Second Year B.Sc. (Honors) Examination 2009
Department of Computer Science & Engineering, University of Dhaka
CSE 201 : Database System

Total Marks: 70 **Time: 3 Hours**

[Answer any five (5) of the following Questions.]

1. a) What do you understand by query processing? What are the various steps of query processing? 3

   b) Why is it not desirable to force users to make an explicit choice of query processing strategy? Are there cases in which it is desirable for users to be aware of the costs of competing query processing strategies? Explain your answer. 3

   c) Consider the following SQL query for bank database: 4

   select T.*branch_name*
   from *branch* T, *branch* S
   where T.*assets*>S.*assets* **and** S.*branch_city* = "Dhaka"

   Write an efficient relational algebra expression that is equivalent to this query. Justify your choice.

   d) When is it preferable to use a dense index rather than a sparse index? Justify your answer. 2

   e) Is it possible in general to have two primary indices on the same relation for different search keys? Explain your answer. 2

2. a) SMAT prides itself on having up-to-date information on the processing and current location of each shipped item. To do this, SMAT relies on a company-wide information system. Shipped items are the heart of the SMAT product tracking information system. Shipped items can be characterized by item number (unique), weight, dimensions, insurance amount, destination, and final delivery date. Shipped items are received into the SMAT system at a single retail center. Retail centers are characterized by their type, uniqueID, and address. Shipped items make their way to their destination via one or more standard SMAT transportation events (i.e., flights, truck deliveries). These transportation events are characterized by a unique scheduleNumber, a type (e.g, flight, truck), and a deliveryRoute. Create an Entity Relationship diagram that captures this information about the SMAT system. Be certain to indicate identifiers and cardinality constraints. 6

   b) Consider the following database schema computer products: 6

   Computer (maker, model, category)
   Model (num, speed, ram, hd, price)
   Maker (name, address, phone)

   Where
   - maker_n indicates the manufacturer of the computer
   - category takes values such as "desktop", "laptop", "server"

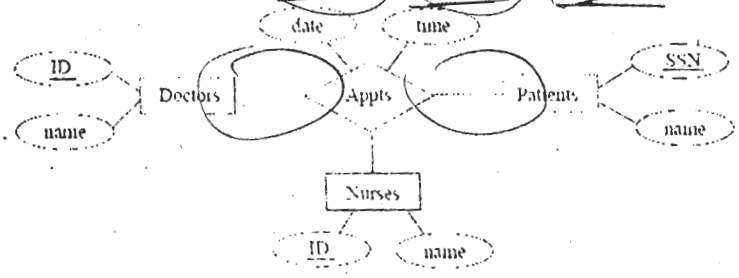
- Following inclusion dependencies hold
  - maker ⊆ name
  - model ⊆ num

Express following queries in relational algebra:

i. Find all the makers who make some laptop(s).
ii. Find the phone numbers of all the makers who make desktops with speed = 3.2.
iii. Find the makers who don't make any desktop, and do make some laptop(s).

b) State the functions of DBA. 2

3. a) Consider the following entity-relationship diagram representing that appointments that include one doctor, one nurse, and one patient. 3



Convert the ER diagram into a relational database schema. Be certain to indicate primary keys and referential integrity constraints.

b) Consider the relational schema Purchase Management System where pid and sid in Catalogue are foreign keys to the same fields in Parts and Suppliers. 8

Suppliers(sid : integer, sname : string)

Parts(pid : integer, pname : string, color : string)

Catalogue(sid : integer, pid : integer, price : real)

Write SQL statement for each of following queries:

i. List the names and prices of all red parts, most expensive first.
ii. For every supplier, list their name, the number of different colors of **spanner** they sell and the average price they charge for those spanners.
iii. Find the names of all the parts that come in just one color.
iv. Make a list containing the name and color of every individual part, along with the name of the cheapest supplier of that part and its price.

c) Distinguish between natural and full outer join with an example. 3

4. a) Consider the relational schema R(A, B, C, D) with the following functional dependencies: 6

FD: AB→ C, C→ D, and D→ A.

Find the candidate keys.

b) Consider the relational schema R(A, B, C, D, E) with the following functional dependencies: 6

FD: AB→ C, C→ D, AB→ E, and D→ A.

