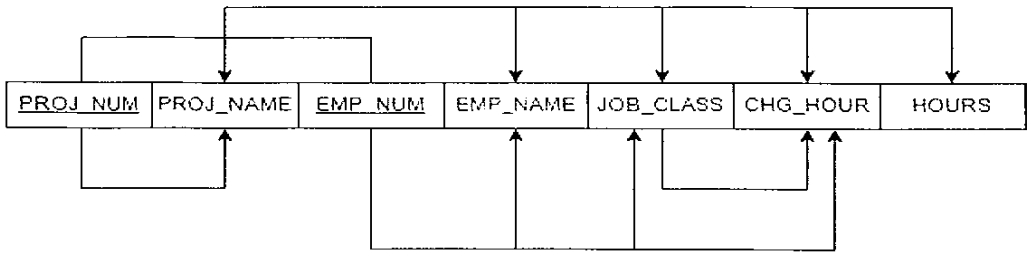
c) Find the LEC_IDs whose salary is greater than 300,000 and where at least one lecturer is older than 40.

d) Count how many lecturers are teaching each subject.

e) Translate the letters in the lecturer names: replace 'r' with 'l' and 'a' with 'e'.

**QUESTION 04**

1) Consider the following diagram.




a) What is the Normal Form that this table is currently in?

b) What is Partial Dependency? If there are any Partial Dependencies in the above diagram identify and mark them.

c) What is Transitive Dependency? If there are any Transitive Dependencies in the above diagram identify and mark them.

d) Normalize this table to conform to both 3NF and Boyce-Codd Normal Forms (BCNF). Clearly show the steps (1NF, 2NF, 3NF and BCNF) you follow and mark the primary keys of each decomposed table.

2) A large organization that does automobile repairs must keep track of its garages, mechanics and vehicles. Descriptions of these items are as follows:

- GARAGE: Garage registration no, Name, Address, Contact no, No-of-mechanics
- MECHANIC: Mechanics ID, Name, Salary, Age
- VEHICLE: Vehicle registration no, Owner name, Model

A Garage has several qualified employees to provide quality services. Several mechanics can be assigned to do the troubleshooting. Finally, they sort out the vehicle problem.

Draw the ER diagram for the above scenario.

a) Identify the Entities
b) Identify the Attributes
c) Identify Relationships
d) Use key Attributes
e) Use the Cardinality Ratio and Participation Constraints
f) Create a Relational Schema based on your ER model.



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**QUESTION 05**

I). Read the following description about Samadhi's DVD collection database.

Samadhi owns a large collection of DVDs that her friends frequently borrow. She needs a way to keep track of who borrows what. Therefore, she maintains a list of friends. Each friend is assigned a unique Friend Identifier (FID) and includes details such as their name and telephone numbers, for contacting them regarding the borrowed DVDs. Each DVD is identified by a unique DVD Identifier (DVDID) and includes information about the star actor and the title of the movie.

Whenever a friend borrows a DVD, Samadhi records the FID, DVDID, and the date the DVD was borrowed in her database. Similarly, when a DVD is returned, she updates the database with the date it was returned. Samadhi's system is designed to maintain a complete history of borrowing activities, allowing her to track which friends borrow frequently and return DVDs on time. This information helps her decide whom to give the DVDs in future, enabling her to ask for favors from reliable borrowers and avoid giving to those who delay in returning DVDs.

This system helps her manage her DVDs more effectively. She does not keep information about friends who do not borrow DVDs. But she has DVDs which have not yet been borrowed by any of her friends.

a) Based on the above scenario, draw a complete ER diagram with proper Entities, Relationship and Cardinalities using Chen notation. Ensure you use standard naming conventions.

b) Transform your ER diagram into a corresponding Relational Schema indicating the Primary and Foreign Keys.

c) Write a SQL query to retrieve the names and telephone numbers of friends who have borrowed more than 3 DVDs.

d) Write a SQL query to list the DVD title(s) and the friend's name for DVDs that have not yet been returned.

e) Write a SQL query to find the total number of DVDs borrowed by each friend.

**QUESTION 06**

1) What does SQL stand for?

2) What is the difference between the UPPER() and LOWER() functions in SQL?

3) What is the purpose of the DISTINCT keyword in a SELECT statement?

4) Consider the following database instances.

**Table: CUSTOMER**

| Customer_ID | Name | Email | Phone | Order_ID |
|---|---|---|---|---|
| 111 | Chaminda Silva | chaminda@gmail.com | 777123456 | 11 |
| 222 | Nimal Perera | nimalperera@yahoo.com | 712233445 | 22 |
| 333 | S. Rajapakse | srajapakse@gmail.com | 766655443 | 33 |
| 444 | K. Bandara | kbandara@hotmail.com | 771112223 | 44 |
| 555 | P. Fernando | pfernando@gmail.com | 755544332 | 55 |

**Table: ORDER**

| Order_ID | Customer_ID | Order_Date |
|---|---|---|
| 11 | 2 | 2022-01-15 |
| 22 | 4 | 2022-02-02 |
| 33 | 1 | 2022-02-20 |
| 44 | 3 | 2022-03-05 |
| 55 | 2 | 2022-04-10 |

**Table: PRODUCT**

| Product_ID | Product_Name | Price |
|---|---|---|
| 10 | Samsung Galaxy S20 | 125000 |
| 20 | Apple iPhone 12 Pro Max | 180000 |
| 30 | Dell XPS 13 | 235000 |
| 40 | LG 55" OLED TV | 325000 |
| 50 | Bose QuietComfort 35 II | 45000 |

Write suitable SQL queries to do the following tasks:

a) Display all columns from the CUSTOMER table.

b) Display the Name and Phone columns from the CUSTOMER table for all Customers whose Name starts with the letter "S".

c) Display the Product_Name and Price columns from the PRODUCT table for all products whose price is greater than 150,000 LKR.

d) Display the total number of orders in the ORDERS table.



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e) Insert a new row into the CUSTOMER table with the values "Thilini Gunasekara" for the Name column, "thilini@gmail.com" for the Email column, and "0777123456" for the Phone column.

f) Update the Email column of the CUSTOMER table to "newemail@gmail.com" for the Customer with ID of 333.

g) Delete the row from the PRODUCT table where the ID column is 20.

h) Display the unique Name values from the CUSTOMER table.

i) Display the Order_Date column from the ORDER table sorted in descending order.

j) Display the Product_Name column from the PRODUCT table for all products whose name contains the word "Samsung".