

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 3rd Year 1st Term Examination, 2019
Department of Computer Science and Engineering
CSE 3109
Database Systems

TIME: 3 hours

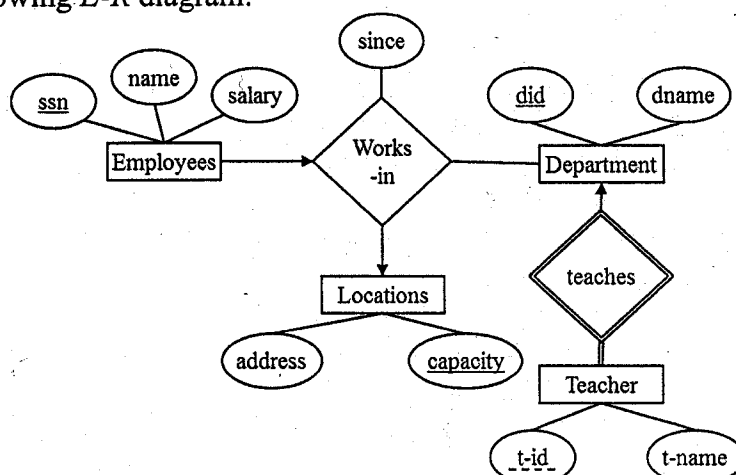
FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define roles of an *E-R* diagram. How can you classify the participation of an entity set in a relationship set? Explain with examples. (08)
- b) Consider two entities E_1 and E_2 having simple and single valued attributes. R_1 and R_2 are two relationships between E_1 and E_2 . R_1 is one-to-many and R_2 is many-to-many relationship. R_1 and R_2 don't have attributes of their own. Draw an *E-R* diagram. (12)
- c) Consider the following *E-R* diagram: (15)



- i) Transform the *E-R* diagram into physical schema.
 - ii) Transform into relations.
 - iii) Convert the non-binary relationships into binary relationships.
2. a) Differentiate between dense index file and sparse index file. (08)
 - b) Construct a B^+ tree for the following data where $n = 3$. (13)
1, 2, 3, 10, 20, 25, 32, 40.
(i) Update the tree after inserting 45. (ii) Update the tree after deleting 20.
 - c) A B^+ tree has height 22 and max. fan out 50. What is the minimum and maximum number of keys possible in this index structure? (06)
 - d) Explain structured, semi-structured and unstructured data with example. (08)
 3. a) What is a lossy decomposition? How it can be solved? (06)
 - b) Consider the following table R: (15)

α	β	γ	δ
x_1	y_1	z_1	w_1
x_2	y_1	z_2	w_1
x_3	y_2	z_1	w_1
x_4	y_2	z_2	w_1
x_5	y_2	z_3	w_1

- i) Find the functional dependencies from R.
- ii) Compute F^+ .
- iii) Compute the super keys.
- c) What are the goals of Normalization? (05)
- d) What is referential integrity? How does it affect database modification? (09)
4. a) How can you specify XML data with attributes in DTD? Define a DTD for the following schema: (10)
Children (name, age, date, country)
Birthday (day, month, year, time).

- b) Given $R = (A, B, C, D, E)$ with functional dependencies (15)
- $$F = (A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A)$$
- i) Find if the relation is in BCNF.
 ii) Apply normalization and decompose the relation until the join is lossless.
 c) How can you measure the normalization performances? Give examples. (10)

SECTION B

(Answer ANY THREE questions from this section in Script B)

5. a) What is DBMS? How many type of users are there in database? How they use database? (08)
 b) What is join operation? Explain different type of join operations. (10)
 c) Define division operation in terms of basic relational algebra operation with example. Let $r(R)$ and $s(S)$ be relations and $S \subseteq R$. (05)
 d) Consider the following schema: (12)

branch (*branch_name*, *branch_city*, *asset*)
customer (*customer_name*, *customer_street*, *customer_city*)
account (*account_number*, *branch_name*, *balance*)
loan (*loan_number*, *branch_name*, *amount*)
depositor (*customer_name*, *account_number*)
borrower (*customer_name*, *loan_number*)

According to the schema, solve the problems given below using relational algebra expression:

