

2125  
B.E. (Computer Science and Engineering)  
Third Semester  
CS-302: Database Systems

Time allowed: 3 Hours

Max. Marks: 50

*NOTE: Attempt five questions in all, including Question No. 1 (Section-A) which is compulsory and selecting two questions each from Section B-C.*

*x-x-x*

**Section-A**

- Q1. a) Define the term data independence and distinguish between logical and physical data independence. 10  
b) Explain the purpose of aggregate functions in SQL.  
c) Explain the difference between primary key and foreign key.  
d) Define deadlock in a database.  
e) What is a log-based recovery?

**Section-B**

- Q2. a) Explain the fundamental differences between a traditional File System and a Database Management System (DBMS). What are the primary advantages of using a DBMS over a file system? 5  
b) Construct an ER diagram for a hospital management system and convert it into relational tables. 5
- Q3. a) Compare hierarchical, network, and relational models. 5  
b) Why are B-trees the preferred Index Data Structure for implementing indexes in most relational database systems? Describe a B-tree's structure and its advantage in minimizing disk I/O. 5
- Q4. a) Compare relational algebra and relational calculus. 3  
b) Explain the role of Triggers in implementing an Active Database. Provide an example of a situation where a trigger would be used. 4  
c) What are Aggregate Operations in SQL? List and briefly explain at least three common aggregate functions 3

P.T.O.

**Section - C**

- Q5. a) Define Multi-valued Dependency (MVD). What type of redundancy does Fourth Normal Form (4NF) eliminate? 2
- b) What type of dependency is eliminated when converting a relation from 2NF to Third Normal Form (3NF)? 3
- c) Explain the two desirable properties of decomposition: Lossless-Join Decomposition and Dependency-Preserving Decomposition. Which property is always guaranteed when decomposing to BCNF? 5
- Q6. a) Describe the two distinct phases of the Two-Phase Locking (2PL) protocol. 5
- b) Define and explain how each of the following concurrency problems occurs: Dirty Read, Lost Update, and Incorrect Summary. 5
- Q7. a) Define the role of Firewalls in protecting a database server. 5
- b) Describe the Shadow Paging technique. How does it simplify the process of transaction undo/abort? 5