00624

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	: 2024/2025
Date	: 17th June 2025
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.

QUESTION 01

1) How does a DBMS help manage a database?

2) What is Data Independence, and why is it important?

3) List two properties of a well-designed database.

4) What are Metadata in a database context?

5) Briefly explain the following terms in the context of database systems.

   a) Foreign Key
   b) Candidate Key
   c) Composite Attribute

6) How would you define Data Integrity?

7) Write a SQL query to display the Names and Emails of all students from the STUDENT table who are enrolled with the 'Computer Science' department.

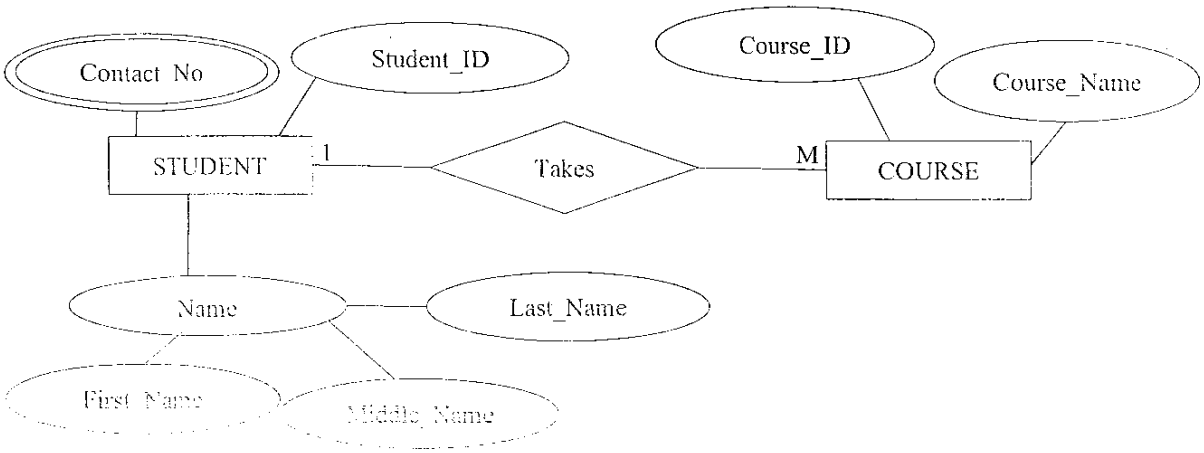
8) How do File Systems suffer from Data Inconsistency?

9) Give an example of a Data Anomaly caused by Redundancy.

10) Given the ER diagram below;

   a) Obtain the appropriate Relational Schema for the Entities and Relationships shown.

   b) Assume a scenario in which students have the opportunity to register for different courses, and each course may have a number of students participating. Suggest improvements to the ER diagram to better model this scenario. Redraw the ER diagram accordingly with your assumptions (if any), and then derive the Relational Schema for the updated ER diagram.



QUESTION 02

1) Describe the concepts of Functional Dependence and Full Functional Dependence in the context of Relational Databases. Provide one example for each.

2) State whether the following statements are **True** or **False**. If your answer is **False**, explain why.

   a) Any changes made to a database structure are automatically recorded in the Data Dictionary.

   b) Data Manipulation Language (DML) is the language used to describe the content of the database.

   c) Conceptual Model focuses on the logical nature of the data representation.

   d) In a Hierarchical Model, each parent can have only one child.

   e) Fields qualified to be selected, but not selected as the primary key are known as secondary keys.