- i) Find the loan number for each loan of an amount greater than \$1200.
 ii) Find the names of all customers who have a loan at the Perryridge branch.
 iii) Find the largest account balance.
 iv) Find all customers who have an account at all branches located in Brooklyn city.
6. a) What is view? "View makes complex query simple" – justify the statement. (10)
 b) Consider the schema given in question 5(d) and solve the following problem using SQL query: (15)
 i) Find the names of all branches where the average account balance is more than \$1200.
 ii) Find all loan numbers for loans made at the Perryridge branch with loan amount greater than \$1200.
 iii) Increase all accounts with balances over \$10,000 by 6% and all other accounts receive 5%.
 iv) Find the average account balance of those branches where the average account balance is greater than \$1200.
 v) Select second highest balance from account table.
 c) Suppose there is a table named Employees in your database. (10)
Employees (*Employee_id*, *Name*, *Email*, *Salary*, *Dept_id*)
 Write a trigger which will automatically insert the name of the employee in INITCAP format. Also generate and insert an email id as "Name_Dept_id_Employee_id@gmail.com".

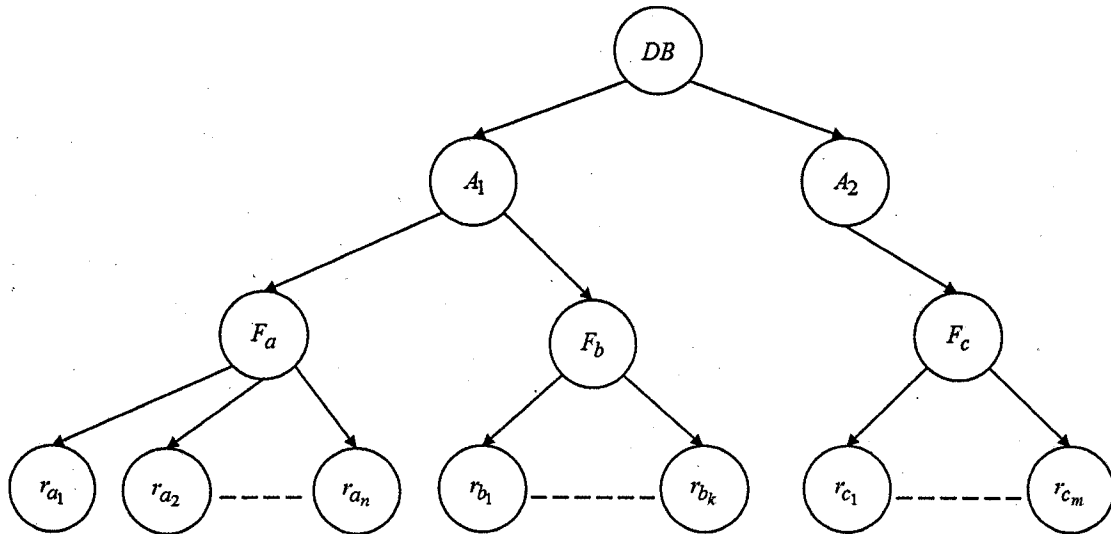
7. a) Consider the following figure: (12)

T_4	T_5	T_6
Read(A) $A = A + 50$ Read(C) Write(A) $C = C - 50$ Write(C)	Read(B) Read(A) $B = B + 50$ Write(B) $A = A - 50$ Write(A)	 Read(C) $C = C + 100$ Read(B) Write(C) $B = B - 100$ Write(B)

Is this schedule conflict Serializable? Justify.

- b) "Every cascadeless schedule is also recoverable" – justify the statement with example. (05)

- c) State the rules for schedules S and S' being view equivalent. (06)
- d) Explain the working principle of a query processor. (12)
8. a) What is PL/SQL? Discuss the tradeoff between anonymous block and named block in PL/SQL. (08)
- b) What are the differences between primary key and unique key? (07)
- c) How does lock manager work in concurrency control? (10)
- d) Consider the following figure which is a granular tree: (10)



T_1 reads ra_2

T_2 modifies ra_9

T_3 reads F_a

T_4 reads DB

- Can T_1, T_2 run concurrently?
- Can T_1, T_3 run concurrently?
- Can T_1, T_3, T_4 run concurrently?
- Can the four transactions run concurrently?

