

Contents

1. Introduction to DBMS	1
2. Data Models	42
3. Entity-Relationship Model	66
4. Relational Database Management	109
5. Relational Algebra and Relational Calculus	138
6. Normalization	179
7. Transaction Management and Concurring Control	238
8. Database Recovery Techniques	295
9. Database Security and Integrity	322
10. Distributed Databases	345
11. Introduction to DBMS packages	370
12. SQL Fundamentals-I	401
13. SQL Fundamentals-II	444
14. SQL Fundamentals-III	487
15. Advanced SQL*PLUS and REPORTS	504
16. Views, Sequences, Indexes and Synonyms	522
17. Managing Users and Roles	536
18. Introduction to PL/SQL	551
19. Control Structure	572
20. Handling errors and Exceptions	588
21. Retrieving Data with cursors	601
22. Procedures, Functions and Packages	619
23. Database Triggers	644
24. Leftovers - (Oracle Utilities & OO features)	659

Note : e-notes on the chapters - '**Big-Data and No-SQL**', '**Object-oriented database**' and/or '**Expert Systems**' will only be available to those whose fill the form at the back of the title and provide a valid copy of the bill of purchase as email attachment. These e-notes (without any printouts) of requested chapters will only be sent via an email on the e-mail address as provided on the form after proper verification only. There is no time limit for reply containing chapters. The publisher/author can refuse to send e-notes of these chapters without giving any reason.

(A7)

DETAILED CONTENTS
with STEPS
Fifth Edition

1.	INTRODUCTION TO DBMS	1	(b) Objectives of ANSI/SPARC 3 level DBMS architecture	33
1.1	Data, Information and Knowledge	1	(c) Mapping	34
	(a) Data	1	(d) Data independence	35
	(b) Information	2	(e) 1-Tier, 2-Tier, 3-Tier DBMS Architecture	
	(c) Knowledge	3		36
1.2	Database	3	2. DATA MODELS	42
	(a) Types of database - historical perspective	5	2.1 Data Model	42
1.3	DBMS	7	2.2 Types of data models	43
	(a) Functions of DBMS	8	2.3 Hierarchical Model	44
	(b) Commercially available DBMS	9	(a) Operations	46
	(c) Requirement of a well designed DBMS	10	(b) Advantages and Disadvantages	47
1.4	Database System	11	2.4 Network Model	49
	(a) Components of Database System	11	(a) Operations	50
	(b) Database System structure	14	(b) Advantages and Disadvantages	52
	(c) Database System languages	18	2.5 Relational data model	53
	(d) Database System interface	20	(a) Operations	55
	(e) Characteristics of Database approach	20	(b) Properties of a table/relation	57
	(f) Implications of database approach	21	(c) Advantages and Disadvantages	58
1.5	Traditional File-based system approach	22	No-SQL data model	60
	(a) File organization	23	2.7 Object oriented data model	61
	(b) Advantages and disadvantages	24	2.8 Which Data Models to use ?	62
	(c) Advantages of database system over file system	25	2.9 Comparison on record based data models	63
	(d) Disadvantages of database system	28	3. ENTITY-RELATIONSHIP MODEL	66
	(e) When to use File based system over database system	29	3.1 ER model	66
1.5	Three-level ANSI/SPARC database system architecture	29	3.2 Terminology	67
	(a) Schema, subschema and instances	32	1. Entity	68
	1. Schema	32	2. Attributes	69
	2. Subschema	33	(a) Type of attributes	70
	3. Instance	33	3. Relationship	71
			(a) Degree of a relationship	73
			(b) Connectivity of relationship	74
			(c) Cardinality of relationship	76
			(d) Directionality of relationship	77
			(e) Participation in a relationship	77
		3.3	Weak and Strong entity and their relationship	78
		3.4	Extended ER features (Enhanced ER Model)	82
			1. Generalization	82

(A8)