Find all non-trivial functional dependencies.

c) State the properties of a Good Database Design. 2

5. a) What does lossless-join decomposition mean? Given relation scheme student(id, name, street, city, zip, result) and 4

FD set : id → name

id → result
id → street, city, zip
street, city → zip

Consider the decomposition S1 (name, street, city, zip) and S2 (id, name, result). Is this decomposition lossless?

b) Consider a relation schema R = (A, B, C, D) and the following set of functional dependencies F = {A → B, BD → C, A → B, AB → C} Find the Canonical cover F^C of F. 5

c) Consider the following relational schema: 5

Sale(clerk, store, city, date, item#, size, color)
Item(item#, size, color, price)

Make the following assumptions, and only these assumptions, about the real world being modeled:

- Each clerk works in one store.
- Each store is in one city.
- A given item# always has the same price, regardless of size or color.
- Each item is available in one or more sizes and one or more colors, and each item is available in all combinations of sizes and colors for that item.

Here are the problems:

i. Based on the assumptions above , specify all keys for relations Sale and Item.
ii. Based on the assumptions above, specify an appropriate set of completely nontrivial functional dependencies for relations Sale and Item.
iii. Are relations Sale and Item in Boyce-Codd Normal Form (BCNF)?

6. a) State the difference between Static hashing and Dynamic hashing. 3

b) Why is hash structure not the best choice for a search key on which range queries are likely? 2

c) What are the causes of bucket overflow in a hash file organization? What can be done to reduce the occurrence of bucket overflows? 3

d) Construct a B^+ tree with 3 pointers for the following set of key values: 6
Values: {3, 6, 12, 23, 34, 44, 56, 57, 67, 89}
Assume that the tree is initially empty and values are added in ascending order. Each step must be shown.

7. a) Consider the following two transactions: 4

```
T1: read(A);
    read(B);
    If A= 0 then B:=B+1;
    Write (B);
T2: read(B);
    read(A);
    If B= 0 then A:=A+1;
    Write (A);
```

Add lock and unlock instructions to transactions T1 and T2, so they observe two-phase locking protocol. Can the execution of these result in a deadlock?

b) When a transaction is rolled back under timestamp ordering, it is assigned a new timestamp. Why can it not simply keep its old timestamp? 4

c) If deadlock is avoided by deadlock avoidance schemes, is starvation still possible? Explain your answer. 3

d) Why the redo operation in deferred database modification (log based recovery) need to be idempotent? 3

1. a) Explain the difference between Physical and logical data independence. 3
b) What is schema? How do you compare schema with instance? 4
c) Explain the distinction among the term primary key, ~~super key~~, candidate key and super key. 5
d) Explain the difference between a weak and a strong entity set. 3

2. Consider the schemas of the following database system: 3×5

employee (emp_id, emp_name, dob, sex, salary, dept_no)
department (dept_no, dept_name, manager_name)
project (p_no, p_name, dept_no)
work_on (emp_id, p_no, hours)

Now give the SQL and Relational Algebra expressions for the following queries:

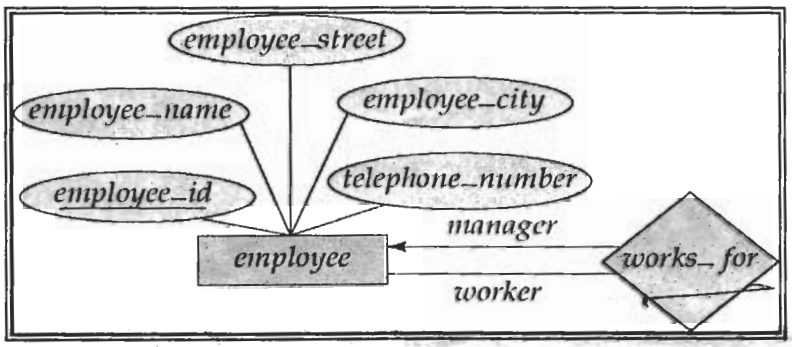
i) Find employees, date of birth with the project name for which they work.
ii) Find how many employees are working with each project with their average working hours.
iii) Find the department number where more than 3 projects are running.
iv) Update salary of the employees by 15% who are female and working for the department number 7.
v) Remove the projects that are supervised by the manager 'Ahsan'.

3. a) Classify database users. What are the jobs of a DBA (Database Administrator)? 2+2
b) Why set-intersection operation is not included in fundamental relational algebra operations? What is the difference between view and relational algebra assignment operation? 2+3
c) Describe the circumstances in which you would choose to use embedded SQL rather than SQL alone or only a general–purpose programming language. 3
d) SQL allows a foreign key dependency to refer to the same relation, as in the following example: 3

```
create table manager
  (employee_name varchar(20) not null,
   manager_name varchar(20) not null,
   primary key (employee_name),
   foreign key (manager_name) references manager on delete cascade)
```

Here, *employee_name* is a key to the table *manager*, meaning that each employee has at most one manager. The foreign key clause requires that every manager also be an employee. Explain exactly what happens when a tuple in the relation *manager* is deleted.

