

Department of Computer Science and Engineering (CSE)

MASTER FINAL EXAMINATION

WINTER SEMESTER, 2016-2017

TIME: 3 Hours

FULL MARKS: 150

CSE 4307: Database Management Systems

~~Programmable calculators are not allowed. Do not write anything on the question paper.~~
~~Answer 5(eight) questions. Question No. 1 and 3 are mandatory. Answer any 4 (Four) from the remaining questions. Figures in the right margin indicate marks.~~

~~The processing system introduces data redundancy and inconsistency. It also incurs inconsistency problem." Place suitable examples to justify these statements.~~ 5

~~What do you mean by 1-1 mapping (or cardinality)? Present a real-life scenario where mapping should be used to design an efficient system.~~ 5

15

~~Suppose there are two relations:~~

- ~~- employees (ID, Name, DOB, DeptName, Dept, Budget, Dept Location).~~
- ~~- Students (ID, Name, DOB, DeptName, Dept Building Area Size (in square meter))~~

~~These tasks are as follows:~~

- ~~i) Criticize the design with its major pros and cons.~~
- ~~ii) Propose an alternative design to eliminate the problems you have just mentioned.~~
- ~~iii) Finally place proper examples to prove that your modified design is able to answer following queries:~~

- ~~• Find the students' name and date of birth who study in the departments that are located at the "Second Academic Building".~~
- ~~• Find the employees name and date of birth who work in the departments that are bigger than 4500 square meter in size.~~

~~Define the following terms with examples:~~

6

~~i) Projection ii) Selection iii) Cartesian Product~~

~~Define super key, candidate key, primary key and foreign key.~~

3+10

~~Now consider the following system description of a typical library automation:~~

~~There are books on different subjects such as Computer Science, Mechanical, Education etc. Each book have information such as Book Title, Author Name, Publisher Name, Publishing Year. There are a number of copies of a single book (e.g Java-How to Program, 60 copies).~~

~~There are a number of departments in the University. Each department runs a number of programs. The students information system stores basic information of each students such as name, date of birth, address, father name, department name (i.e. CSE, EEE), program~~

name (i.e. B.Sc. or I.I.D).

Students can borrow book and return book in time without fine.

Your tasks are:

- i) Design the E-R diagram and its equivalent DDL statements.
 - ii) In each case determine the primary key and foreign key.
 - c) What is the difference between inner join and outer join? Explain left outer join and right outer join with suitable example data. "Natural join removes meaningless records." Justify with suitable example.
3. a) Explain DDL and DML with suitable examples.
b) Consider the following description:

Table: Department

Attribute	Description and/or Data Type	Requirement / Other information
ID	Numeric with no decimal part.	Primary key
Short Name	3 characters	Exactly 3 characters, can not be null
Full Name	100 characters	Can be null
Date of Establishment	Date	Can be null
Location	35 characters	Value should be either i) First Academic Building or ii) Second Academic Building
Head of Dept	Present head of department	Foreign key referencing the table Teachers

Table: Teachers

Attribute	Description and/or Data Type	Requirement / Other
ID	Numeric with no decimal part.	Primary key
Name	50 characters	It may be used by other than English language such as Chinese.
DOB	Date	No date before January 1, 1950 is allowed.
Designation	25 characters	Any values from the List: {Lecture, Assistant Professor, Associate Professor, Professor}
Salary	Monthly Basic Salary	May be null only for unemployed.
BloodGroup	Character	Any value from List{A+ve, A-ve}

Immediate Boss		B+ve, B-ve, AB+ve, AB-ve} Foreign Key referencing Teachers table itself (self-reference).
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Table: Students

Attribute	Description and/or Data Type	Requirement / Other information
ID	Numeric	Primary key, E.g. 164409
Name	60 characters	
DOB	Date	It must be greater than 31-DEC-1985
Dept	Student's dept.	Foreign key referencing the table Department

Table: Courses

Attribute	Description and/or Data Type	Requirement / Other information
ID	8 characters	Primary key, E.g. CSE 4401
Title in Full	60 characters	
Credit Hour	Numeric	It must be between 0.5 to 4.0
Offering Dept	Which dept is offering the course	Foreign key referencing the table Department

Your tasks are as follows:

- i) Create tables as described.
- ii) Note that the table Department has the Head of Dept field that stores only the present head of the department. It has no way to store the history of heads of each department. How can you include this feature? Explain. 
- iii) Students should be able to take a number of courses in each semester. First comment on the cardinality between students and courses. Finally present the DDL in this regard.
- iv) Consider the table definitions of Question No. 3 and answer the followings using standard SQL query: 5x2
 - i) List of the teachers name, date of birth and his/her immediate boss's name (if any) according to Salary in decreasing order.
 - ii) Find the students name and his/her department name whose names start with 'A' and end with 'A'.
 - iii) List the department name and total number of students admitted of the corresponding department.
 - iv) List the department name and total number of students admitted of the corresponding department for the departments whose budgets are more than 90000.
 - v) List the department name and total number of students admitted of the corresponding department for those departments that have at least 100 students admitted.

