

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



Department	: Computer Science
Level	: 3
Name of the Examination	: Final Examination
Course Title and – Code	: COU3301 - Database Management Systems
Academic Year	: 2026/2027
Date	: 21 st June 2026
Time	: 9.30am -11.30am
Duration	: 02 Hours

General Instructions

1. Read all instructions carefully before answering the questions.
 2. This question paper consists of SIX (06) main questions in Ten (10) pages. Each 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 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.
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QUESTION 01

01. Define each of the following terms as used in database systems:

- i. Database
- ii. Database Management System
- iii. Database Model

02. Why is database design important? Explain with suitable examples.

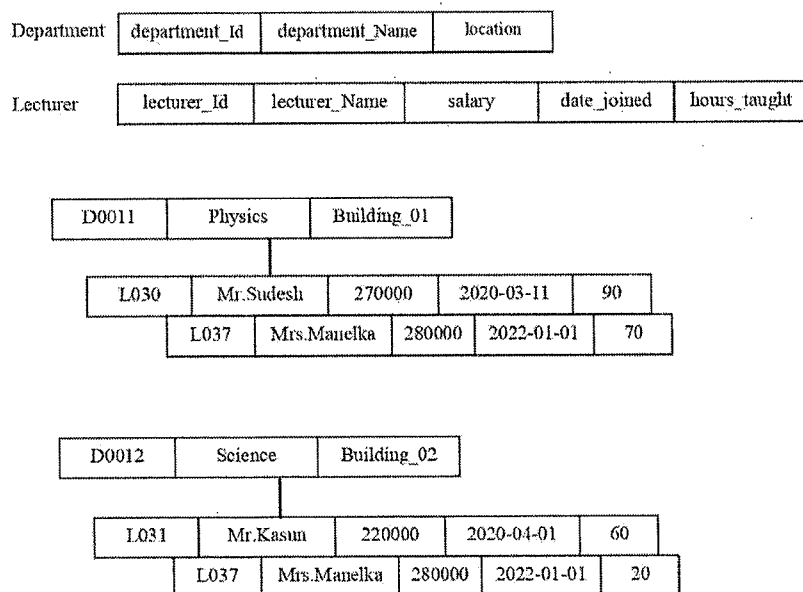
03. A traditional banking system used a “file-based system” to store data on a computer before the introduction of database systems.

- i. Explain briefly how the file-based system manages the bank’s data using suitable sample data or diagrams.
- ii. Describe two major problems that can be encountered in the above banking file-based system with suitable examples.
- iii. Explain briefly how modern database approaches overcome the problems described in part (ii).

04. Explain the different types of Database Management Systems based on:

- i. Number of users
- ii. Database site location
- iii. Type of use

05. Consider the hierarchical database model provided below to answer the following questions:



State whether the following operational scenarios can be successfully applied to this database model without causing errors or data loss. Justify your answers using the sample data provided in the diagram.

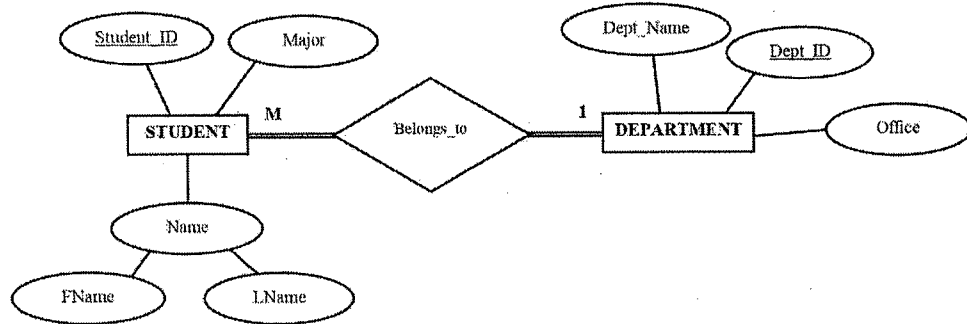
- a. Inserting a newly hired lecturer (L045, Mr. Perera) who has not yet been assigned to any department.
- b. Updating the salary of Mrs. Manelka (L037) to 300,000 in a single database operation.
- c. Deleting the Physics (D0011) department segment because the university is closing that department.
- d. Recording that Mrs. Manelka (L037) has completed 10 additional teaching hours in the Science department (D0012).
- e. Adding a new Computer Science department (D0020) located in Building_03 before any lecturers have been hired for it.

