Ans 9)

a) i)

Query Tree 1 for Q1:

A piece of paper with writing on it

Description automatically generated

This query tree will be used in the circumstance of commuting the Select by using the .

Query Tree 2 for Q1:

A piece of paper with writing on it

Description automatically generated with medium confidence

This query tree will be used in the circumstance of commuting the join ⋈ with help of .

Query Tree 1 for Q2:

A piece of paper with writing on it

Description automatically generated

This query tree will be used in the circumstance of commuting the Select by using the .

Query Tree 2 for Q2:

Diagram, engineering drawing

Description automatically generated

This query tree will be used in the circumstance of commuting the join ⋈ with help of .

Query Tree 1 for Q3:

A piece of paper with writing

Description automatically generated with medium confidence

This query tree will be used in the circumstance of commuting the Select by using the .

Query Tree 2 for Q3:

A piece of paper with writing

Description automatically generated with medium confidence

This query tree will be used in the circumstance of commuting the join ⋈ with help of .

a) ii)

For Q1:

Initial Query Tree

A piece of paper with writing

Description automatically generated with medium confidence

The query tree is further converted by changing the Select with (σ or π) and adding the join ⋈ condition.

A piece of paper with writing on it

Description automatically generated

The query tree is further optimized by replacing the join ⋈ with (× or π).

Optimized Query Tree

A piece of paper with writing on it

Description automatically generated with medium confidence

For Q2:

Initial Query Tree

A piece of paper with writing on it

Description automatically generated with medium confidence

The query tree is further converted by changing the Select with (σ or π) and adding the join ⋈ condition.

A piece of paper with writing on it

Description automatically generated

The query tree is further optimized by replacing the join ⋈ with (× or π).

Optimized Query Tree

Diagram, engineering drawing

Description automatically generated

For Q3:

Initial Query Tree

Diagram, engineering drawing

Description automatically generated

The query tree is further converted by changing the Select with (σ or π) and adding the join ⋈ condition.

A piece of paper with writing

Description automatically generated with medium confidence

The query tree is further optimized by replacing the join ⋈ with (× or π).

Optimized Query Tree

A piece of paper with writing

Description automatically generated with medium confidence

Ans 9)

b)

Deadlock

The problem of Deadlock can be caused due to the implementation of the two-phase locking approach where a transaction T1 is requesting a data item X which is held by another transaction T2 which will not be released by transaction T2 until it has been allocated with the requested data item Y, that is held by transaction T1 and will not be released until its request for data item X is granted. Thus, it creates the deadlock problem since neither of transaction are ready to release the held items so the scheduled requests can be granted.

Starvation

The problem of starvation is one which may be caused during the two-phase locking approach. The problem describes the situation where a transaction T is consistently waiting (or requesting) for data item, but it is not allocated to it even once during execution cycle, leading the transaction not to proceed further in its execution.

Different approaches to deal with deadlock

1. Deadlock Prevention: This approach locks all desired data item before the transaction executes.
2. Deadlock Detection and Resolution: In this approach, the deadlock is allowed to happen. The identification of deadlock done by ‘Weight For Graph’ in which if there is a cycle, then deadlock present and otherwise not. Once detected, the deadlock is resolved accordingly either by rolling back the transaction or terminating its execution.
3. Deadlock Avoidance: If it is detected that locking due to a transaction may lead to deadlock then the transaction is rolled back. It is done by techniques of ‘Bound Weight’ and ‘Wait and die’.

Different approaches to deal with starvation

The problem of Starvation can be dealt by using “Time Stamp”. Time Stamp is monotonically increasing value (integer) indicating the age of an operation or transaction.

With the use of time stamp, it can be determined how young or old a transaction is, providing us the provision to check whether a predefined time (or quantum) so as to implement Round Robin scheduling in the execution of transaction where an incomplete transaction may roll back or be paused so that some other transaction may execute some portion of it.