



# Table of Contents

<b>Preface</b> .....	<b>iii</b>
----------------------	------------

## UNIT - I: SQL

<b>Chapter 1: Introduction to SQL</b> .....	<b>3</b>
Describing the Importance of SQL in RDBMS.....	4
Exploring the Components of SQL .....	5
Data Definition Language .....	5
Data Manipulation Language .....	5
Query Language .....	6
Data Control Language.....	6
Transaction Control, Session Control, and System Control.....	7
Starting SQLPLUS.....	7
Working with Data Definition Language.....	8
Working with Data Manipulation Language .....	11
Inserting Data in Table.....	11
Inserting Null Values .....	12
Retrieving Data .....	13
Retrieving Data from a Single Table .....	13
Retrieving Data from Selected Columns .....	14
Writing a Query .....	16
Understanding Datatypes .....	18
Introducing TIMEZONE and TIMESTAMP .....	23
Converting Character Data to Timestamp .....	25
Working with The TO_TIMESTAMP() Function .....	26
Working with The TO_TIMESTAMP_TZ() Function .....	26
Working with The CAST() Function .....	26
Working with Tables.....	26
Summary .....	29
Exercise.....	29

<b>Chapter 2: Set Operations</b> .....	<b>31</b>
Basic Set Operations.....	32
The Union Operation .....	32
The Intersect Operation .....	33
The Minus Operation .....	33
Other Set Operations .....	37
The In Clause.....	37
The Exists Clause .....	40
Using Multicolumn Subqueries .....	43
Retrieving Data from Multiple Tables .....	44
Using Cartesian Product.....	44
Self Join (Using Alias of Tables) .....	48
Summary .....	49
Exercise.....	50
<b>Chapter 3: SQL Operators</b> .....	<b>51</b>
SQL Arithmetic Operators .....	52
SQL Logical Operators .....	53
SQL Query Expression Operators.....	55
SQL Functions.....	56
Number Functions.....	56
Character Functions .....	57
Date Functions .....	60
Other Functions .....	61
Pseudo-Columns .....	62
The LEVEL Pseudo-Column .....	62
The ROWID Pseudo-Column.....	62
The ROWNUM Pseudo-Column.....	63
The ROWSCN Pseudo-Column.....	64
The SYSDATE Pseudo-Column.....	64
The UID Pseudo-Column .....	65
The USER Pseudo-Column .....	65
Defining Single and Double Ampersand (&) Variables .....	65
Summary .....	66
Exercise.....	66
<b>Chapter 4: Aggregate Functions and Group By Clause</b> .....	<b>67</b>
Aggregate Functions.....	68
The GROUP BY Clause.....	71
The HAVING Clause .....	72
Using the WITH Clause.....	73
The ORDER BY Clause.....	74

---

Summary .....	76
Exercise.....	76
<b>Chapter 5: Updating and Deleting Data in Existing Table (DML) .....</b>	<b>77</b>
The UPDATE Statement.....	78
The DELETE Statement .....	82
Deleting Row from a Table (DML).....	82
Dropping the Table.....	83
Renaming the Table .....	83
Inserting Data Using Query (DML).....	84
Creating Table Using Query .....	85
Summary .....	86
Exercise.....	86
<b>Chapter 6: Views .....</b>	<b>87</b>
Creating Views .....	88
Synonyms.....	91
Miscellaneous Facilities of Sqlplus.....	92
Creating Reports with Sqlplus.....	92
Giving Title Output.....	92
Showing Timing in Output .....	95
Outputting Data to File or Printer .....	95
Computing Data at the Time of Output .....	97
Defining Specification for Printing Columns.....	97
Formatting Data .....	99
Formats .....	99
Footer of the Report.....	101
Performing Action During Printing.....	102
Summary .....	104
Exercise.....	104
<b>Chapter 7: Assignment-I.....</b>	<b>105</b>
Assignment No. 1.....	106
Assignment No. 2.....	107
Selecting Data from Single Table.....	107
Assignment No. 3.....	108
Join or Cartesian Product.....	108
Assignment No. 4.....	109
Set Operations.....	109
Assignment No. 5.....	111
Aggregate Functions .....	111
Assignment No. 6.....	113
GROUP BY and HAVING Clause .....	113