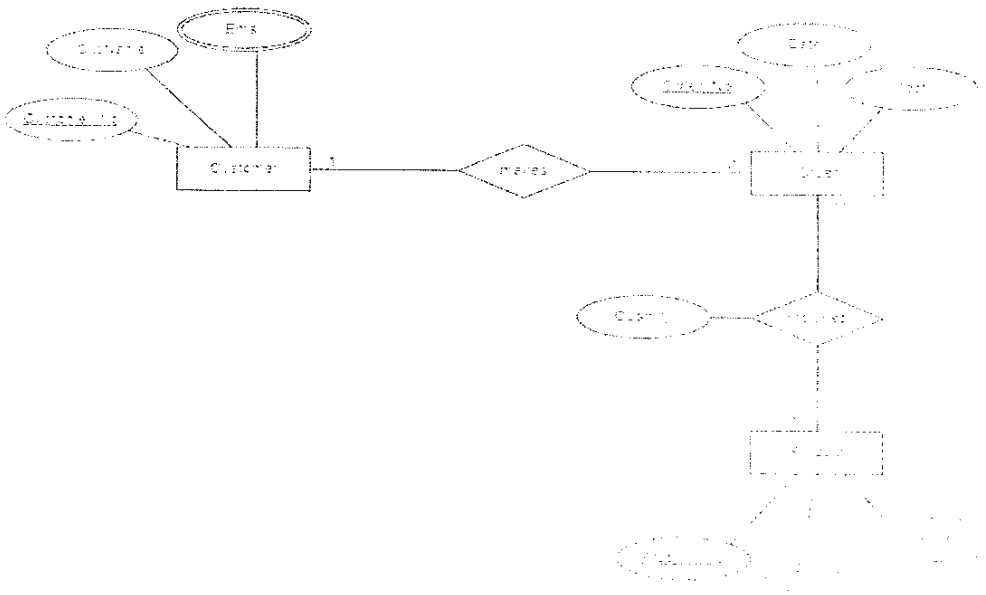
3) Given the ER diagram below;

   a) Draw the appropriate Relational Schema.

   b) Now enhance the below ER diagram to include the details of spare parts of a product.

   Note: A spare part cannot exist on its own and a spare part's Primary Key includes the Product's ID.

Draw the updated ER diagram and derive the Relational Schema for the updated ER diagram.



4) By looking at the two tables (LEADER & TEAM) in the "FOOTBALL" database, write suitable SQL queries to do the following tasks.

LEADER

LEA_ID	LEA_NAME	LEA_ROLE	NATIONALITY	TEA_ID
1	John Smith	Manager	USA	1
2	Carlos Mendes	Captain	Brazil	1
3	Sarah Johnson	Manager	Canada	2
4	Diego Alvarez	Captain	Argentina	2
5	Hans Müller	Manager	Germany	3
6	Liam O'Connor	Captain	Ireland	3

TEAM

TEA_ID	TEA_NAME	CITY	STADIUM_NAME
1	Red Warriors	New York	Warrior Stadium
2	Blue Falcons	Los Angeles	Falcon Arena
3	Green Giants	Chicago	Giant Dome

a) List all leader names that contain the letter 'a' anywhere in their name.

b) Display each leader's name and a modified version where all occurrences of the letter 'a' are replaced with an asterisk (*).

c) Show the names of all leaders along with their corresponding team names.

d) Count and display the number of leaders associated with each team ID.

e) Find the names of leaders who are from 'Argentina' or 'Ireland'.

QUESTION 03

01) Explain below concepts.

a) Define what a Superclass and Subclass are.

b) Describe the purpose of Generalization and Specialization.

02) Consider a hospital database system.

Nova - Care hospital situated in Nugegoda, depends on a large number of persons for its continued success. This hospital wishes to construct a database for its operations. The requirements are given as follows:

The hospital mainly depends on three groups of persons. They are employees, physicians and patients. All these persons have an identification number, name, address, birthdate and a phone number. In addition, employees have a hire date, physicians have a specialty and patients have a contact date. Some persons in the hospital community do not belong to any of these groups. However, a particular person may belong to two or more of these groups at a given time

Each patient has only one physician responsible for that patient. At a given time, a physician may or may not be responsible for one or more patients. There are two groups of patients. They are in-patients and out-patients. Each in-patient has a date admitted. Each out-patient visits the hospital one or more time(s). For each visit, date and comments are recorded. An instance of a visit cannot exist without an out-patient

There are three groups of employees. They are nurses, staff and technicians. Qualification, job type and skills are recorded for each nurse, staff and technician respectively. Each nurse is assigned to one ward. For each ward the name (unique) and the location is recorded.

A ward may have one or more nurses assigned to it. In addition, for each ward one of the nurses is appointed as a nurse in charge. A ward may have 10 or more beds. For each bed an identification number is recorded. The bed identification consists of the bed number and room number. Each in-patient is assigned to a bed. A bed may or may not have an in-patient assigned to it, at a given time. Each technician is assigned to one or more laboratories. A laboratory has a name (unique) and location. A laboratory must have at least one or more technicians assigned to it.

a) Identify the Entities that could be used for the above requirements.

b) Identify suitable Attributes and the Primary Keys, if any, for each of the Entities that you have identified. List one Composite Attribute

c) Is/Are there any Weak Entity(s)? Justify your answer.

d) Identify a list of likely Superclass/Subclass relationship. Justify your answer.

e) Draw a suitable ER diagram for the above given requirements. State any assumptions you make.