	2. Specialization	83	5.1.1	Operations in relational algebra	139
	3. Attribute inheritance	85	(a)	Basic set operations	140
	4. Aggregation	85		1. Union (\cup)	141
3.5	ER diagram	86		2. Intersection (\cap)	141
3.6	Problems with ER model	91		3. Difference (-)	142
	1. Fan trap	91		4. Cartesian Product (\times)	143
	2. Chasm trap	93	(b)	Special relational operations	144
3.7	Conversion of ER diagram into table	95		1. Selection (σ)	145
	(a) Creating table for each entity	95		2. Projection (Π)	146
				3. Join	148
				(a) Equi join and non-equi join	148
				(b) Natural join	149
				(c) Self join	150
				(d) Semi join	151
				4. Division (\div)	152
			(c)	some additional operations	155
				1. Rename (ρ)	155
				2. Assignment (\leftarrow)	156
				3. Aggregate functions and grouping	157
				4. Outer join	159
			(a)	Types	159
				(i) Left Outer Join	160
				(ii) Right Outer Join	161
				(iii) Full Outer Join	162
			5.1.4	Some relational algebra queries	163
			5.2	Relational calculus	166
			5.2.1	Tuple Relational calculus	167
			(a)	Expressions and Formulas	168
			(b)	Quantifiers : Existential (there exists) and Universal (for all)	169
				Free and Bound tuple variables	169
				Quantifiers in Formulas	170
			(c)	Examples of queries in Tuple Calculus	170
			5.2.2	Domain Relational calculus	171
			(a)	Examples of queries in domain Calculus	172
			5.2.3	Tuple calculus v/s Domain calculus	173
			5.2.4	Relational Algebra v/s Relational calculus	174
5.1	Relational algebra	139			

6.	NORMALIZATION	179	6.17	Denormalization	228
6.1	Normalization - Introduction	179	6.18	Explanation of Normalization with example	229
6.2	Why Normalization is needed ?	181			
	Disadvantages	182			
6.3	First normal form (1NF)	182	7.	TRANSACTION MANAGEMENT AND CONCURRING CONTROL	238
6.3.1	Anomalies in First Normal Form (1NF)	185	7.1	Transaction	238
	(a) Insertion Anomaly	185		(a) Read/Write operations	239
	(b) deletion Anomaly	186	7.1.1	Properties of transaction	240
	(c) Updation Anomaly	186		(a) Atomicity	240
6.4	Functional dependency	187		(b) Consistency	241
	Properties of Functional dependency	190		(c) Isolation	242
	Armstrong Axioms	190		(d) Durability	243
	Advantages of Functional dependency	191	7.1.2	States of a transaction	243
6.5	Attribute closure	192	7.2	Concurrency control	245
	(a) Obtaining closure	192		(a) Need	245
	(b) Applications of attribute closure	193		(b) Problems in concurrent access	246
	1. Identifying the candidate key(s) of a relation	193		(c) Concurrency control mechanisms	250
	2. Determining the minimal cover	197	7.2	Scheduling of transactions	251
	3. Determine equivalence of functional dependency	200		(a) Types of schedules	252
6.6	Fully Functional dependency	202		(b) Serializability	253
6.7	Second Normal form	203		1. Conflict equivalent serializable schedule	254
	(a) Use of 2NF to remove associated anomalies of relation in 1NF	205		(a) Conflicting operations	254
	(b) Anomalies in a relation in 2NF	205		(b) Example	255
6.8	Transitive dependency	209		(c) Creating conflict equivalent schedule	255
6.9	Third Normal Form (3NF)	210		(d) Using precedence graph to determine whether a given schedule is Conflict	
	(a) Use of 3NF to remove anomalies of a relation in 2NF	211		equivalent serializable	256
	(b) Anomalies in a relation in 3NF	212	2.	View equivalent serializable schedule	260
6.10	Boyce-Codd Normal Form (BCNF)	215	7.3	Characterizing schedules on basis of recoverability	262
	(a) Comparison between 3NF and BCNF	217		(a) Recoverable schedule	262
6.11	Multivalued Dependency	220		(b) Non-cascading schedule	263
	(a) Properties of multivalued dependency	222	7.4	(c) Strict recoverable schedule	264
6.12	Fourth Normal Form (4NF)	222	7.4.1	Concurrency control mechanisms	264
6.13	Lossless Decomposition	223	7.4.1.1	Lock-based concurrency control	265
6.14	Join dependency	226	7.4.1.2	Two-Phase Locking (2PL)	268
6.15	Fifth Normal form	226	7.4.1.2.1	Deadlock	271
6.16	Steps for Normalization	227	7.4.1.2.2	Deadlock prevention	271
				Time-out based approach	275