4. a) With example explain participation constraint in E-R model. How primary keys are defined for binary relationship sets for different mapping cardinalities in E-R model? 3+2
b) What will be the schema representation for the following E-R diagram: 2



c) Give the E-R and schema diagram for the following database: 2+2

book(ISBN, title, year, price)
author (author-id, name, address, url)
warehouse (code, address, phone)
written-by (author-id, ISBN)
stocks (code, ISBN, number)

d) What are the methods for representing specialization as schemas with relative advantages and disadvantages? 4

a) Why Armstrong's axioms are called 'sound' and 'complete'? Use Armstrong's axioms to prove the soundness and completeness of 'union', 'decomposition' and 'pseudotransitivity' rules. 1+4

b) What are the uses of closure of attribute sets, $\alpha+$. What is the importance of canonical cover? 4+1

c) Why certain functional dependencies are called trivial functional dependencies? 1+4
Consider a relation schema R = (A, B, C, D, E) and a set of functional dependencies holding on schema R, F = {A → BC, CD → E, B → D, E → A}. List the candidate key(s) for R.

6. a) What are the pitfalls of relational database design? What are the conditions for lossless join decomposition of R into smaller schemas i) using functional dependencies ii) without using functional dependencies. 1+4

b) Consider a relation schema R = (A, B, C, D) with F = {A → BC, B → D, D → B}. Show a decomposition of R into R_1 and R_2 so that each relation of the decomposition is in BCNF and also dependency preservation is achieved. 5

c) Define 3NF. Give the differences between BCNF and 3NF. 2+3

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Department of Computer Science & Engineering, Dhaka University
First In-Course Examination
2nd Year 2nd Semester B.Sc., Session: 2010-2011
Database Management Systems

Total Marks: 25 Time: 1 Hour 10 Minutes

1. a) What is DBMS? Mention the differences between schema and instance. 1+2
   b) What can be done using DML? Define the types of DML with example. 2+2
   c) What are the functions of a DBA? 4
   d) With example define super key, candidate key and primary key. 4
   e) Consider the following relational database: 10

employee (person_name, street, city)
works (person_name, company, employee_name, salary)
company (company_name, city)
manages (person_name, manager_name)

Now give an expression in relational algebra (RA) to express each of the following queries:

i) Find the names of all employees in the database who do not work for First Bank Corporation.
ii) Find the information of all employees in the database who live in the same city as the company for which they work.
iii) Give all managers in this database a 10 % salary rise.
iv) Delete all tuples in the works relation for employees of Small Bank Corporation.
v) Find the company with smallest payroll (total salary given to employees).

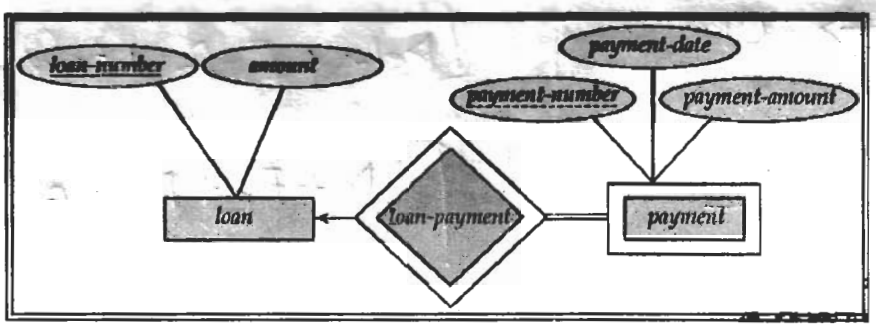
Department of Computer Science & Engineering, Dhaka University
Second In-Course Examination
2nd Year 2nd Semester B.Sc., Session: 2010-2011
Database Management Systems

Total Marks: 20 **Time: 1 Hour**

1. a) Define 'entity set' and 'relationship set'. 2
   b) With example and E-R symbol define composite, multivalued and derived attributes. 3
   c) Draw an E-R diagram for the following database: 3

   employee (employee-id, employee-name, street, city)
   branch (branch-name, branch-city, assets)
   job (title, level)
   works-on (employee-id, branch-name, title, salary)

   c) Explain the difference between a weak entity set and strong entity set. What will be the schema representation of the following E-R diagram? 2+3



   d) Let A and B are two entity sets and R be the relationship set between them. How can you combine the schemas (if possible) for different mapping cardinalities? 4

   e) With example define the constraints used in specialization/generalization. 3

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University of Dhaka
Department of Computer Science & Engineering
Second Year B.Sc. (Honors) Examination 2010
CSE 201 : Database System