QUESTION 02

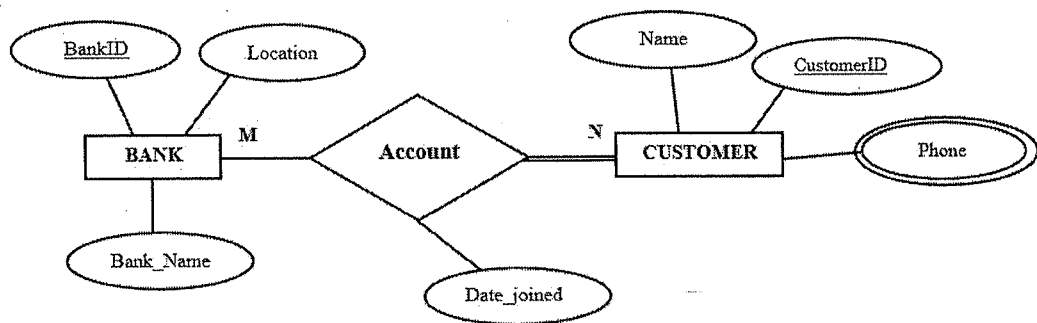
01. Explain how a DBMS acts as an intermediary between users and databases.
02. List four major functions of a Database Management System.
03. List the major steps of the database design process and briefly describe each.
04. Suppose that you are responsible for designing a database of a small-scale Bookshop. Describe briefly the activities that you would carry out for the design with the help of the steps listed in part (03).
05. Describe each of the following concepts in the context of the relational data model with the aid of examples:
 - i. Relation Schema
 - ii. Domain
06. What are the reasons that lead to the occurrence of NULL values in relations?

07. Map each of the following ER diagrams into Relational Schemas

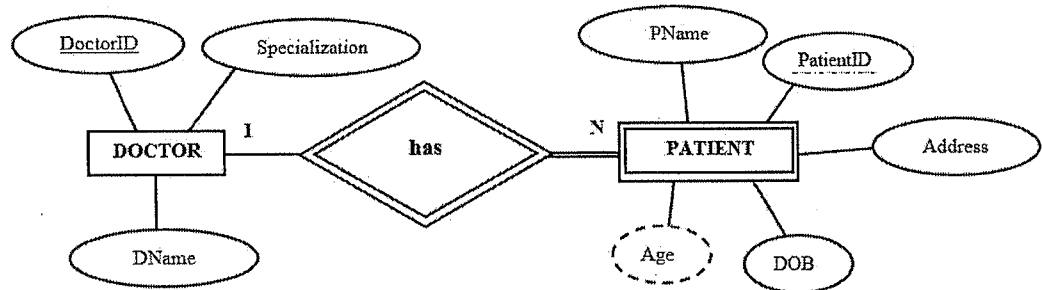
a)



b)



c)



QUESTION 03

01. Draw an ER diagram that captures the following information about the **“RideGo Transport Service System”**. State any assumptions that you make.

The system stores information about passengers who use the transport service. Each passenger is identified by a unique Passenger ID. For each passenger, the system records name (first name and last name), contact numbers (a passenger may have multiple phone numbers), email address, and home location details.

The system also stores information about drivers. Each driver is identified by a unique Driver ID. For each driver, the system records name, NIC number, contact number, driving license number, years of experience, and current availability status. When a driver registers in the system, exactly one vehicle is assigned to that driver. Each vehicle is uniquely identified by a Vehicle ID. For each vehicle, the system records vehicle number plate, model, type, and seating capacity. Each driver is assigned one specific vehicle, and that vehicle must be used by the driver for all rides handled through the system.

When a passenger requests a ride, a ride record is created. Each ride is identified by a unique Ride ID and includes pickup location, drop location, start time, end time, and fare amount. Each ride is requested by one passenger and assigned to one driver. A passenger may request many rides, and a driver may complete many rides. When a ride request is made, the system automatically suggests and assigns an available driver along with their assigned vehicle.

Each ride has exactly one payment record associated with it. Payment information includes Payment ID, payment method, payment status, and amount paid.

A ride may include several intermediate stops between the pickup and drop locations. The system stores stop number, stop location, arrival time, departure time, and stop notes for each stop. A Ride Stop cannot exist without a corresponding Ride and is uniquely identified using the combination of Ride ID and Stop Number.

The system also stores information about technicians who maintain vehicles. Each technician is identified by a unique Technician ID. For each technician, the system records technician name, contact number, specialization, and years of experience. A technician may maintain many vehicles, and a vehicle may be maintained by many technicians over time. The system also records maintenance details such as maintenance date, maintenance type, and service notes.

02. Transform the ER diagram developed for the RideGo Transport Service System into a corresponding relational schema, clearly indicating the primary keys and foreign keys for each relation.

QUESTION 04

01. A database stores employee information including employee details and their project assignments. The design of the table has redundancy, where the salary of each employee is repeated in multiple tuples, and employee-project records are stored together in a single relation.

Based on this scenario:

- i. Explain what is meant by *data redundancy* in a database.
- ii. Describe the following anomalies that may occur in such a database design:
 - a. Update anomaly
 - b. Deletion anomaly
 - c. Insertion anomaly
- iii. Suggest how these anomalies can be reduced or avoided in database design.