7.4.1.2.3	Deadlock Detection and Recovery	275		Immediate update in Multiuser Environment	314
	Wait for graph	276		Shadow Paging	314
7.4.2	Concurrency control based on Timestamp ordering approach	277	8.6.3	Database Recovery from catastrophic failures	317
	(a) Strict timestamp ordering	281	8.7	ARIES algorithm	317
	(b) Thomas write Rule	281	8.8		
7.4.3	Concurrency control based on multiple granularity	282	9.	DATABASE SECURITY AND INTEGRITY	322
7.4.4	Multiversion concurrency control techniques	283	9.1	Database security	322
7.4.4.1	Multiversion Timestamp Ordering	284	9.2	Data security Requirements	327
7.4.4.2	Multiversion Two-phase Locking	285	9.3	access control	329
7.4.5	Concurrency control based on Optimistic scheduling	285	9.4	Protecting data within the database	330
7.4.6	Graph-based or Tree-Locking protocol for concurrency control	288	9.5	Privileges	332
			9.6	Database Roles	334
			9.7	Views	335
			9.9	Data Encryption	337
8.	DATABASE RECOVERY TECHNIQUES	295	9.10	Statistical database security	340
8.1	Difference between failure, fault and error	295	9.11	Data Integrity	340
				(a) Integrity constraints	341
8.2	Data storage media	296	10.	DISTRIBUTED DATABASES	345
8.3	Types of failures	297	10.1	Distributed Database	345
8.4	Why Recovery is needed ?	298		(a) Example	346
8.5	Some Important concepts relating to recovery	299		(b) DDBMS Components	347
8.5.1	System Log	299		(c) Advantages of distributed Databases	348
8.5.2	Caching of Disk Blocks	301		(d) Disadvantages of distributed Databases	349
8.5.3	Checkpoints	302		(e) Distributed databases vs centralized databases	350
8.5.4	Steal/No-steal and Force/No-force	304		(f) Reference architecture for distributed databases	352
8.5.5	Write Ahead Logging	305		(g) Homogenous and heterogenous DDBMS	353
8.6	Recovery techniques	306	10.2	Distributed database design	354
8.6.1	Deferred Update	306	10.2.1	Data Fragmentation	355
	(a) Recovery based on Deferred update in a Single-User Environment (SUE)	307	10.2.1	Horizontal Fragmentation	356
	(b) Recovery based on Deferred Update with concurrent execution in a multi-user Environment(MUE)	310	10.2.2	Vertical Fragmentation	357
8.6.2	Immediate Update	311	10.2.3	Mixed Fragmentation	358
	(a) UNDO /REDO Recovery based on Immediate Update in a single-user Environment (SUE)	312	10.2.4	Advantages of Fragmentation	359
	(b) Undo/ Redo recovery based in		10.2.5	Disadvantages of Fragmentation	360
			10.2.2	Data replication	360

(AII)

10.2.3	Data Allocation	362		ALTERTABLE	422	
10.3	Transparency in DDBMS	363		(a) Adding new columns/constraints in an existing table	423	
10.4	Client/Server V/S DDBMS	364		(b) Modifying columns/constraints in existing table	424	
10.5	Parallel DBMS v/s Distributed DBMS	366		(c) Dropping columns/constraints	425	
10.6	Date's twelve rules for DDBMS	367		(d) Renaming tables	427	
11.	INTRODUCTION TO DBMS PACKAGES	370		12.8	Drop Table	427
11.1	PostgreSQL	370		12.9	Data dictionary	428
	(a) History	371		12.10	DML Statements	428
	(b) Installation	371			1. Insert DML statement	429
	(c) Working with PostgreSQL	373			(a) Insert with SELECT	431
	(d) Applications	374			(b) Inserting rows using substitution variables (&, &&)	432
11.2	MySQL	374			(c) Inserting multiple rows using Insert all	433
	(a) History	375			2. Update statement	433
	(b) Installation	375			3. Delete statement	434
	(c) Working with MySQL	378			(a) Truncate table statement	435
	(d) Applications	379			4. Select statement	435
	(e) Limitations	379		12.11	Adding comments to a table	435
11.3	Oracle	379		12.12	TCL statements	436
	(b) Oracle Architecture	381			(a) commit	436
	(c) Oracle Products	391			(b) rollback	437
	(d) Editions of Oracle	392			(c) savepoint	438
	(e) Installation & Working	393		12.13	Set Transaction statement	439
	(f) Applications	399		12.14	Some commonly encountered errors	440
	(g) Limitations	399		12.15	Processing SQL statements	441
12.	SQLFUNDAMENTALS -I	401		13.	SQLFUNDAMENTALS-II	444
12.1	History	401		13.1	Operators	444
12.2	SQL commands	402			(a) Arithmetic operators	445
12.3	3GL and 4GL	404			(b) Comparison operators	445
12.4	SQL Grammar	404			(c) Logical operators	446
12.5	Oracle data types	405			(d) Concatenation operator	447
12.6	Working with table	409			(e) Set operators	447
	(a) Creating a table	410			(f) Precedence and associativity of operators	447
	(b) Specifying Integrity constraints	412		13.2	SELECT statement	448
	Types	414			(a) To retrieve all columns	449
	(c) Viewing user constraints	420			(b) To retrieve the selective columns	450
	(d) Default value for a column or default constraint	420			(c) To retrieve the distinct rows	450
	(e) Creating table from an existing table	421			(d) Filter data using WHERE clause	450
12.7	Modifying the table structure using					

