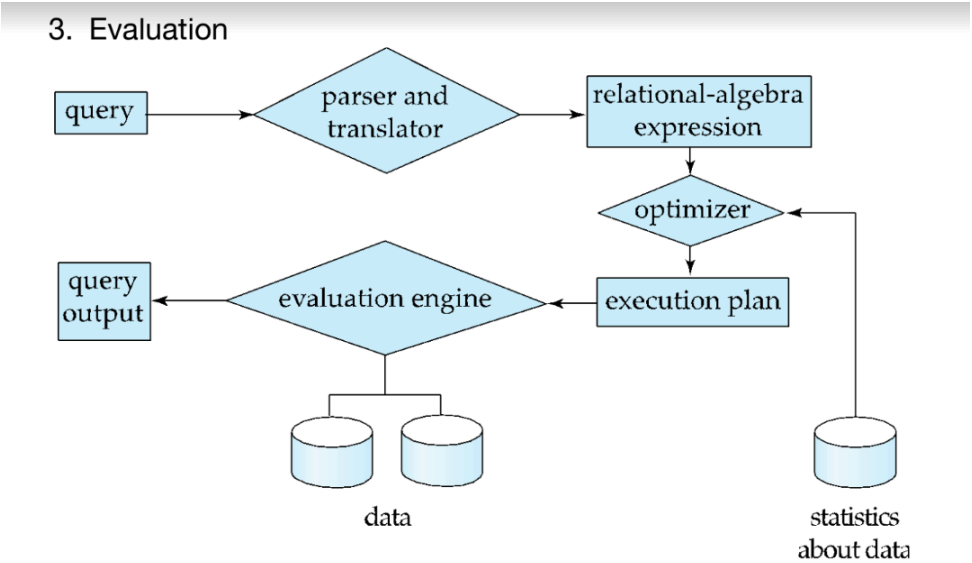
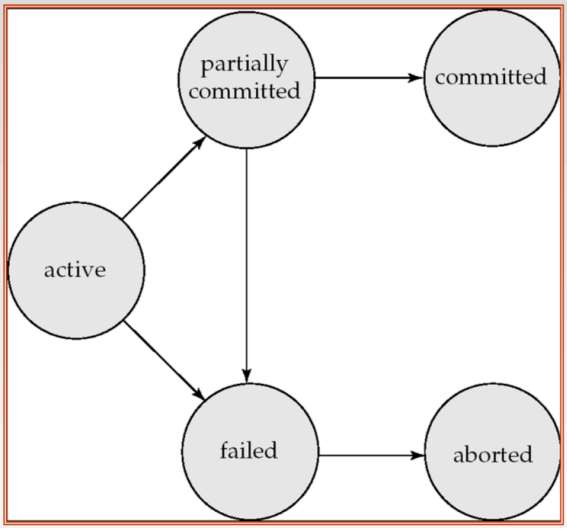
SOMAIYA VIDYAVIHAR UNIVERSITY

Semester: January 2024 –April 2024 **Maximum Marks: 100** **Examination: ESE Examination** **Duration:3 Hrs.**		
Programme code: 1 **Programme:B.Tech Computer Engineering**	**Class: SY**	**Semester:IV (SVU 2020)**
Name of the Constituent College: **K. J. Somaiya College of Engineering**	**Name of the department: Computer**	
Course Code: 116U01C403	**Name of the Course: Relational Database Management System**	
Instructions: 1)Draw neat diagrams 2) All questions are compulsory **3) Assume suitable data wherever necessary**		

