

CONTENTS

Unit 1—INTRODUCTION	1–54
1.1 Data	1
1.1.1 Three-layer data architecture	1
1.2 Information	2
1.3 Data Warehouse	2
1.4 Data Dictionary	2
1.5 Records	2
1.6 Files	3
1.7 Database	3
1.8 Database Management System	3
1.8.1 Application of database system	3
1.8.2 Functions and services of DBMS	4
1.8.3 Database vs. file systems	5
1.8.4 Advantages of file processing system	5
1.8.5 Disadvantages of files processing system	5
1.8.6 Advantages of DBMS	6
1.8.7 Disadvantages of DBMS	8
1.9 Data Abstraction	9
1.10 Instances and Schemas	9
1.11 Data Independence	10
1.12 Data Models	11
1.12.1 The entity-relationship model	11
1.12.2 Relational model	12
1.12.3 Object-oriented data model	12
1.12.4 The object-relational data model	13
1.12.5 Hierarchical model	14
1.12.6 The network data model	14
1.13 Types of Database Systems	15
1.13.1 Centralised database system	15
1.13.2 Distributed database system	16
1.13.3 Parallel database system	17
1.13.4 Client/Server database system	19
1.14 Database Languages	20
1.14.1 Data definition language	20
1.14.2 Data-manipulation language	21
1.14.3 Data control language	21
1.14.4 Data query language	22
1.15 DBMS Interfaces	22

1.16	Database Users and Administrators	22
1.16.1	Database administrator	22
1.16.2	Database users	24
1.17	Overall Database Structure	24
1.17.1	Storage manager	24
1.17.2	Query processor	26
1.18	Fourth-Generation Language (4GL)	26
1.19	Metadata	26
1.19.1	Types of metadata	27
1.20	ER-Model Concepts	27
1.20.1	Entity	27
1.20.2	Attributes	27
1.21	Relationships and Relationship Sets	28
1.22	Constraints	28
1.22.1	Mapping cardinalities	28
1.22.2	Participation constraints	29
1.23	Existence Dependency	30
1.24	Keys	31
1.25	Association	32
1.26	Specialization	32
1.27	Generalization	33
1.28	Aggregation	33
1.29	Relationships of Higher Degree	33
1.30	Reduction of an E-R Diagram to Tables	34
1.30.1	Tabular representation of strong entity set	34
1.30.2	Tabular representation of weak entity set	34
1.30.3	Tabular representation of relationship sets	35
	<i>Solved Problems</i>	35–54
	Review Questions	55

Unit 2—RELATIONAL DATA MODEL CONCEPTS**56–124**

2.1	Relational Data Model Concepts	56
2.2	Integrity Constraints	56
2.2.1	Entity integrity	56
2.2.2	Referential integrity	56
2.3	Domain Constraints	57
2.4	Relational Algebra	57
2.4.1	Select operation	57
2.4.2	Project operation	58
2.4.3	Union operation	58
2.4.4	Set-difference operation	59
2.4.5	Cartesian product operation	59

2.4.6	Division operation	60
2.4.7	Rename operation	61
2.4.8	Join	61
2.4.8.1	Natural join	61
2.4.8.2	Semi join	62
2.4.8.3	Anti join	62
2.4.8.4	Outer join	63
2.4.9	Projection	63
2.5	Relational Calculus	64
2.6	The Domain Relational Calculus	65
2.7	Introduction to SQL	66
2.7.1	Data types	67
2.7.2	Types of SQL commands	67
2.7.3	Insertion of Data into Tables	68
2.7.4	Select command	68
2.7.5	Elimination of duplicates from the select statement	69
2.7.6	Sorting data in a table	69
2.7.7	Creating a table from a table	69
2.7.8	Inserting data into a table from another table	69
2.7.9	Delete operations	70
2.7.10	Update command	70
2.7.11	Modifying the structure of tables	71
2.7.12	Renaming command	71
2.7.13	Destroying table	71
2.7.14	Logical operators	71
2.7.15	Range searching	72
2.7.16	Unique key	73
2.7.17	Primary key	73
2.7.18	Foreign key	73
2.7.19	Aggregate functions	73
2.7.20	Subqueries	76
2.7.21	Joins	77
2.7.22	Union clause	78
2.7.23	Intereset clause	79
2.7.24	Minus clause	80
2.8	Views	82
2.9	Indexes	82
2.10	Row Num in SQL Statement	83
2.11	Sequences	84
2.12	Cursor	85
2.13	Database Triggers	86
2.14	Oracle Packages	87

