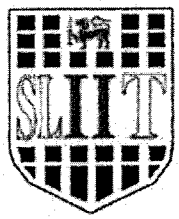


Sri Lanka Institute of Information Technology

B.Sc. Honors Degree in Information Technology

Specialized in Cyber Security

Final Examination
Year 2, Semester 1 (2022)

IE2042 – Database Management Systems for Security

Duration: 2 Hours

June 2022

Instructions to Candidates:

- This paper has 4 questions.
- Answer all questions in the booklet given.
- The total marks for the paper is 100.
- This paper contains 7 pages, including the cover page.
- This paper is preceded by a 10-minute reading period. The supervisor will indicate when answering may commence.

Question 01 (25 Marks)

a) A manufacturing company produces products. The following product information is stored: product name, product ID, Type which can be (Rubber, Metal, Wood, Hybrid), quantity on hand and price. These products are made up of at least 2 components and can have many components. The following component information is kept component ID, name, description, suppliers who supply them, and products in which they are used Each component in the database is supplied by one or more suppliers and different suppliers will specify different prices for the same component. Suppliers have an ID, Name, Address, and email. All the products are designed by an employee. Employees have a Name, ID, Address, email, multiple phone numbers, salary. Products are bought by buyers through a purchase order. A buyer can place many orders. For the orders the ID, date, delivery date and total amount is stored. Additionally, each purchase order can be for one or more products and each product can be part of zero or more purchase orders. The price of the product at purchase order date needs to be remembered as well.

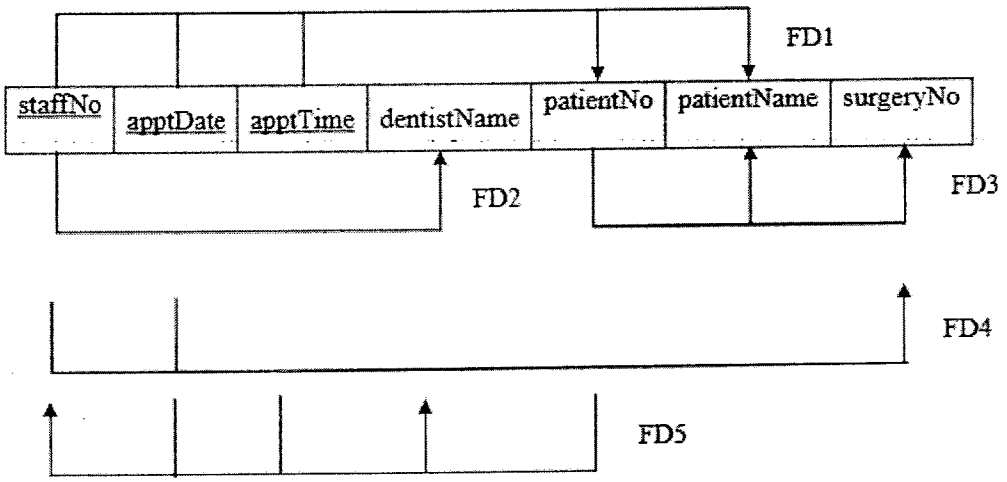
Create an ERD using Chens notation to show how you would track this information. Show entity names, primary keys, attributes for each entity and the relationships between the entities with the cardinality. Any assumptions you make must be also indicated.

(12 marks)

b) List down the requirements for a relation to be in 1NF, 2NF, 3NF.

(3 marks)

c) Below diagram shows a schema proposed for a dentist office database along with the functional dependencies which are shown using arrows. Decompose the given relation to 3NF. Show the work and application of rules when you are decomposing.



(10 marks)

Question 02 (25 Marks)

a) The below diagram shows an ERD used to create part of the database used by an educational institute. The answers to the below shown questions should be written based on the ERD given below.

i. Write the SQL statement that will display names of all the courses studied by the student with first name "Nishanthi".