- b) What is a view? What is the basic difference between a table and a view? "Most SQL implementations allow updates only on simple views" Justify it using suitable example.
- c) Describe the single-level index entry deletion process using a suitable example.
5. a) Describe the ACID properties of transaction.
 b) Consider the following 2 transactions:

T_1 : Transfer \$50 from A to B

T_2 : Transfer 10% of the balance from A to B

Present three schedules S_1 , S_2 and S_3 such that S_1 is serial and S_2 and S_3 are not serial. Moreover, S_1 and S_2 logically equivalent and preserve the correctness while S_3 does not preserve the correctness.

- c) Define entity and attribute. Explain different types of attributes with appropriate examples.
6. a) What is a weak entity set? Define discriminator. "*The primary key of a weak entity set is formed by the primary key of the strong entity set on which the weak entity set is existing dependent, plus the weak entity set's discriminator.*" Explain with suitable example.
 b) Classify the constraints on generalization or specialization based on the followings:
 i) Attribute of higher-level entity determines lower-level entity membership
 ii) The number of branching in its lower-level entity
 iii) Completeness
 c) "Each occurrence of an entity set plays a role in the relationship" Explain with example.
7. a) "Two schema can be merged into one larger schema". Explain this concept with a suitable example and discuss its relative pros and cons.
 b) What is functional dependency? Explain with a suitable example.
 c) "Bad decomposition may result in invalid records". Establish this fact with a suitable example data set.
8. a) Define superkey using functional dependency. "Trivial dependency is always valid" Explain with an example.
 b) Explain the conditions of Boyce-Codd normal form (BCNF). State a general rule for decomposing schema that are not in BCNF.
 c) What is the basic purpose of indexing in database? What is the basic difference between primary index and secondary index.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

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WINTER SEMESTER, 2017-2018
FULL MARKS: 150

CSE 4307: Database Management Systems

Programmable calculators are not allowed. Do not write anything on the question paper.

You are 8 (eight) questions. Question No. 7 and 8 are compulsory to answer. Answer any 4 (four) from the remaining questions. Figures in the right margin indicate marks.

File processing system introduces difficulty in accessing data. It also incurs integrity problem. 10

- Place suitable examples to justify these statements.

Write down the main responsibilities of a Database Administrator (DBA). 5

What is relational algebra? Briefly outline its major three operations. What is the basic 10

difference between the relational algebra and query language?

Consider the following database design: 3x4

employee (person name, street, city)

works (person name, company name, salary)

company (company name, city)

Give expressions both in the relational algebra and standard SQL to express each of the following queries:

i. Find the names of all employees who live in city "Dhaka".

ii. Find the names of all employees whose salary is greater than \$60000.

iii. Find the names of all employees who live in "Dhaka" and whose salary is greater than \$60000.

What is the basic difference between DDL and DML? Explain with example. 5

What is the difference between inner join and outer join? Explain left outer join and right outer join with suitable example data. 8

Answer the followings: 4+4

i. Explain DDL and DML with suitable examples.

ii. Null values introduce a number of problems in arithmetic operations in SQL statements.
 Justify with suitable example.

Is it possible to add a "where" clause in an SQL statement involving aggregate functions? 5
 Justify your opinion with example.

Consider the following relations: 2x6

Note: ID is the primary key of each entity. x(FK[r]) indicates x a foreign key referencing entity r)

persons(ID, Name, DOB, Address)

schools(ID, Name, Establish_Year)

companies(ID, Name, Location)

students(ID, Person_ID (FK[persons]), gpa, school_ID(FK[schools]))

emp(ID, Person_ID(FK[persons]), Salary)

Write the following SQLs:

- i. List the person Name, ID and Address according to their age (i.e. Older first)
 - ii. List each student's information as following:
Student ID, Student Name, Name of School, gpa
 - iii. List the school's summary as : School Name, Total Students, average gpa
 - iv. List top 5 schools based on the average gpa (as obtained in iii)
 - v. List employees name, his/her company name, salary
 - vi. Update each employee salary by 20% for those who currently get less than the salary of his/her company's employees salary
4. a) Define Super Key, Candidate key, Primary key with example data.
- b) What is jdbc? What are essential parameters for making a jdbc connection? Present example code (only relevant part of the code is expected).
- c) What is a view? What is the basic difference between a table and a view? Can you insert into a view? Justify it using suitable examples.
- d)
 - i. What is cardinality? How do you ensure many-many cardinality? Use example explain.
 - ii. Differentiate between Cartesian product and natural join.
 - iii. "Natural join removes meaningless records." - Justify with suitable example.
5. a) Name the four integrity constraints on single relation. Create one table involving constraints (use standard SQL).
- b)
 - i. What is a trigger? Mention one scenario where you are advised to use trigger; another scenario where it is not encouraged to use trigger.
 - ii. Consider emp(ID, Name, DOB, address, Retired (yes or no)). You are the dba of company. Whenever any employee finishes his/her job and gets into retirement, Retired flag is set to YES. And all personal information of that employee should copies to another table for historical reference.
- Write SQL code to perform the above task.
- c) Define entity and attribute. Explain different types of attributes with appropriate examples
6. a) Classify the constraints on generalization or specialization based on the followings:
- i. Attribute of higher-level entity determines lower-level entity membership
 - ii. The number of branching in its lower-level entity
 - iii. Completeness
- b) What is functional dependency? Explain with a suitable example.
- c) Explain the conditions of Boyce-Codd normal form (BCNF). State a general rule for decomposing schema that are not in BCNF.

7. [Compulsory]

Consider following Library Management System (LMS):

System description: The existing manual Library Management System (LMS) should be replaced by an automated system. Library stores books on various major subjects such as Physics, Chemistry, Science and so on. Each major subject may have further details such as: Computer Science is further detailed (e.g. Networking, Database, AI and so on). Library procures books from various publishers, it contains information such as publisher name, country and reputation (allowed values are: excellent, good, bad). The system should store book's basic information such as: title of the publisher, year of publish, price. It can store multiple copies of the same book and uniquely identify each book efficiently.

Both students and staffs can borrow (normal borrow) books. Once a book is issued to a student or staff, it cannot be borrowed again until it is returned.

• staff the book is no longer available until he/she returns it. After borrowing book
• return book within 7 days. Apart from normal borrow the system also allows to issue
• against a number of students (e.g. 3 students can take one book) and the number of
• not fixed. This mode of borrowing is called shared borrow. In shared borrow multiple
• one book but one student is assigned as major user while others are associate users.
• user is responsible for any unusual cases such as: book lost or stolen (this module will not

Ques 7 Reports:

Given book report with the following information:

Book No, Book Title, Publisher Name, Country of Publisher, Date of Purchase

Summary book report with the following information:

Book No, Book Title, Publisher Name, Country of Publisher, Total Copy, Total Copy Available

Given a student ID or staff ID list of books he/she borrowed but yet not returned.

Given a student ID or staff ID list of books he/she borrowed during the last 30 days.

Take E-RD of the system. (You are free to make additional assumption for both entities and attributes)

Implement E-RD using proper DDL statements.

Write SQL statements for the mentioned reports.

Ques 8 Compulsory

10

X is database designer of very large company containing 20000 employees. As part of the system design he has done the following in regard to employee's information:

- The total salary of each employee is calculated as follows:

Total Salary = Basic + 40% of Basic (as house rent)

Mr. X designed emp entity as follows:

emp(ID, Name, Date of Birth, Join Date, Age, Basic Salary, House Rent, Total Salary)

- In order to make employee ID more informative he designed the ID as follows:

ID: X-NNN where X is either S or M or J, NNN is a 3-digit number.

Here S, M and J stand for Senior, Medium and Junior. An employee has S status if he/she worked more than 10 years, M status if he/she worked more than 3 years and less than 10 years, others are with J status.

Since you have taken the database course in your undergrad, you think Mr. X has some design problems in this context. Your task is to explain the major design problem and at the same time propose an ideal solution to eliminate those problems.

Referring the Q.8 a) the business rule for calculating total salary has been changed as follows:

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Total Salary = Basic + 40% of Basic (as house rent) + 50\$ for each child.

Your tasks are:

- Modify the DDLs to accommodate the new requirement.
- Write a PL/SQL function that takes employee ID as IN parameter and computes and returns the total salary.