QUESTION 04

1) A railway operator has asked for a new database to be designed for them to keep track of trains. They have been provided with the following sample table capturing their requirements:

Route	Train No and Type	Engine	Scheduled departures	Scheduled Arrivals
London-Paris	103 Express	Class 3	London 10:02 Ashford 13:05	Ashford 13:00 Paris 16:00
London Glasgow	104 Express	Class 3	London 7:00 Birmingham 9:00 Manchester 10:00	Birmingham 8:45 Manchester 9:45 Glasgow 14:00
	105 Express	Class 3	London 9:00 Birmingham 11:00 Manchester 13:00	Birmingham 10:45 Manchester 12:45 Glasgow 17:00
London Birmingham	207 Local	Class 5	London 7:00	Birmingham 13:00
London Southhampton	308 Local	Class 5	London 14:00	Southhampton 19:00

Consider the above table and answer the following questions:

a) The table is in unnormalized form.

i. Explain the characteristics of an unnormalized table.

ii. What problem can occur when searching for data about departures from a particular station? Give an example from the table.

iii. What problem can occur when a row is deleted from this unnormalized table? Give an example from the table.

b) Normalize the above table to 1NF.

c) Identify the Partial Dependencies in the 1NF table from part b).

d) Convert the table from part b) to 3NF.

2) Consider the given database system of a company.

A company operates with several departments. Each department has a unique department number (d_no), a name, and can be located in one or more locations. Each department is managed by one manager, who is an employee of the company. A department can be associated with multiple projects, but each project is controlled by only one department.

Each project has a project name, a unique project number, and a location.

The company employs a number of employees. Each employee has a name, ID, address, job title, and date of joining. Every employee works in only one department, but they may work on multiple projects. The system keeps track of the number of hours each employee works on each project.

Each employee has one or more dependents. For each dependent, the name (d_name), gender, and relationship to the employee are recorded.

a) Draw a complete Entity-Relationship (ER) diagram using Chen Notation.

b) Show all Entities, Attributes and Relationships clearly.

c) Indicate Cardinalities and Participation constraints (Mandatory/Optional) for each Relationship.

d) Include any Weak Entities and Associative Entities, if only applicable.

3) Many-to-Many (M: N) relationships can cause problems when directly implemented in Relational Databases.

a) Explain why M: N relationships are difficult to handle directly. Focus on issues like Data Redundancy and the complexity of operations such as updates and deletions.

b) Describe what an Associative Entity is, how it works, and why it is a good solution for handling M: N relationships.

QUESTION 05

Explore the following database instances tailored for managing Sri Lanka's vibrant tourism sector:

Table: HOTEL

Hotel_ID	Hotel_Name	Location	Stars
H101	Lagoon Paradise	Negombo	5
H102	Mountain View	Kandy	4
H103	Beachside Bliss	Hikkaduwa	4
H104	Ancient Gateway	Anuradhapura	3

Table: ACTIVITY

Activity_ID	Activity_Name	Location	Cost (LKR)
A201	Whale Watching	Mirissa	6000
A202	Cultural Tour	Kandy	1500
A203	Surfing Lessons	Arugam Bay	2500
A204	Safari	Yala	8000

Table: VISITOR

Visitor_ID	Visitor_Name	Country
V301	Alice	UK
V302	Bob	Australia
V303	Chen	China
V304	Devi	India

Table: BOOKING

Visitor_ID	Hotel_ID
V301	H101
V302	H102
V303	H103
V304	H104
V301	H102
V302	H103

Table: ATTRACTION

Attraction_ID	Attraction_Name	Location	Hotel_ID
AT401	Fort Frederick	Trincomalee	H104
AT402	Temple of the Tooth	Kandy	H102
AT403	Ramboda Falls	Nuwara Eliya	H102
AT404	Galle Fort	Galle	H103

1) What are the output tables you get when you apply the following Relational Database Operators to the above tables (HOTEL, ACTIVITY, VISITOR, BOOKING and ATTRACTION are table names)?

   a) HOTEL `DIVIDE` BOOKING

   b) VISITOR `DIFFERENCE` BOOKING

   c) ACTIVITY `INTERSECT` ATTRACTION

   d) ATTRACTION `PRODUCT` VISITOR

   e) HOTEL `JOIN` ACTIVITY

2) Write suitable SQL queries to perform the following tasks:

   a) Select the Hotel_Name and the character length of the Hotel_Name from the HOTEL table.

   b) Identify visitors whose names start with the letter 'A.'

   c) Retrieve the names of visitors from 'India'.

   d) Find the hotel close to 'Temple of the Tooth' attraction.

   e) Calculate the total number of records in the ATTRACTION table.