Que. No.	Question	Max. Marks
Q1	Solve any **Four**	**20**
i)	Discuss the advantages of using a Database management system over a file system ***Atleast 3 points*** *with explaination like Enforcing integrity constraints, security, concurrent access, Controlling redundancy etc…*	5
ii)	With respect to an ER diagram, what does the participation constraint specify? What are the two types of participation constraints? significance of participation constraint- 1M types of participation constraint - cardinality ratio- 2M , existence dependency - 2M	5
iii)	Explain the basic steps of query processing with a suitable diagram. Diagram – 2 M Explanation – 3M 	5

iv)	State the four informal guidelines used as measures to determine the quality of relation schema design Each guideline – 1M +1M+1M+2M ▪ 1.1Semantics of the Relation Attributes ▪ 1.2 Redundant Information in Tuples and Update Anomalies ▪ 1.3 Null Values in Tuples ▪ 1.4 Spurious Tuples GUIDELINE 1: Informally, each tuple in a relation should represent one entity or relationship instance. (Applies to individual relations and their attributes). GUIDELINE 2: ▪ Design a schema that does not suffer from the insertion, deletion and update anomalies. GUIDELINE 3: ▪ Relations should be designed such that their tuples will have as few NULL values as possible ▪ Attributes that are NULL frequently could be placed in separate relations (with the primary key) GUIDELINE 4: ▪ The relations should be designed to satisfy the lossless join condition . ▪ No spurious tuples should be generated by doing a natural-join of any relations.	5
v)	Draw a state diagram and discuss the typical states that a transaction goes through during execution. Drawing – 2M Discussion of states- 3M	5



- **Active** – the initial state; the transaction stays in this state while it is executing
- **Partially committed** – after the final statement has been executed.
- **Failed** -- after the discovery that normal execution can no longer proceed.
- **Aborted** – after the transaction has been rolled back and the database restored to its state prior to the start of the transaction. Two options after it has been aborted:
  - restart the transaction
    - can be done only if no internal logical error
  - kill the transaction
- **Committed** – after successful completion.

vi) Discuss Data Control commands in SQL with example — 5

GRANT and REVOKE COMMAND – 2.5 M each

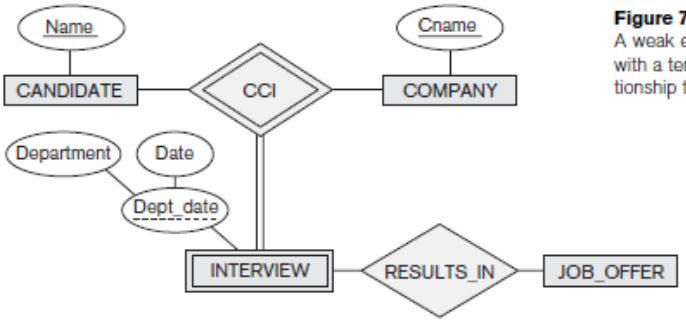
- **GRANT command** gives user's access privileges to the database.
- This command allows specified users to perform specific tasks.

Syntax:

GRANT <privilege list>
ON <relation name or view name>
TO <user/role list>;

GRANT ALL ON
employee
TO ABC;
[WITH GRANT OPTION]

	• **REVOKE command** is used to cancel previously granted or denied permissions. • This command withdraw access privileges given with the GRANT command. • It takes back permissions from user. **Syntax:** REVOKE <privilege list> ON <relation name or view name> FROM <user name>; REVOKE UPDATE ON employee FROM ABC;	

Que. No.	Question	Max. Marks
Q2 A	Solve the following	**10**
i)	Can identifying relationship of a weak entity be of degree greater than two? Give example to illustrate your answer *Yes. – 1M* *Example with explanation – 4M*  **Figure 7.19** A weak entity type INTERVIEW with a ternary identifying relationship type.	5
ii)	Discuss entity integrity and referential integrity constraints with an example Entiry integrity constraint with example – 2 M **Entity Integrity:** ▪ The *primary key attributes* PK of each relation schema R in S cannot have null values in any tuple of r(R). ▪ This is because primary key values are used to *identify* the individual tuples. ▪ t[PK] ≠ null for any tuple t in r(R) ▪ If PK has several attributes, null is not allowed in any of these attributes Referential integrity constraint with example– 3M	5