Total Marks: 70 **Time: 3 Hours**

[Answer any five (5) of the following Questions]

1. a) Define DDL and DML. Give classifications of DML with example. 2+2

   b) Define composite, multi-valued and derived attributes. 3

   c) Explain the participation constraints of E-R model with example. 3

   d) Construct the E-R diagram for the following database: 4

   person (driver-id, name, address)
   car (license, model, year)
   accident (report-no, date, location)
   owns (driver-id, license)
   participated (driver-id, license, report-no, damage-amount)

2. a) **What do you mean by database management system (DBMS)? Mention the primary goals of DBMS.** 4

   b) **Explain the distinctions among the terms primary key, candidate key and super key with examples.** 3

   c) **Explain what is meant by *repetition of information* and *inability to represent information*. Explain why each of these properties may indicate a bad relational database.** 4

   d) **What are the functions of a database administrator?** 3

3. a) Consider the part of a bank database schema below: 8

   Branch (branch-name, branch-city, assets)
   Customer (customer-name, customer-street, customer-city)
   Loan (loan-no, branch-name, amount)
   Borrower (customer-name, loan-no.)
   Account (account-no, branch-name, balance)
   Depositor (customer-name, account-no.)

   Now give Relational Algebra expression for the following queries:

   i) Find all customers who have either an account or a loan (but not the both) at the bank.

   ii) Find the average account balance of those branches where the total account balance for individual branch is greater than 300,000.

   iii) Find the no. of depositors for each branch.

   iv) Find the branch that has the highest average balance.

   b) Consider the part of a company database schema below: 6

   employee (person-name, street, city)
   works (person-name, company-name, salary)
   company (company-name, city)
   manages (person-name, manager-name)

   Now give SQL expression for the following queries:

   i) Find the names, street addresses and cities of residence of all employees who work for GrameenPhone Limited and earn more than 30,000.

   ii) Find all employees in the database who earn more than the average salary of the employees of BTCL.

   iii) Give all managers of Qubee a 10 percent salary raise.

   iv) Find the company with the largest payroll.

4. a) Suppose that we decompose the schema R=(A, B, C, D, E) into (A, B, C) and (A, D, E). Show that this decomposition is a lossless-join decomposition if the following set F of functional dependencies holds: 3

A→BC
CD→E
B→D
E→A

b) Compute the closure of the following set F of functional dependencies for relation schema R=(A, B, C, D, E). 4

A→BC
CD→E
B→D
E→A

List the candidate keys for R.

c) Mention the desirable properties of decomposition with explanation. 4

d) What are the differences between BCNF and 3NF? 3

5. a) Define RAID and different levels. What are the factors for choosing a RAID level? 3+2

b) Define Primary index, Secondary index, Dense index and Sparse index. 4

c) Construct B^+ tree with 3 pointers for the following set of key value: 5
Values : {5, 12, 17, 23, 29, 34, 47, 55, 67, 91}
Assume the tree is initially empty and values are added in ascending order. Each step must be shown.

6. a) Define foreign key and dangling tuples. How foreign key defines acceptability of dangling tuples? 3

b) Compare the advantages of fixed-length record representation and variable length record representation. 2

c) Define data models. Explain its importance. 3

d) List all non-trivial functional dependencies satisfied by the following relation: 3

A	B	C	D
a1	b1	c1	d1
a1	b2	c1	d2
a2	b2	c2	d2
a2	b2	c2	d3
a3	b3	c2	d4

e) Classify file organization. Why reorganization is required in sequential file organization? 3

7. a) How does the concept of an object in the object-oriented model differ from the concept of an entity in the ER model? 3

b) What are the desirable qualities of hash function distribution? 2

c) Why bucket overflow occurs in hash file organization? What are the ways to handle bucket overflow? 2+3

d) Let relations r_1(A, B, C) and r_2(C, D, E) have the following properties: r_1 has 20,000 tuples, r_2 has 45,000 tuples, 25 tuples of r_1 fit on one block, and 30 tuples of r_2 fit on one block. Estimate the number of block access required, using each of the following join strategies between r_1 and r_2: 4

i) Nested-loop join
ii) Block nested loop join
iii) Merge join
iv) Hash join