2.15	Assertions	88
	<i>Solved Problems</i>	89–123
	Review Questions	124
Unit 3–DATABASE DESIGN AND NORMALIZATION		125–156
3.1	Database Design	125
3.2	Decomposition	126
3.3	Universal Relation	126
3.4	Functional Dependency	126
3.5	Prime Attribute	128
	3.5.1 Non-prime attribute	128
3.6	Armstrong's Axioms	128
3.7	Closure of Set of Functional Dependencies	129
3.8	Non-Redundant Covers	130
3.9	Canonical Cover or Minimal Set of FD's	131
3.10	Normalization	132
	3.10.1 First normal form (1NF)	133
	3.10.2 Second normal form (2NF)	133
	3.10.3 Third normal form (3NF)	135
	3.10.4 Boyce-Codd normal form (BCNF)	137
	3.10.5 Fourth normal form (4NF)	139
	3.10.6 Fifth normal form (5NF)	141
	3.10.7 Sixth normal form	142
	3.10.8 Domain/key normal form	143
	3.10.9 Conclusion of database normalization	143
3.11	Lossless-join Decomposition	143
	<i>Solved Problems</i>	144–155
	Review Questions	155
Unit 4–TRANSACTION PROCESSING CONCEPTS		157–179
4.1	Transaction Concept	157
4.2	Transaction Access Data	157
4.3	Transaction State	158
4.4	Concurrent Executions	158
	4.4.1 Schedules	158
4.5	Serializability	158
	4.5.1 Conflict serializability	159
	4.5.2 View serializability	161
	4.5.3 Testing of serializability	162
4.6	Recoverability	162
	4.6.1 Recoverable schedules	163
	4.6.2 Cascadeless schedules	163

Contents	(v)
4.7 Transaction Recovery	163
4.7.1 Failure classification	164
4.7.2 Types of transaction recovery	165
4.8 Log Based Recovery	167
4.9 Check Points	168
4.10 Deadlocks	169
4.10.1 Deadlock handling	169
4.10.1.1 Deadlock prevention	170
4.10.1.2 Deadlock detection and recovery	170
4.11 Concept of Phantom Deadlock	172
<i>Solved Problems</i>	173–177
Review Questions	177
Unit 5–CONCURRENCY CONTROL TECHNIQUES	180–214
5.1 Locking Techniques for Concurrency Control	180
5.1.1 Lock	180
5.1.2 The two-phase locking protocol	181
5.2 Concurrency Control Based on Timestamp Protocol	183
5.3 Validation (Optimistic)-Based Protocol	185
5.4 Multiple Granularity Locking	186
5.5 Multi-Version Schemes	188
5.6 Multi-Version Two-Phase Locking	189
5.7 Recovery with Concurrent Transactions	190
5.8 Distributed Database	190
5.8.1 Classification of distributed database	191
5.8.2 Functions of distributed database	192
5.8.3 Advantages of distributed database	193
5.8.4 Disadvantages of distributed database	194
5.8.5 Architecture of distributed database	194
5.8.6 Distributed database system design	196
5.8.7 Transaction processing in distributed system	197
5.8.7.1 System structure	197
5.8.7.2 System failure modes	198
5.8.8 Data fragmentation	198
5.8.9 Data replication and allocation	199
5.8.10 Data allocation	200
5.8.11 Overview of concurrency control	201
5.8.12 Distributed recovery	202
5.8.13 Two-phase commit protocol	202
5.8.14 Handling of failures	203
<i>Solved Problems</i>	204–213
Review Questions	213

APPENDIX

215–235

Appendix A : Lab Assignment

215–242

Appendix B : Tick the Appropriate Answer

243–274

Appendix C : UPTU Question Paper

275–283

Appendix D : DBMS Interview Questions and Answers

284–305

INDEX

(i)–(iv)