	Referential Integrity ▪ A constraint involving **two** relations ▪ The previous constraints involve a single relation. ▪ Used to specify a **relationship** among tuples in two relations: ▪ The **referencing relation** and the **referenced relation**. **Referential Integrity (or foreign key) Constraint** ▪ Statement of the constraint ▪ The value in the foreign key column (or columns) FK of the the **referencing relation** R1 can be **either**: ▪ (1) a value of an existing primary key value of a corresponding primary key PK in the **referenced relation** R2, or ▪ (2) a **null**. ▪ In case (2), the FK in R1 should **not** be a part of its own primary key.	
	OR	
Q2 A	What is a view? How do views help in database management? Can you give an example of when they're useful? View definition -2 M Purpose of view -3M Example - 5 M	10
Q 2 B	Solve any **One**	**10**
i)	Explain the process of mapping an Entity-Relationship (ER) model to the Relational model. Illustrate with an example. ER diagram -2M Steps - 8M ● **ER-to-Relational Mapping Algorithm** Step 1: Mapping of Regular Entity Types Step 2: Mapping of Weak Entity Types Step 3: Mapping of Binary 1:1 Relation Types Step 4: Mapping of Binary 1:N Relationship Types. Step 5: Mapping of Binary M:N Relationship Types. Step 6: Mapping of Multivalued attributes. Step 7: Mapping of N-ary Relationship Types.	10
ii)	What are the different types of joins in relational algebra? Provide examples for any 4 *listing of join types- theta join, Equi join, natural join left outer, right outer, full outer join- 2M*	10

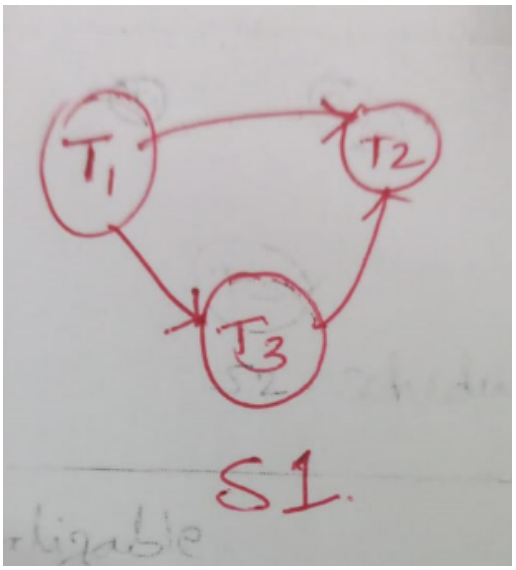
	4 example - 2M each	

Que. No.	Question	Max. Marks
Q3	Solve any **Two**	**20**
i)	Consider the following database schema: member(membno, name) book(isbn, title, authors, publisher) borrowed(membno, isbn, date) Write SQL queries a) Update the author of Database system book to "Korth" b) Find the average number of books borrowed per member c) Find the member number and name of each member who has borrowed every book published by "McGraw-Hill" *Q a) Update book* *Set authors="Korth"* *Where title ="Database System" - 3M* *Q b) SELECT membno, AVG(*) AS Average_borrow_count* *FROM borrowed* *GROUP BY membno - 3M* *c) SELECT m.membno, m.name* *FROM member m* *WHERE NOT EXISTS (* *SELECT b.isbn* *FROM book b* *WHERE b.publisher = 'McGraw-Hill'* *EXCEPT* *SELECT br.isbn* *FROM borrowed br* *WHERE br.membno = m.membno* *); - 4M*	10
ii)	Discuss any 5 algorithms used for implementing SELECT relational algebra operation and circumstances under which each algorithm can be used ● Implementing the SELECT Operation Examples: ○ (OP1): $\sigma_{SSN='123456789'}$(EMPLOYEE) ○ (OP2): $\sigma_{DNUMBER>5}$(DEPARTMENT) ○ (OP3): $\sigma_{DNO=5}$(EMPLOYEE) ○ (OP4): $\sigma_{DNO=5\ AND\ SALARY>30000\ AND\ SEX=F}$(EMPLOYEE) (OP5): $\sigma_{ESSN=123456789\ AND\ PNO=10}$(WORKS_ON)	10