	(e) Using expressions in the SELECT statement	452	15.	ADVANCED SQL*PLUS AND REPORTS	504
	(f) Referencing columns with an alias	452	15.1	Some commonly used terms	504
	(g) Use of Concatenation operator ()	453	15.2	SQL*PLUS commands	505
	(h) Use of LIKE operator	453	15.3	Purpose of Editors in SQL*PLUS	507
	(i) Use of IN operator	454	15.4	SQL*PLUS system variables	509
	(j) Use of 'BETWEEN' Operator	455	15.5	Generating Reports Using SQL*PLUS	511
	(k) NULL and NOT NULL	456	15.6	Practise Session for making Report	515
	(l) ORDER BY clause	456	15.7	Difference between & and &&	517
13.2	DUAL table	458	15.8	Setting up Profiles (Glogin.SQL and Login.SQL)	518
13.3	SQL Built-in functions	458	15.9	Difference between SQL and SQL*PLUS	519
	1. Single-Row functions	459	15.10	How are SQL*PLUS reports executed	520
	(a) Numeric functions	459			
	(b) String functions	462			
	(c) Date Functions	467	16.	VIEWS,SEQUENCES,INDEXES AND SYNONYMS	522
	(d) Conversion Functions	470	16.1	Views	522
	(e) Miscellaneous Functions	473		(a) Join views	524
	2. Aggregate Functions	475		(b) Uses of a View	525
13.4	Group By clause	477		(c) Changing view definition	525
	(a) HAVING clause	479		(d) Inline View	526
13.5	Order of execution of SELECT statement	479	16.2	Indexes	526
13.6	Oracle Tree Walking	480		(a) Types of Indexes	527
				(b) Creating an Index	527
				(c) Creation of unique index	529
14.	SQLFUNDAMENTALS-III	487		(d) Dropping existing indexes	530
14.1	Joins	487		(e) Always remember	530
	(a) Equi join	488	16.3	Sequences	531
	(b) Outer Join	490		(a) Uses of sequences	532
	(c) Self Join	491		(b) Alter Sequence	533
14.2	Set operations	492		(c) Dropping a sequence	533
	(a) UNION [ALL]	492	16.4	Synonyms	533
	(b) Intersect	493		(a) Uses of synonyms	534
	(c) MINUS	493		(b) Dropping Synonyms	534
14.3	Nested Queries	494	17.	MANAGING USERS AND ROLES	536
	(i) Scalar subqueries	495	17.1	Managing Users	536
	(ii) Single-Row subqueries	495		(a) Creating a user	537
	(iii) Multiple-Row subqueries	496		(b) ALTER USER	538
	(iv) Multiple-Column subqueries	498		(c) Dropping an existing user	539
	(v) Correlated Queries	498	17.2	Privileges	539
14.4	EXISTS operator	500			
14.5	Query optimization	502			