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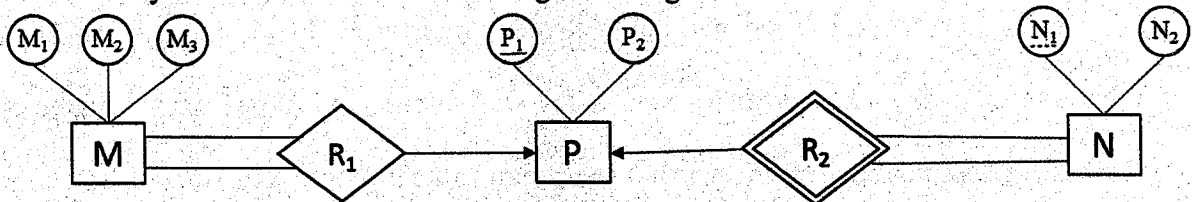
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SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define relationship set and degree of relationship set. For a binary relationship set, explain the mapping cardinalities. (10)
- b) Consider the following concepts in an E-R model. (15)
 - i) M:M relationship
 - ii) Total and Partial Participation
 - iii) Generalization and Specialization
 - How are they represented in E-R model?
 - Represent the logical model into a Physical model.
- c) Find the Physical Schema of the following E-R diagram. (10)



2. a) What are the advantages of database systems over file based systems? (06)
 - b) Why do you use index in databases? What are the metrics to evaluate an index? (08)
 - c) Define sparse index. How can you design a sparse index using page block size? (08)
 - d) What are the properties of leaf and non leaf nodes of a B^+ tree index structure? Explain. (13)
3. a) What are the guidelines to select an index? (05)
 - b) Define functional dependency. How can you explain functional dependency as a generalization of superkey? (10)
 - c) What is closure of attributes? How can you calculate closure of attributes? Given (12)
 $R = (A, B, C, G, H, I)$
with functional dependencies
 $F = \{A \rightarrow B, A \rightarrow C, CG \rightarrow H, CG \rightarrow I, B \rightarrow H\}$.
Do you think (AG) and (BG) are the keys of R ?
 - d) What are the goals of relational database design? How can you achieve it using $3NF$? (08)
4. a) What is database security and integrity? Differentiate between domain constraint and integrity constraint. (10)
 - b) How can you check the referential integrity on database update for the purpose of database modification? (12)
 - c) Define DTD. How can you specify the attributes in a DTD? Define a DTD for a Banking Schema using account(account no., branch name, balance) and customer(customer ID, customer name, customer city). (13)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Define Data model and list different types of Data models. Explain the basic structure of Relational Data model. (08)
- b) Consider the following relational database where the primary keys are underlined. (13)

Branch (Branch _id, Branch _name, Branch _city)

Customer (Customer _id, Customer _name, Customer _city)

Loan (Loan _number, Branch _id, Amount)

Borrower (Customer _id, Loan _number)

Account (Account _number, Branch _id, Balance)

Depositor (Customer _id, Account _number)

Draw the Schema Diagram and give an expression using Relational Algebra for each of the following queries: (i) Delete all loans from 'Khulna' city, (ii) Find the customer names who have loans at 'Fulbarigate Branch', (iii) Find the customer names who have account at 'Dhaka' city.

- c) "Data type is a physical thing while Domain is a logical thing" – justify the statement. (07)
d) What do you mean by database management system? What are the classification of database users? (07)

6. a) What is view? "View makes complex query simple" – justify the statement with example. (09)
b) What is join operation? Why do you need join operation? Explain different types of join operations. (10)
c) Consider the Relational Database given in question 5(b). Give an expression in SQL for each of the following queries: (16)

i)	$Customer \leftarrow Customer \cup \{105, "Farid", NULL\}$
ii)	$\prod_{Customer_name} (Customer \bowtie Borrower)$
iii)	$Branch_id \xrightarrow{Avg(Amount)} \left(\sigma_{Loan.Loan_number=Borrower.Loan_number} (Loan \times Borrower) \right)$
iv)	$\prod_{Account_number} \left(\sigma_{Branch_id=\prod_{Branch_id} \left(\sigma_{Branch_city="Khulna"}(Branch) \right)} (Account) \right)$