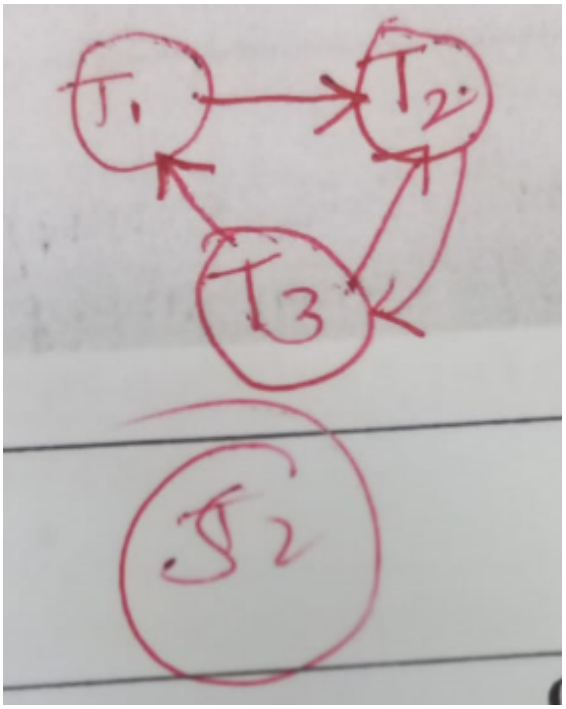
	● Search Methods for Simple Selection: ○ S1 **Linear search** (brute force): ■ Retrieve every record in the file, and test whether its attribute values satisfy the selection condition. ○ S2 **Binary search**: ■ If the selection condition involves an equality comparison on a key attribute on which the file is ordered, binary search (which is more efficient than linear search) can be used. (See OP1). ○ S3 **Using a primary index or hash key to retrieve a single record**: ■ If the selection condition involves an equality comparison on a key attribute with a primary index (or a hash key), use the primary index (or the hash key) to retrieve the record. ● Search Methods for Simple Selection: ○ S4 **Using a primary index to retrieve multiple records**: ■ If the comparison condition is >, ≥, <, or ≤ on a key field with a primary index, use the index to find the record satisfying the corresponding equality condition, then retrieve all subsequent records in the (ordered) file. ○ S5 **Using a clustering index to retrieve multiple records**: ■ If the selection condition involves an equality comparison on a non-key attribute with a clustering index, use the clustering index to retrieve all the records satisfying the selection condition. ○ S6 **Using a secondary (B+-tree) index**: ■ On an equality comparison, this search method can be used to retrieve a single record if the indexing field has unique values (is a key) or to retrieve multiple records if the indexing field is not a key. ■ In addition, it can be used to retrieve records on conditions involving >,>=, <, or <=. (FOR RANGE ■ QUERIES)	
iii)	Consider the three transactions T1, T2, and T3, and the schedules S1 and S2 given below. Draw the serializability (precedence) graphs for S1 and S2, and state whether each schedule is serializable or not. If a schedule is serializable, write down the equivalent serial schedule(s). T1: r1 (X); r1 (Z); w1 (X); T2: r2 (Z); r2 (Y); w2 (Z); w2 (Y); T3: r3 (X); r3 (Y); w3 (Y); S1: r1 (X); r2 (Z); r1 (Z); r3 (X); r3 (Y); w1 (X); w3 (Y);r2 (Y); w2 (Z); w2 (Y); S2: r1 (X); r2 (Z); r3 (X); r1 (Z); r2 (Y); r3 (Y); w1 (X);w2 (Z); w3 (Y); w2 (Y); Precedence Graph (2*2.5m)=5m	10