3) One of the private banks in Sri Lanka has decided to store their information in a database. The information is as follows:

   - A Customer has an ID, Name and an Address. In addition, he/she may hold several Phone Numbers.
   - Each Customer holds at least one Account with the bank and an Account must have only one Customer. An Account should have an ID, Name and Type
   - An ATM has an ID and a location and each branch has an ID and a name. Many customers can use any number of ATMs to perform Transactions.
   - A branch owns at least one Account and an Account is owned by only one branch.
   - An ATM may (may not) belongs to a branch and a branch can have at least one ATM.

   a) Draw the complete ER diagram.

   b) Show the proper Connectivity of the Relationships.

   c) Show the Cardinalities of each Entity with each Relationship.

   d) Represent the Relationship's Participation as Optional or Mandatory

QUESTION 6

1) What is the difference between the UPPER () and LOWER () functions in SQL?
2) What is the purpose of the 'having' clause in a SELECT statement?
3) Consider the following database instances

Table: STUDENT

Stu_ID	Name	Email	Phone
1	Anjali Perera	anjali@gmail.com	0711122334
2	K. Fernando	kfernando@yahoo.com	0774455667
3	Nuwan Bandara	nbandara@gmail.com	0769988776
4	Isuru Madushan	imadu@hotmail.com	0712345678
5	S. Wijesinghe	swije@outlook.com	0786655443

Table: COURSE

Course_ID	Course_Name	Lecturer	Credit_Hours
1	Database Systems	Prof. Ruwan	3
2	Network Security	Dr. Hansika Perera	4
3	Operating Systems	Prof. D. Nimal	3
4	Software Engineering	Dr. K. Jayasinghe	2
5	Artificial Intelligence	Prof. Uditha Silva	4

Table: ENROLLMENT

Enroll_ID	Stu_ID	Course_ID	Enroll_Date
1	2	1	2023-01-15
2	1	3	2023-01-20
3	5	5	2023-02-12
4	4	2	2023-02-25
5	3	4	2023-03-01

Write suitable SQL queries to do the following tasks.

a) Display all columns from the STUDENT table.

b) Display the Course_Name and Lecturer for all courses that have more than 3 credit hours.

c) Insert a new student into the STUDENT table with the name "Dilini Gunasekara", email "dilini@gmail.com", and phone "0755544332".

d) Update the Email of the student with Stu_ID = 3 to "newemail@gmail.com"

e) Delete the row from the COURSE table where the Course_ID is 4.

f) Display the Name and Phone of all students whose name starts with the letter 'S'.

g) Display all unique Lecturer values from the COURSE table.

h) Display the Enroll_Date column from the ENROLLMENT table sorted in descending order.

i) Display the Course_Name from the COURSE table for all courses that contain the word "Systems".

j) Show a list of students who have enrolled in "Artificial Intelligence", displaying their Name and Email.

4). The "Sri Lanka Tourism" agency wants to manage information about tourists, hotels, and tourpackages. Here are the requirements for the database:

- A tourist can book one or more tour packages.
- A tour package is offered by one or more hotels.
- A hotel offers one or more tour packages.
- Each hotel has a unique name, location, and number of rooms.
- Each tourist has a unique name, nationality, and email address.
- Each tour package has a unique name, description, duration, and price.
- Each booking should include the date of booking, the date of check-in, the date of check-out, and the number of guests.
- A tourist can book multiple rooms for a single tour package.
- A hotel can offer multiple tour packages.

Using the above requirements, answer the following questions:

a) Identify the Entities that could be used for the above given requirements.

b) Is there a Weak Entity type?

c) Identify suitable Attributes for each of the Entity Types that you have identified.

d) Design an ER diagram for the above requirements. Any assumptions you make should be clearly stated.