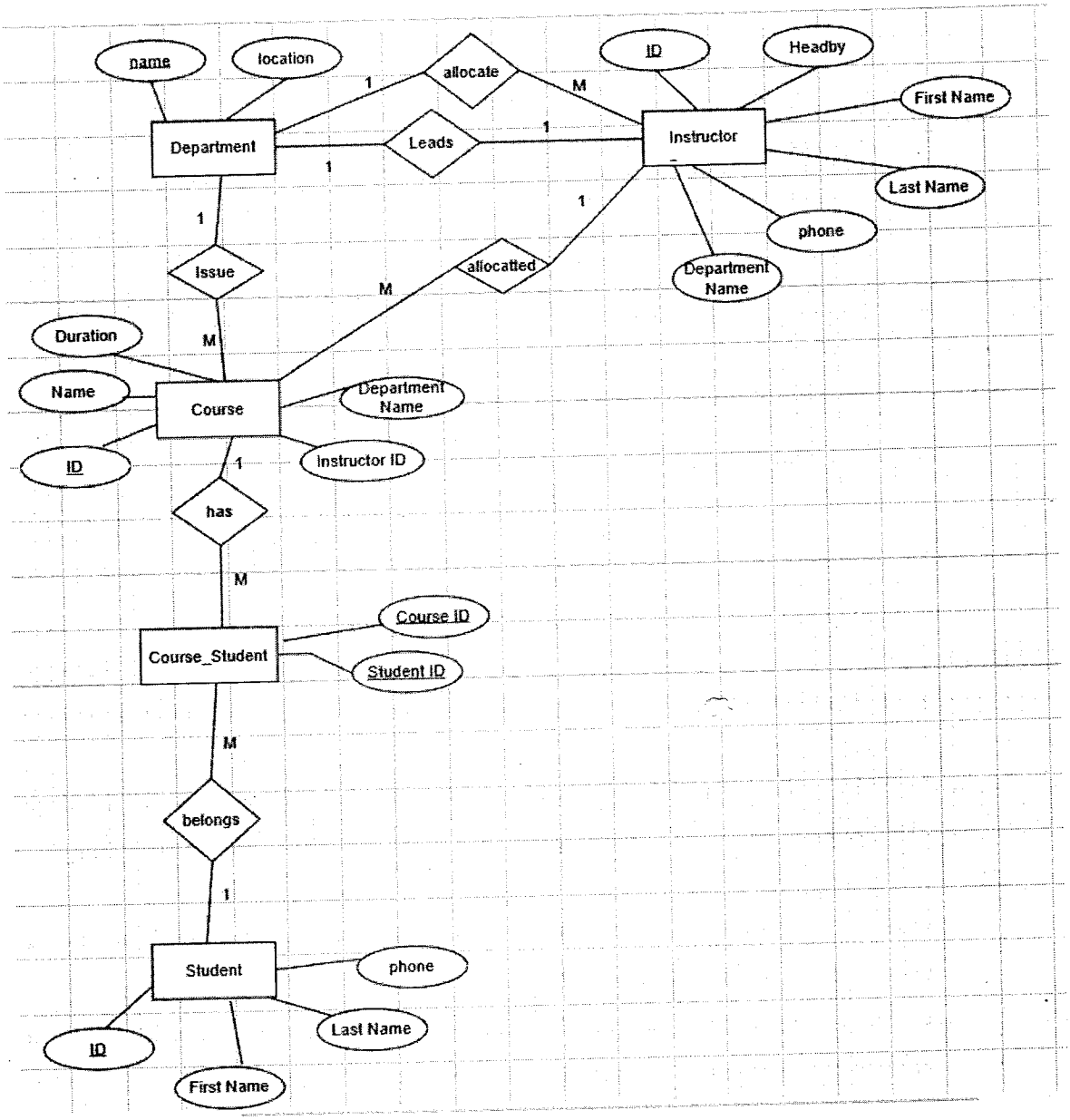
ii. Write the SQL statement that will list the name of each department, its location, and the number of instructors assignment to that department

iii. Write the SQL statement that will generate a view named *Course_Teaching* and will have the following attributes

   a. Course (ID, Name, Duration) and Instructor (First name, Last name)

iv. Write a SQL stored procedure named *InsHours* that will take as input an instructor ID and display the instructors first name and total number of course hours assigned to him.