7. a) What is PL/SQL? Discuss the trade-off between Anonymous block and Named block in PL/SQL. (07)
b) What are the differences between primary key and unique key? When do you make a key unique? (07)
c) "Procedure does not have return type but can return value" – how? Explain with example. (06)
d) Define Trigger and Cursor. Consider the following two tables 'Product' and Purchase: (15)

Product					
Product_id	Name	Actual Price	Total Sell Price	Total Unit Sold	Profit
1	A	950	0	0	0
4	B	400	0	0	0
5	C	120	0	0	0

Purchase	
P_id	Sell Price
4	500
1	1000
4	520
5	130
1	980
5	150
1	1050

Now, (i) Create a Trigger after insert on 'Purchase' so that it will update 'Total_Sell_Price' and 'Total_Unit_Sold' field of 'Product' table. (ii) Create a Procedure that will calculate profit for each product and update 'Profit' field of 'Product' table.

8. a) Define Transaction for a Database. Briefly describe the 'ACID' properties of a DBMS. (09)
b) Discuss exclusive lock and shared lock in case of Concurrency Control. Refer to the following table: (12)

Time	T ₁	T ₂	T ₃	X	Y
t ₁	Begin_tran.			100	100
t ₂	read(X)	Begin_tran.		100	100
t ₃	X = X + 100	read(Y)	Begin_tran.	100	100
t ₄	write(X)	Y = Y + 100	read(Y)	200	100
t ₅	commit	write(Y)	Y = Y + 50	200	200
t ₅		commit	write(Y)	200	150
t ₆			commit	200	150

Which concurrency problem does it reflect? How can you overcome the problem by using 2-Phase Locking (2PL)?

- c) Define Deadlock in a system. When does it occur? (05)
d) What is the working principle of Wait For Graph (WFG)? How can it be used to detect deadlock in transactions? Explain. (09)

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SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define mapping cardinality. Describe the mapping cardinality with respect to a binary relationship. (08)
b) Consider the following concepts in E-R model: (16)
M:M relationship, total and partial participation, weak and strong entity set, ternary relationship.
i) Define the above concepts. How are they represented in E-R model? Draw the representation.
ii) Represent the logical model into a physical model.
c) Suppose you are given the following information for a simple database for Bangladesh Premier League (BPL). (11)
The BPL has many teams. Each team has a name, city, coach, captain and set of players. Each player belongs to only one team. Each player has a name, position, skill level and injury record. A captain is also a player. A game is played between two teams (referred as Team1 and Team2) and has a date and a score.
Construct a clean and concise E-R diagram for the BPL database. Show the cardinalities. Hence draw the physical schema.
2. a) What are the purposes to place an index in a database? Mention the metrics that are used to evaluate an index. (07)
b) Give a brief classification of index structures? What is the difference between hashing and indexing? (12)
c) Why do you need multilevel indexing? Briefly describe a typical B^+ tree node. (10)
d) Suppose a key value is 9 bytes, pointer is 7 bytes and page size is 512 bytes. How many key values you can enter in a leaf and non leaf node of a B^+ tree? (06)
3. a) What are the differences between integrity constraints and domain constraint? (05)
b) Define trigger. Write a trigger in SQL to carry out the following action: on delete of an account, for each owner of the account, check if the owner has any remaining accounts, and if he does not, delete him from the depositor relation. (11)
c) What are the forms of authorization on parts of a database? (07)
d) Define functional dependency. How can you explain functional dependency as a generalization of superkey? (12)
4. a) Define attribute closure. What are the applications of attribute closure? (05)
b) Define BCNF and 3NF. When do you prefer 3NF over BCNF. Consider the following relation: (15)
 $BOOK(title, author_name, author_designation, type, price, publisher)$
Following functional dependencies exist:
 $title \rightarrow publisher, type$
 $type \rightarrow price$
 $author_name \rightarrow author_designation$
Apply normalization until you cannot decompose the relation further.
c) Explain structured, semi-structured and unstructured data with example. (08)
d) What is DTD? How can you specify an element in DTD? (07)

SECTION B

(Answer ANY THREE questions from this section in Script B)