Is it possible to declare one attribute as primary key and foreign key (referencing different entity)? Justify your position with a suitable real-life example.

5

Is it possible to declare one attribute as primary key and foreign key (referencing the same entity)? Justify your position with a suitable real-life example.

5

CSE 4307: Database Management Systems

Calculators are not allowed. Do not write anything on the question paper. There are 8(eight) questions. Question No. 7 and 8 are compulsory to answer. Answer any 4(four) from the remaining questions. The numbers in the right margin indicate marks.

One of the major drawbacks of traditional file processing system is the *difficulty to access data*. Explain it with a suitable example. Mention some widely used applications of modern database systems. [10]

A major purpose of a database system is to provide users with an abstract view of the data. Explain the concept of different types of *data abstraction* in modern database systems. [10]

What are projection and selection? Does the order of these operations matter in the final result? Explain with example. [05]

Explain and differentiate between Data-Definition Language (DDL) and Data-Manipulation Language (DML). [05]

Explain super key, candidate key, primary key and foreign key. Consider the following system [5+10] description of a typical library automation:

There are books on different subjects such as Computer Science, Mechanical Engineering, Education etc. Each book have information such as Book Title, Author Name, Publisher Name, Publishing Year. There are a number of copies of a single book (e.g Database System Concepts, 10 copies). There are a number of departments in the University. Each department runs a number of programs. The students information system stores basic information of each students such as name, date of birth, address, father name, department name (i.e. CSE, EEE), program name (i.e. B.Sc. or M.Sc.). Students can borrow book and return book.

Two tasks are:

i Design the E-R diagram and its equivalent DDL statements.

ii In each case determine the primary key and foreign key.

What is the difference between inner join and outer join? Explain left outer join and right outer join with suitable examples. [05]

Following are the requirements of some tables. Each field is separated by comma (,) and additional requirements are stated in brackets []. [10]

- Departments(ID primary key, Name of dept [Can not be empty], Establishment Year)
- Employees(ID primary key [it is exactly a 9-digit number without any decimal part], Name [20 characters long but it can be in any language other than English], Date of birth [must not be empty and it can be less than 01-01-1960], Dept [foreign key of departments entity and it can not be empty], Blood Group [must be any one from A+,A-,B+,B-,AB+,AB-])
- Salary(EmpID [foreign key of Employees entity], Date of Payment, Amount)

Two tasks are:

i Create the tables using standard SQL.

ii Now you forgot to include Salary (per month) and Join Date of the Employees. How can you solve this problem?

(b) Write the SQL for the following queries:

- i. Find out the name and date of birth of all Employees who joined in the last 3 months (i.e. 90 days).
 - ii. Find out the name, date of birth and name of the department of all Employees in the last 3 months (i.e. 90 days).
 - iii. Generate a list containing department name and its total employees.
 - iv. Generate a list containing department name and its total employees but include department with at least 20 employees.
 - v. Generate a list containing department name and its total employees but include department with at least 20 employees and whose departmental average salary is greater than 20000.

(c) What is cardinality? Briefly explain different types of cardinality.

4. (a) Null value introduces a number of problems in arithmetic operations in SQL statements. Explain with suitable example.

(b) What is jdbc? Consider the entity Emp(ID,Name,Address,Dept). Write a java program which will print the name, address and dept of those employees who work in 'Accounts' department. Assume that jdbc driver is already loaded. Write only the relevant part of the code.

(c) There are four integrity constraints on single relation. Name them with suitable examples.

5. (a) What is the domain of attribute? Explain different types of attributes used in E-R model
(b) Consider the following description:

XYZ is a large company comprising about 5000 employees. To automate the Human Resources, programmers are hired. Mr. Simple, one of the programmers, designs the ID of employee as simple numbers such as 000001, 000002 and so on. Mr. Complex, another programmer, designs the ID for the format: DEPTCODE-DESIGNATIONCODE-JOINDATE-SEQUENCENUMBER (i.e. ACCOUNTS-MANAGER-01JAN2017-001).

Your tasks are:

- i. Criticize the above designs mentioning the strength and weakness of each option.
 - ii. Propose your solution minimizing the weaknesses you have just mentioned.

(c) Classify the constraints on generalization or specialization based on the followings:

- i. Attribute of higher-level entity determines lower-level entity membership
 - ii. The number of branching in its lower-level entity
 - iii. Completeness

6. (a) What is the purpose of Normal Forms in database design? Explain the concept of 1st Normal Form with example.