	(a) Types	539		(a) Loop Labels	583
	(b) Granting and revoking system privileges	541	19.3	Sequential Control	584
	(c) Granting and Revoking the Object Privileges	543		1. GOTO statement	584
	(d) Revoking privileges	544		2. NULL statement	586
17.3	Roles	545	20.	HANDLING ERRORS AND EXCEPTIONS	588
	(a) Creating a Role	546	20.1	PL/SQL warnings	588
	(b) Granting privileges to role	547	20.2	PL/SQL Exception	589
	(c) Granting a Role to Another Role	547		(a) Exception block	590
	(d) Enabling or Disabling roles	547		(b) Types of Exceptions	591
	(e) Password protecting database Roles	548		1. Pre-defined exceptions	591
	(f) Revoking privileges from a role	548		2. User-defined exceptions	592
	(g) Dropping the Role	549	20.3	3. Non-predefined exceptions	594
	(h) Granting and Revoking Access to/ From Public	549	20.4	PRAGMA EXCEPTION_INIT exception	594
			20.4	Using raise_application_error	595
			20.5	Using SQLCODE and SQLERRM in handler clauses	596
18.	INTRODUCTION TO PL/SQL	551	20.6	Exception Propagation	597
18.1	PL/SQL - Introduction	551	20.7	Reraising an Exception	598
	(a) Features of PL/SQL	551	20.8	Exceptions raised in Declarations	599
	(b) Advantages of PL/SQL	552	21.	RETRIEVING DATA WITH CURSORS	601
	(c) PL/SQL Architecture	553	21.1	Cursor	601
	(d) PL/SQL Block structure	554	21.1.1	Types of cursors	602
18.2	Basic elements in PL/SQL	555		(a) General Cursor attributes	602
18.3	PL/SQL data types	558		1. Implicit Cursor	603
	1. Scalar data types	558		2. Explicit cursors	604
	2. Composite data types	560		1. Declaring and defining explicit cursors	605
	3. LOB data types	560		2. Opening an Explicit cursor	606
	4. Reference data types	560		3. Fetching the records/rows	606
18.3	Variables and Constants	561		4. Closing the cursor	607
	(c) Variable attributes	562		(a) Explicit cursor attributes	608
18.4	Displaying messages in PL/SQL	563	21.1.2	Processing query result set with Cursor FOR loop	611
18.5	Handling SQL statements in PL/SQL program	566	21.1.3	Passing parameters to cursors	612
18.6	Nested blocks	568	21.1.4	For update clause	616
	(a) Scope and Visibility	569	21.1.5	Implicit cursor vs Explicit cursor	617
18.7	To execute a DDL statement in PL/SQL	570			
18.8	SQL vs PL/SQL	570			
19.	CONTROL STRUCTURE	572			
19.1	Conditional control statements	572			
19.2	Looping statements	577			

22.	PROCEDURES, FUNCTIONS AND PACKAGES	619	24.	LEFTOVERS-(ORACLE UTILITIES & OO FEATURES)	659
22.1	Subprograms	619	24.1	Export Utility	659
	(a) Types of subprograms	619	24.2	Modes of Export	662
	(b) Parts of a subprogram	620	24.3	Import Utility	662
	(c) Advantages of subprograms	620	24.4	SQL*Loader	663
22.1.1	Procedures	621	24.5	Object oriented features of Oracle	666
	1. Local procedure	621		(a) Object Types	666
	2. Stored Procedures	624		1. Create Type Command	667
22.1.2	Functions	629		2. Object Methods	668
	1. Local Functions	629	(b) Collections	668	
	(a) Return statement	630	1. Varray	668	
	2. Stored functions	631	2 Nested Table	669	
	(b) Difference between		3. Object Tables	669	
	Procedures and Functions	635	(c) References	670	
22.2	Packages	635			
	(a) Referencing package contents	638			
	(b) Bodiless package	639			
	(c) Recompiling Packages	640			
	(d) Advantages of packages	640			
	(e) Oracle supplied packages	641			
	(f) Dropping Procedure/Function/ Package	642			
	(g) Using USER_OBJECTS, USER_SOURCE	642			
23.	DATABASE TRIGGERS	644			
23.1	Database triggers	644			
	(a) Creating a Trigger	645			
	(b) Trigger components	646			
	1. Trigger timing	646			
	2. Triggering event	647			
	3. Trigger restriction	647			
	4. Trigger Action	649			
	(c) Accessing Old and New values of columns in Row triggers	649			
	(d) Use of conditional predicates	654			
	(e) Enabling and disabling triggers	656			
	(f) Dropping a trigger	656			
	(g) Getting Trigger information from data dictionary	656			

(A16)