5. a) What do you mean by data abstraction in database system? Explain the levels of data abstraction in database. (11)
- b) Differentiate between physical and logical data independence. (08)
- c) Define data model. Explain the basic structure of a relational model. (08)
- d) Mentions the name of the aggregation functions. How are they handled in relational algebra? (08)

6. a) Consider the following table: (27)

RESULT(*roll*, *sub1*, *sub2*, *sub3*, *gp1*, *gp2*, *gp3*, *CGPA*)

The task of the above table is to calculate the result of the students from *roll* number '1 to 5'. Now create a trigger (before insertion) for the above table to insert the following:

- i) Take the number of the subjects *sub1*, *sub2* and *sub3* from the user and insert into the table.
- ii) Pass the number of the subject *sub1* from (6)(a)(i) as a parameter of a PL/SQL function named 'CAL_GPA()' and return GPA value of the subject and insert into *gp1*. Do this step for *sub2* and *gp2*, *sub3* and *gp3*. To create the PL/SQL function 'CAL_GPA()' use the following condition:

Subject Number (<i>sub</i>)	GPA(<i>gp</i>)
80 ≥	4
60–79	3
< 60	2

- iii) First create a PL/SQL function named 'CGPA_CAL()' that takes the GPA from (6)(a)(ii) and return the CGPA $\left(\frac{gp1+gp2+gp3}{3}\right)$ of the students and then insert into the 'CGPA' column.

- b) What is PL/SQL function and procedure? Consider a relation TABULATION having attributes *student_ID* and *marks*. Write a SQL statement to find the *student_ID* having second highest *marks*. (08)

7. a) Let $R = (A, B)$ and $S = (A, C)$ and let $r(R)$ and $s(S)$ be relations. Using the special constant *null* define the following using tuple-relational-calculus expressions: (08)

(i) $r \bowtie s$ (ii) $r \bowtie \subset s$ (iii) $r \supset \bowtie s$ (iv) $r \supset \subset s$

- b) Since every conflict-serializable schedule is view serializable, why do we emphasize conflict serializability rather than view serializability? Explain with example. (09)

- c) What do you mean by cascading roll-back? How does 2-phase locking avoid cascading roll-back? Explain. (07)

- d) Discuss the working principle of a lock manager in concurrency control scheme. (11)

8. a) Define the lock modes of a multiple granularity scheme. Show the compatibility matrix for all lock modes of a multiple granularity scheme. (08)

- b) What is deadlock? Discuss some strategies to prevent deadlock. (09)

- c) Explain the working principle of a query processor. (11)

- d) Mention the measures needed in determining query cost of a query and then explain the query cost of a nested loop join operation. (07)

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SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define attribute and domain of attribute with proper example. (05)
b) Represent the following concepts by entity relationship diagram and hence find the physical schema of the concept. (20)
 - i) Attribute with relationship
 - ii) Role in a relationship
 - iii) Total and partial participation
 - iv) Weak entity set
 - v) Many to many relationship
- c) Consider two entities E_1 and E_2 having simple and single valued attributes. R_1 and R_2 are two relationships between E_1 and E_2 . R_1 is one-to-many and R_2 is many-to-many relationship. R_1 and R_2 do not have attributes of their own. Draw an ER diagram. (10)
2. a) "In a B+ tree index structure, 50% storage utilization is guaranteed" – justify the system. (06)
b) Give a comparison between (i) primary index and secondary index (ii) dense index and sparse index. (10)
c) A B+ tree index structure has height 2 and maximum fan out 5. What is the minimum and maximum number of keys possible in this index structure? (06)
d) Explain the overflow and underflow situation for a B+ tree index structure. How do you perform range key query in a B+ tree index structure? (13)
3. a) Define referential integrity and referential integrity constraints with example. Consider the following relational database (13)
 employee(e-name, street, city)
 works(e-name, c-name, salary)
 company(c-name, city)
 manages(e-name, m-name)
 Give an SQL DDL definition of the database. Identify relational integrity constraints that should hold and include them in the DDL definition.
b) Define trigger. A bank does not allow any negative account balances, the bank deals with overdrafts by (10)
 - i) setting account balance to zero
 - ii) creating a loan in the amount of over draft.
 - iii) giving this loan a loan number identical to account number of the withdrawn account.Create a trigger on update of the account relation.
c) Define BCNF. When do you prefer 3NF over BCNF? Explain with example. (07)
d) Why are certain functional dependencies called trivial? Give example. (05)
4. a) How can you relate functional dependency and primary key? Consider the patient scheme PDB(patno, patname, appno, time, doctor) and functional dependencies $F = \{patno \rightarrow patname, patno \rightarrow appno, appno \rightarrow time, time \rightarrow doctor, time \rightarrow appno\}$. Find the super key of the schema. (10)
b) A relation $R(A, B, C, D, E)$ is decomposed into $R_1(A, B, C)$ and $R_2(A, D, E)$. Is the decomposition lossless? If the following functional dependencies hold $F = \{A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A\}$. (08)
c) What do you mean by document type definition (DTD)? A document of a company contains following items- (12)
 "Report, Section, Subsection, ShortSection, Title, Para, List, Code, Keyword and example"
 Report has attribute security having value high / low / medium.
 Code and keyword are required field.
 Define a DTD for the above document.
d) Give a comparison between XML data and relational data. (05)