(b) Mention the conditions of Boyce-Codd Normal Form (BCNF). Cite two examples both valid and invalid BCNF schema. Also mention how you will decompose an invalid BCNF into valid BCNF schema.

(c) Consider the following schema and records (as presented in table 1) for a student information management system:

students(ID, Name, Date of Birth, Country Name, Capital Name, Total Population)

Yours,

Your tasks are:

- Verify if the given schema is in BCNF.
- If it is not in BCNF then decompose it as directed by the BCNF algorithm.

Table 1: Records for Question No. 6.(e)

ID	Name	DOB	Country Name	Capital	Population (in m)
1	a	1-1-87	Bangladesh	Dhaka	160
2	b	1-2-85	Afghanistan	Kabul	32
3	c	1-3-81	Bangladesh	Dhaka	160
4	d	1-3-81	Cameroon	Yaounde	17
5	e	1-4-77	Afghanistan	Kabul	32

query)

the following scenario:

A large bank with few hundreds of branches located at different parts of the country. Customers provide their profile information such as Name, Date of Birth, Address before opening account. Once a customer's profile is available he/she can open multiple accounts reusing the information. After opening account regular transactions are made. There are two types of transactions such as withdraw and deposit.

For loans Only existing customers who have valid accounts are primarily eligible for getting loans. There are 3 types of loan schemes such as Platinum, Gold and Silver . Each loan has its own terms as described in table 2.

Table 2: Properties of loan schemes for Question No. 7

Scheme	No. of Instalment	Interest Rate (per year)	Eligibility
Platinum	100	5	Total Transaction (i.e. add both types of transactions) in the last 12 months must be ≥ 2000000
Gold	75	8	Total Transaction in the last 12 months must be between 2000000 and 1500000
Silver	50	12	Total Transaction in the last 12 months must be between 1500000 and 1000000

Write:

Based on the table definitions and issue the required DDLs. Additional assumptions are welcome [08] during phase.

Write a function to assign a customer to a specific category of loans as mentioned. (assume each customer makes regular transactions such as deposit and withdraw). [08]

Output: Account No, Output:Rejected or Accepted, if Accepted it should also show which type of loan can be granted based on the Eligibility parameter as described in table.

As a customer is assigned to a specific loan scheme, write a procedure to schedule the loan. [09]
Each loan must be paid after 6 months interval.

Output: Account No, Loan Scheme, Total Amount, Starting Date. Output: It will schedule x number of equal instalments based on Total Amount and No. of Instalment of that particular scheme. The schedule information should include: account no, loan scheme, Instalment Number (starts from 1 to x), Instalment amount (i.e. total amount will be equally distributed), Payment Date (i.e. after every 6 months from the Starting Date), Payment Status. All fields except Payment Status should be initialised by the procedure. Payment Status should be set to null.

8. (Compulsory)

- (a) Suppose you have issued an UPDATE statement to a table *citizens* as mentioned in No. 8.(c) with some WHERE CLAUSE (as you like).

Write an anonymous block that will execute the above UPDATE statement. If no records are affected by the statement then it will print *NO RECORDS ARE UPDATED*, otherwise it will count the total number of updated records (i.e. X) and will print *X RECORDS ARE UPDATED*.

- (b) What is the basic difference between row-level trigger and statement-level trigger? Give with example.

- (c) Consider the table *citizens(id, name, dob, salary)*. The Government of Bangladesh (GOB) created one fund of total BDT *total_aid_amount*.

GOB wants to ensure (but can not guarantee) each citizen receives an amount *gob_allowance* such that after receiving it his/her total earning (i.e. *salary + gob_allowance*) is equal to average income of the country (average is computed before any *gob_allowance* is given). citizens having more than the average salary of the country are not eligible for this scheme.

For this purpose GOB invites applications from needy and interested people. The applications are stored in *applied(citizen_id, date of application)* table (assume only the valid applications apply). The citizens who have not applied will not be considered even his/her salary is less than average.

The citizen (who applied) with the lowest salary will get the highest priority to receive allowance and *gob_allowance* amount is determined by the difference of his/her salary and average salary of the citizen. GOB can not ensure sufficient fund for all needy citizens. So the process continues whenever the fund is exhausted (i.e. *total_aid_amount=0* or *total_aid_amount <= the difference of the average salary and the salary of the particular citizen*).

When a citizen receives *gob_allowance* an appropriate update of *citizens* table should be:

- Your task is to write a procedure *distribute_allowance* satisfying the above requirement. The procedure will take only one IN parameter i.e. *total_aid_amount* [Hint: use cursor to select the candidates as per the description]