## Table of Contents

---

Assignment No. 7.....	114
The UPDATE Statement .....	114
Assignment No. 8.....	117
The DELETE Statement .....	117
<b>Chapter 8: Assignment-II.....</b>	<b>119</b>
Inserting Data into the Tables .....	123
Simple Exercises .....	124
Cartesian Product Exercises.....	128
Renaming Exercises .....	130
IN/EXIST Exercises .....	131
Aggregate Function Exercises.....	135
Date Function Exercises.....	137
SQL Function Exercises .....	139
Delete/Update Exercises.....	141
<b>Chapter 9: Advanced Queries.....</b>	<b>143</b>
Hierarchical Queries .....	144
Using Pseudocolumns .....	148
Advanced Queries.....	158
Running sum.....	158
Additional Queries Based on Running Sum.....	161
Data Transformation using DECODE.....	166
Summary .....	168
Exercise.....	168
<b>Chapter 10: Integrity Constraints .....</b>	<b>169</b>
Domain Constraints .....	170
Key Constraints.....	172
Primary Key .....	173
Unique Key .....	173
Foreign Key.....	175
Implementation of Foreign Key .....	177
Enabling/Disabling a Constraint .....	179
Enabling a constraint.....	181
NOVALIDATE Clause.....	182
Initially Immediate Deferrable.....	182
Updatable Join Views .....	183
Summary .....	185
Exercise.....	185

<b>Chapter 11: Analytical Queries .....</b>	<b>187</b>
Analytical Functions .....	188
Architecture of a Warehouse Server .....	188
The RANK Function .....	189
Syntax of the RANK Function.....	190
Using Partitions .....	192
The DENSE_RANK Function .....	192
Ordering on Multiple Expressions.....	193
The TOP_N Queries.....	193
The CUME_DIST Function .....	194
The PERCENT_RANK Function.....	194
The NTILE(N) Function .....	194
The ROW_NUMBER Function.....	195
Windowing Functions .....	195
Syntax of Windowing Functions .....	195
Finding the Cumulative Sum of Amount Channel Wise.....	197
Finding the Sales of the Last Date Channel Wise.....	198
Finding the Moving Average.....	198
Calculating the 7 Days' Moving Average.....	199
Calculating the Average of the Previous Rows and the Current Row .....	199
Defining a Variable-Size Window .....	200
Reporting Functions.....	201
Syntax of a Reporting Function .....	201
Finding the Ratio of Channel Sales to Maximum Sales .....	202
The RATIO_TO_REPORT Function.....	202
Syntax of the RATIO_TO_REPORT Function.....	202
The LAG/LEAD Functions.....	203
Syntax of the LAG/LEAD Functions.....	203
The FIRST/LAST Functions.....	205
Syntax of the FIRST/LAST Functions.....	205
Regression .....	206
The Inverse Percentile Functions .....	208
Syntax of the INVERSE PERCENTILE Functions .....	208
Hypothetical Rank .....	210
Syntax of the Hypothetical Rank .....	210
Summary .....	210
Exercise.....	210
<b>Chapter 12: Understanding ROLLUP and CUBE .....</b>	<b>211</b>
Understanding ROLLUP.....	212
Using Partial Rollup.....	214

## Table of Contents

---

Understanding CUBE .....	216
Using the Partial Cube .....	217
Grouping Set .....	218
Grouping Clause .....	219
GROUP_ID Clause .....	220
Summary .....	221
Exercise.....	221
<b>Chapter 13: Understanding Joins.....</b>	<b>223</b>
Natural Join.....	224
Cross Join .....	225
Using the Column Clause .....	225
Using ON Clause.....	226
OUTER JOIN.....	226
FULL OUTER JOIN.....	228
Generating Histogram Using Decode.....	229
Summary .....	230
Exercise.....	230
<b>Chapter 14: Scalar Subqueries .....</b>	<b>231</b>
Use of Scalar Subquery in the SELECT Clause.....	232
Use of Scalar Subquery in the WHERE Clause.....	232
Use of Scalar Subquery in the ORDER BY Clause .....	233
Summary .....	233
Exercise.....	233
<b>Chapter 15: Case Expressions.....</b>	<b>235</b>
Simple CASE Statement .....	236
Searched CASE Statement.....	237
The NULLIF Function .....	237
The NVL2 Function.....	237
The COALESCE Function .....	238
Summary .....	239
Exercise.....	239
<b>Chapter 16: Multitable Insert and Merge .....</b>	<b>241</b>
Multitable INSERT Statement.....	242
Unconditional INSERT Statement .....	242
Pivoting INSERT Statement .....	244
Conditional INSERT Statement .....	244
The INSERT FIRST Statement.....	246
The MERGE Statement .....	247