SECTION B

(Answer ANY THREE questions from this section in Script B)

5. a) What do you mean by database management system? What is the purpose(s) of a database system? (10)
- b) Consider a two dimensional integer array of size $n \times m$ that is to be used in your favourite programming language. Using the array as an example, illustrate the difference (12)
- i) Between the three levels of data abstraction
 - ii) Between a schema and instances.
- c) Consider a relation account having attributes account_number, branch_name and balance. (05)
Write a relation algebra statement to increase the balances by 5%.
- d) "SQL is a non procedural language". Do you agree with the statement? Explain with (08) example.
6. a) Consider the relational database given in Fig 01, where the primary keys are underlined. Give (12)
an expression in the relational algebra to express each of the following queries
- i) Find the names of all employees in the database who live in the same city and on the same street as do their managers.
 - ii) Find the names of all employees in the database who do not work for First Bank Corporation.
 - iii) Find the names of all employees who earn more than every employee of Small Bank Corporation.

employee(<u>person-ID</u> , person-name, street, city) works(<u>person-ID</u> , company-name, salary) company(<u>company-name</u> , city, minm-salary, maxm-salary, sales) manager(<u>person-ID</u> , manager-name)
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Fig. 01 for Q. 6 (a) and Q. 7(a)

- b) What is join operation? Why do you need join operation? Explain different types of join operation. (11)
- c) Let the following relation schemas be given: (12)
 $R = (A, B, C), S = (B, D, E, F)$
Let relations $r(R)$ and $s(S)$ be given. Give an expression in SQL that is equivalent to each of the following queries
- i) $\prod_{AB}(r) \bowtie \prod_{BC}(r)$ ii) $\prod_{A,F}(\sigma_{C=D}(r \times s))$
 - iii) $\rho_T(\sigma_{R.B = S.B}(\sigma_{A=17}(r \times s)))$
7. a) Consider the relational database of Fig. 01. Now (i) create a procedure using SQL to give all managers of First Bank Corporation a 10% raise unless the salary becomes greater than \$100,000; in such cases give only a 3%. (ii) create a trigger in SQL that checks the 'works' table before insertion whether the salary is appropriate according to the range mentioned in 'company' table. (12)
- b) What do you mean by query processing? Write down the basic steps needed in query processing. (10)
- c) "Every cascadeless schedule is also recoverable" – justify the statement with example. (06)
- d) Why do we need concurrency control for database transaction though we have transaction control? (07)
8. a) How does a tree protocol ensure deadlock freedom? Explain with example. (10)
- b) "2-phase locking protocol overcomes the disadvantages of locking protocol". What are the disadvantages and how are they solved by 2-phase locking protocol? (10)
- c) 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 accesses required, using each of the following join strategies for $r_1 \bowtie r_2$ (15)
- i) Nested-loop join ii) Block nested loop join
 - iii) Merge join

