- The MGL protocol states that a transaction T can unlock a node N, only if none of the children of node N are still locked by transaction T. Show that without this condition, the MGL protocol would be incorrect.
- Using the bank example, write relational-algebra queries to find the accounts held by more than two customers in the following ways:
 - Using an aggregate function.
 - Without using any aggregate functions. Let the following relation schemas be given:

$$R = (A, B, C)$$

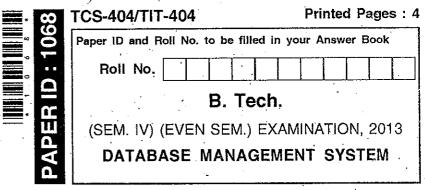
$$S = (D, E, F)$$

Let relations r(R) and s(S) be given. Give an expression in the tuple relational calculus that is equivalent to each of the following:

- (1) $\Pi_A(r)$
- $\sigma_B = 17^{(r)}$

(4)
$$\Pi_{A,F}\left(\sigma_c = D^{(r \times s)}\right)$$

- Assuming a suitable relational schema for a banking system, write an SQL query, without using a with clause, to find all branches where the total account deposit is less than the average total account deposit at all branches.
 - Using a nested query in the from clause
 - Using a nested query in a having clause.



Time: 3 Hours

[Total Marks: 100-

4×5

- Attempt any four parts of the following:
- (a) List four significant differences between a file-processing system and a DBMS.
- (b) Define the concept of aggregation. Give two examples of where this concept is useful.
- Consider a two-dimensional integer array of size n × m that is to be used in your favourite programming language. Using the array as an example, illustrate the difference (i) between the three levels of data abstraction, and (i) between a schema and instances.
- Construct an E-R diagram for a hospital with a set of patients and a set of medical doctors. Associate with each patient a log of the various tests and examinations conducted.
- Draw the overall structure of DBMS and explain its various components.

- (f) Define the following terms:
 - (i) Data redundancy and consistency
 - (ii) Referential Integrity
 - (iii) Data atomicity
 - (iv) Domain constraints
 - (v) Data models.
- 2 Attempt any four parts of the following:

4×5

- (a) Describe the wait-die and wound-wait protocols for deadlock prevention.
- (b) Discuss the selection, projection and join operator of relational algebra with a suitable example.
- (c) Discuss two multi-version techniques for concurrency control.
- (d) What is a view in SQL, and how is it defined? Discuss the problems that may arise when one attempts to update a view. How views are typically implemented?
- (e) Describe conceptually how an SQL query will be executed by specifying the conceptual order of executing each of the six clauses.
- (f) Describe the circumstances in which you would choose to use embedded SQL rather than SQL alone or only a general-purpose programming language.

3 Attempt any two parts of the following:

2×10

- (a) Define first, second, and third normal forms when only primary keys are considered. How do the general definitions of 2NF and 3NF, which consider all keys of a relation, differ from those that consider only primary keys?
- (b) Define Boyce-Codd normal form. How does it differ from 3NF? Why is it considered a stronger form of 3NF?
- (c) Consider the universal relation R = {A, B, C, D, E, F, G, H, I, J} and the set of functional dependencies F = {{A, B}} → {C},
 {A} → {D, E}, {B} → {F}, {F} → {G, H},
 {D} → {I, J}}. What is the key for R? Decompose R into 2NF and then 3NF relations.
- 4 Attempt any two parts of the following:

2×10

- (a) What is a serial schedule? What is a serializable schedule? Why a serial schedule is considered correct? Why a serializable schedule is considered correct?
- (b) What is the system log used for? What are the typical kinds of records in a system log? What are transaction commit points, and why are they important?
- (c) Why an explicit transaction end statement is needed in SQL2 but not an explicit begin statement?