v. Write a trigger named *DurationIncrease* that will increase the duration of any course entered into the course table by 5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Question 03

(25 Marks)

a) File Organization defines how file records are mapped onto disk blocks. Compare and contrast the three types of "File Organization" **(6 marks)**

b) Explain the importance of an "Index" using an example **(3 marks)**

c) "We can have more clustered indexes and only one un-clustered index per a table"

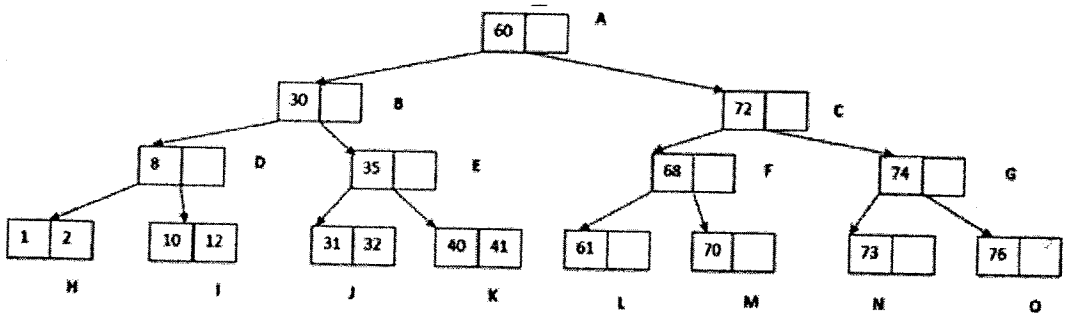
i. Identify whether the above statement is true or false. **(1 mark)**

ii. Justify your above answer (you can use diagrams) **(3 marks)**

d) Consider the following B+ tree and draw the final B+ tree s after doing the given operations.

i. Delete 31 and 32 **(2 marks)**

ii. Insert 11 after deleting 32 **(2 marks)**



e) Consider the following database design information and answer the following question.

Customer(cus_id, cus_name, age)

Account(acc_no, acc_type,total_bal)

Transaction(cus_id, acc_no, amount)

Customer relation contains 6000 pages with 300 tuples per page, Account relation contains 50000 tuples and 100 tuples per page, and Transaction relation contains 700 pages with 100 tuples per page.

Assume 52 buffer pages are available.

i. Use the **"Block Nested Loop Join"** algorithm to calculate the cost of joining two relations **Transactions (T) and Account (A)** **(3 marks)**

f) Consider the following schemas and answer the following questions.

Emp(eno, ename, age, department_name)

Company(cmp_name, cmpId,city)

Work(eno, cmpId, time)

i. Write the query to find the names of the employees who work for the department and whose age is above 50 years. **(1 mark)**

ii. Write a relational algebraic expression for the above query. **(2 marks)**

iii. Draw a Query tree correspondence to the above answer (ii). **(2 marks)**

Question 04

(25 Marks)

a) Consider the following schedule which uses the **Strict 2PL protocol.**

T1	T2	T3	T4
S(A)			
R(A)	X(A)		
	W(A)		
S(B)		S(C)	
		R(C)	
	X(C)		
			X(B)
		X(B)	

i. Identify whether a deadlock exists in the above schedule. **(1 mark)**

ii. Explain how you obtained the above answer (i). **(3 marks)**

iii. If a deadlock has occurred, describe how does the DBMS resolve the deadlock?

(3 marks)

iv. Briefly explain the **Phantom problem.** **(2 marks)**

v. Use an example and briefly describe how does the DBMS avoid the phantom problem **(2 marks)**

b) Analyze how you can preserve Confidentiality, Integrity, and Availability when making a secure database application. **(5 marks)**

c) Compare and contrast Dictionary and Mandatory Access control methods, **(4 marks)**

d) Describe what a Brute force attack is. **(2 marks)**

e) List down 3 methods to prevent Brute force attacks **(3 marks)**

END