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SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define attribute and domain of attribute with example. (07)
b) Consider the following two entity sets (18)
Employee(ssn, name, address)
Dependents(pname, age)
The entity sets are related via a relation policy(amount). Employee is a strong entity set and Dependents is a weak entity set.
(i) Define weak entity set and strong entity set.
(ii) Draw the ER diagram and hence the schema diagram to represent the system.
(iii) Create the system using DDL.
c) What is the role of mapping cardinality for designing a good candidate key? Explain with example. (10)
2. a) When do you prefer the secondary index instead of primary index? (06)
b) What are the characteristics of leaf nodes and non leaf nodes of a B+ tree index structure? Explain with necessary figures. (10)
c) Give the formal definition of referential integrity. How does cascading implement the referential integrity? (09)
d) What is assertion? Create an assertion for the following statement- (10)
"The sum of all loan amounts for each branch must be less than the sum of all account balances at the branch."
3. a) Define trigger. Why do you need trigger? (15)
"A banking system does not allow any negative balance. Instead of negative balance, the system creates a new loan account with the loan amount and a loan number identical to the account number and sets the account balance to zero." Create a trigger after update on the account.
b) "Functional dependency is the generalization of the super key."- Justify the statement. (10)
c) What is the purpose of database normalization? Consider the schema R(a, b, c, d) having functional dependencies $F=\{ac \rightarrow bd, ad \rightarrow b\}$. Determine whether R is in BCNF or NOT? Explain your answer. (10)
4. a) When do you prefer – (06)
(i) BCNF over 3NF
(ii) 3NF over BCNF
b) Consider the patient schema PDB(patno, pname, appno, time, doctor) and functional dependencies $F=\{patno \rightarrow pname, patno \text{ appno} \rightarrow time \text{ doctor}, time \rightarrow appno\}$. Find the super key of the schema. (10)
c) Define multivalued dependency and 4th normal form. (07)
d) How can you specify the attributes in a DTD? Define a DTD for a Banking schema using account(account no, branch name, balance) and customer (Customer ID, customer name, customer city). (12)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Define different database users. Mention the purposes of using a database system. (07)
b) Consider the following relational database where the primary keys are underlined. (20)
BRANCH(BRANCH_NAME, BRANCH_CITY, ASSETS)
CUSTOMER(CUSTOMER_NAME, CUSTOMER_STREET, CUSTOMER_CITY)
LOAN(LOAN_NUMBER, BRANCH_NAME, AMOUNT)
BORROWER(CUSTOMER_NAME, LOAN_NUMBER)
ACCOUNT(ACCOUNT_NUMBER, BRANCH_NAME, BALANCE)
DEPOSITOR(CUSTOMER_NAME, ACCOUNT_NUMBER)

Draw the schema diagram and give an expression using relational algebra for each of the following queries:

- (i) Find all loan numbers with loan value greater than \$10,000.
 - (ii) Find the names of all depositors who have an account with a value greater than \$6,000.
 - (iii) Find the names of all depositors who have an account with a value greater than \$6,000 at the 'uptown' branch.
- c) "It is possible for tuples to have a null value." How do you handle this null values for (08) arithmetic and logical operations in a relational database?
6. a) What are the aggregate functions? How are the functions handled in relational algebra? (12)
- b) Discuss the trade-off between a sub query operation and join operation. (07)
- c) What is a view? What are the advantages of view? How does a view execute? (08)
- d) Let the following relational schema is given (08)
- R(A, B, C)
S(D, E, F)
- the relations r(R) and s(S) are also given. Give an expression in SQL that is equivalent to each of the followings:
- (i) $\pi_{AB}(r) \bowtie \pi_{BC}(r)$
 - (ii) $\pi_{A,F}(\sigma_{C=D}(r \times s))$
 - (iii) $\sigma_{B=17}(r)$
 - (iv) $\rho_T(\sigma_{A=D}(r \times s))$
7. a) Discuss the ACID properties required for maintaining data integrity. (13)
- b) How does precedence graph determine whether two concurrent transaction are serializable or not? Explain with example. (08)
- c) Discuss the working principle of a lock manager to execute lock with example. (09)
- d) When do you kill a transaction? (15)
8. a) What are the functions of commit and rollback for transaction management in SQL? Explain (08)
- b) Explain the differences between primary key and unique key. (06)
- c) What is the purpose of cursor? Create a cursor to find the name and roll no. of the student having "First class" in the CGPA field. (08)
- d) Write a function in PL/SQL that takes the birth date in its parameter and return the age. (13)