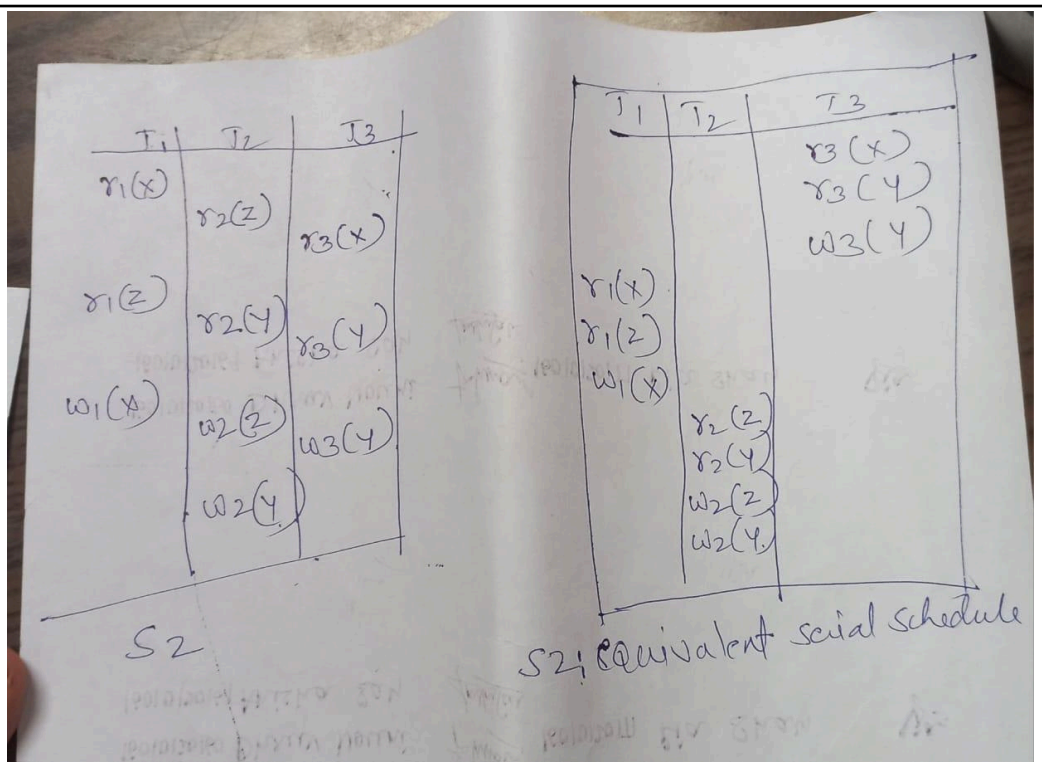
equivalent serial schedule((2*2.5m)=5m

Precedence graph for S1



Precendence graph for S2



	 Equivalent serial schedule for S2 T3->T1->T2	

Que. No.	Question	Max. Marks
Q4	Solve any **Two**	**20**
i)	Consider the relation schema R = (A, B, C, D, E) and set of functional dependencies. A →BC CD →E B→ D E→ A List the candidate keys for R? Decompose R into 2NF and 3NF relation *The candidate keys are A, BC, CD, and E. – 4M* *2NF -4 M , 3NF- 2M* *Final relation R1(A,B,C,E) R2(B,D)*	10
ii)	Discuss the ACID properties of transactions and their significance in ensuring data consistency and reliability.	10

	A **transaction** is a unit of program execution that accesses and possibly updates various data items.To preserve the integrity of data the database system must ensure: • **Atomicity.** Either all operations of the transaction are properly reflected in the database or none are. • **Consistency.** Execution of a transaction in isolation preserves the consistency of the database. • **Isolation.** Although multiple transactions may execute concurrently, each transaction must be unaware of other concurrently executing transactions. Intermediate transaction results must be hidden from other concurrently executed transactions. • That is, for every pair of transactions T_i and T_j, it appears to T_i that either T_j finished execution before T_i started, or T_j started execution after T_i finished. • **Durability.** After a transaction completes successfully, the changes it has made to the database persist, even if there are system failures.	
iii)	Discuss the Two-Phase Locking (2PL) protocol for concurrency control in database systems. How does it ensure serializability? *2 PL protocol - 6M* *example for ensuring serializability - 4M.*	10

Que. No.	Question	Max. Marks
Q5	(Write notes / Short question type) on any **four**	**20**
i)	Database Administrator *function of DBA*	
ii)	User-defined and Predicate defined subclasses Example for each 2.5M	5
iii)	Triggers in SQL T*riggger definition -2 M Row-level or Statement level trigger in SQL- 3M*	5
iv)	Boyce-Codd Normal Form Statement of BCNF - 3M and example - 2M	5
v)	Shadow paging recovery technique *Explanation*	5
vi)	Deadlock handling- wait for graph *Wait for graph useful for deadlock detection - 3M* *Deadlock recovery - 2M*	5