02. The relation instance R below shows customer order information of a small electronics store.

Order No	Order Date	Cust ID	Cust Name	City	Product Code	Product Desc	Unit Price	Qty
1001	10-02-26	C01	Nimal	Colombo	P01	Mouse	1200	2
1001	10-02-26	C01	Nimal	Colombo	P02	Keyboard	2500	1
1001	10-02-26	C01	Nimal	Colombo	P03	Monitor	15000	1
1002	11-02-26	C02	Kamal	Kandy	P01	Mouse	1200	3
1002	11-02-26	C02	Kamal	Kandy	P04	Printer	22000	1
1003	12-02-26	C03	Nuwan	Galle	P03	Monitor	15000	1
1003	12-02-26	C03	Nuwan	Galle	P02	Keyboard	2500	2
1004	13-02-26	C04	Saman	Jaffna	P05	Speaker	3200	2
1005	14-02-26	C05	Ruwan	Matara	P01	Mouse	1200	1
1005	14-02-26	C05	Ruwan	Matara	P02	Keyboard	2500	1

- a. State the highest normal form of this relation R. Justify your answer.
- b. Describe the following functional dependencies with the aid of the relation R:
 - a. Full functional dependency
 - b. Partial functional dependency
 - c. Transitive functional dependency
- c. Identify the primary key of the relation R. Why?
- d. Describe how you would normalize this relation up to 3NF, and show the resulting tables. State any assumptions you make.

QUESTION 05

01. What is SQL?
02. List the two main sublanguages of SQL and describe them briefly.
03. Explain the purpose of the following SQL clauses/keywords with suitable examples:
 - i. HAVING
 - ii. ORDER BY
 - iii. EXISTS
 - iv. LIKE
04. Explain the difference between Equi-Join and Natural Join in SQL.
05. Consider the following tables and answer the questions below.

STUDENT Table

Student_ID	Student_Name	Address	Contact_No
S001	Nimal Perera	Kandy	0712345678
S002	Kasuni Silva	Colombo	0723456789
S003	Tharindu Jayasuriya	Galle	0774567891
S004	Dilini Fernando	Kurunegala	0765678912
S005	Chamod Wijesinghe	Matara	0756789123
S006	Ishara Gunawardena	Negombo	0747891234

SUBJECT Table

Subject_ID	Subject_Name	Credit_Value
SUB101	Database Management Systems	3
SUB102	Programming Fundamentals	4
SUB103	Computer Networks	3
SUB104	Software Engineering	4
SUB105	Web Development	2

ENROLLMENT Table

Student_ID	Subject_ID
S001	SUB101
S001	SUB102
S002	SUB101
S002	SUB102
S002	SUB103
S003	SUB103
S004	SUB101
S004	SUB104
S004	SUB105
S005	SUB105
S006	SUB101
S006	SUB104
S002	SUB104
S002	SUB105

- a. What is the purpose of the ENROLLMENT table in this database design?
- b. Explain how SQL handles duplicate tuples in query results. How can duplicate values be removed from the result set?
- c. Write suitable SQL queries to do the following tasks:
 - i. Find the names of students who are from “Colombo” or “Galle”.
 - ii. Display the names of subjects that have a credit value greater than 3.
 - iii. Find the number of students enrolled in each subject.
 - iv. Find the students who are enrolled in “SUB101”.
 - v. Display the student names and subject names for all enrollments using a JOIN operation.

QUESTION 06**STUDENT Table**

Student_ID	Student_Name	Address
S001	Gayana	Kandy
S002	Kalana	Colombo

ENROLLMENT Table

Student_ID	Subject_ID
S001	SUB101
S003	SUB102

01. Answer the following questions:
- Identify the primary key and foreign key in the above tables.
 - Explain the Entity Integrity Rule using the STUDENT table.
 - Explain the Referential Integrity Rule using the ENROLLMENT table.
 - State whether the value 'S003' in the ENROLLMENT table violates any integrity rule. Give reasons.
02. Consider the relation R2 (A, B, C, D, E) and the given Functional Dependencies to answer the following questions:

$$AB \rightarrow C$$

$$C \rightarrow D$$

$$D \rightarrow E$$

- What is/are the candidate key(s) of the relation R2?
 (a) A (b) B (c) AB (d) CD (e) DE
- Which of the following statements is/are true? Why?
 (a) The Functional dependency $C \rightarrow D$ violates 2 NF.
 (b) The best normal form of the relation R2 satisfies is 1 NF.
 (c) The Functional dependency $D \rightarrow E$ violates 3 NF.
 (d) The best normal form of the relation R2 satisfies is 2 NF.
 (e) The Functional dependency $AB \rightarrow C$ violates 2 NF.

03. Consider the following tables:

STUDENT Table

Student_ID	Student_Name	City
S001	Akil	Kandy
S002	Rishi	Colombo
S003	Robin	Galle
S004	Andrea	Colombo
S005	John	Matara

SPORT Table

Student_ID	Sport	Level
S001	Cricket	School
S002	Volleyball	District
S004	Tennis	School
S005	Football	National

MUSIC Table

Student_ID	Instrument	Grade
S002	Piano	9
S003	Guitar	7
S004	Violin	8
S005	Drums	8

- a. Describe the following operators in Relational Algebra with the aid of examples from the above tables:
- Union ($\cup$)
 - Intersection ($\cap$)
 - Difference ($-$)
 - Cartesian Product ($\times$)

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