---

Summary .....	248
Exercise.....	248
<b>Chapter 17: Regular Expression.....</b>	<b>249</b>
Specifying Patterns using Regular Expressions .....	250
Metacharacters .....	250
Using the REGEXP_SUBSTR FUNCTION.....	255
Using the REGEXP_REPLACE Function .....	258
Using the REGEXP_LIKE Function.....	260
Summary .....	261
Exercise.....	261
<b>Chapter 18: Statistical Functions .....</b>	<b>263</b>
Variance.....	264
Covariance .....	265
Correlation .....	266
Spearman Rank-Correlation Coefficient.....	266
Other Correlation Coefficients .....	269
Analysis of Variance (ANOVA) .....	270
Chi-Square.....	272
F_Test.....	274
K-S TEST (Kolmogorov-Smirnov Test).....	276
MODE.....	277
Mann-Whitney Test (MW_TEST).....	277
Wilcoxon Signed-Rank Test (WSR_TEST).....	280
BINOMIAL_TEST .....	283
Summary .....	284
Exercise.....	284
<b>Chapter 19: Model Queries.....</b>	<b>285</b>
Dimensions and Cells in model query.....	286
Construction of a Model Query.....	286
Additional Clauses in Model Query .....	288
The PIVOT Query .....	294
Displaying Data for Multiple Columns.....	295
Displaying Data by using Multiple Aggregate Functions .....	295
Displaying Data by using Multiple Aggregate Functions and Multiple Rows.....	296
The UNPIVOT Clause .....	296
Summary .....	297
Exercise.....	297

**Table of Contents**

---

<b>Chapter 20: SQL Quiz .....</b>	<b>299</b>
DATATYPES.....	300
JOINS.....	300
SET Operation.....	300
Miscellaneous .....	300
UPDATE, DELETE, INSERT.....	301
CONSTRAINTS.....	301
Analysis Queries .....	302
VIEWS.....	302
JOINS, SCALAR Subqueries, and MERGE Statement .....	302

**UNIT - II: PL/SQL**

<b>Chapter 21: PL/SQL Program Features.....</b>	<b>305</b>
Nature of PL/SQL Programs.....	306
Some Sample programs.....	308
Block-Structured Language .....	311
Declarative Part .....	313
Work Area Cursor.....	313
FOR Loop in a Cursor .....	314
Cursor Variables .....	314
Attributes.....	314
About Control Structures.....	315
Conditional Control .....	315
Iterative Control.....	316
Changing the Flow of Program .....	317
Modularity .....	317
External Procedures.....	318
Package.....	318
Data Abstraction.....	319
Collections .....	320
Records .....	320
Object Types.....	320
Information Hiding.....	321
Information Hiding for an Algorithm.....	321
Information Hiding for Data structures.....	321
Error Handling .....	321
Architecture of PL/SQL.....	322
PL/SQL Engine in the Oracle Sever.....	322
PL/SQL Engine in Oracle Tools .....	322
Database Triggers.....	322
Advantages of PL/SQL.....	322



---

Support for SQL.....	323
Support for Object Oriented Programs.....	323
Better Performance.....	323
Portability.....	323
Higher Productivity.....	323
Integration with Oracle.....	323
Summary.....	323
Exercise.....	323
<b>Chapter 22: PL/SQL Datatypes .....</b>	<b>325</b>
Lexical Units.....	326
Delimiters.....	327
Identifiers.....	328
Reserved Words.....	329
Predefined Identifiers.....	330
Quoted Identifiers.....	330
Literals.....	330
Comments.....	331
Datatypes.....	332
Scalar Datatypes.....	333
LOB Types.....	338
User-Defined Subtypes.....	339
Defining Subtypes.....	339
Using Subtypes.....	340
Type Compatibility.....	340
Datatype Conversion.....	340
Explicit Conversion.....	341
Implicit Conversion.....	341
Implicit vs. Explicit Conversion.....	342
Declarations.....	342
The DEFAULT Value.....	343
The NOT NULL Type.....	343
Forward Reference.....	343
Using %TYPE.....	343
Using %ROWTYPE.....	344
Aggregate Assignment.....	344
Using Aliases.....	345
Restrictions on Forward References.....	345
Naming Conventions.....	346
Scoping.....	346
Case Sensitivity.....	346
Name Resolution.....	346

## Table of Contents

---

Scope and Visibility .....	348
Assignment .....	349
Database Value .....	350
Expressions and Comparisons.....	350
Logical Operators .....	351
Order of Evaluation in AND.....	351
Order of Evaluation in OR.....	351
Comparison Operator .....	352
Relational Operator .....	352
IS NULL Operator .....	352
LIKE Operator.....	352
BETWEEN Operator .....	353
IN Operator.....	353
Concatenation Operator .....	353
Boolean Expression .....	353
Functions .....	355
Built-in Functions in PL/SQL.....	356
Summary .....	356
Exercise.....	356
<b>Chapter 23: Understanding Control Structure.....</b>	<b>357</b>
Conditional Control Statements .....	358
The IF.....THEN Statement.....	359
The IF.....THEN.....ELSE Statement.....	360
The IF.....THEN.....ELSIF Statement .....	360
Guidelines for Using the IF Statement.....	362
Iterative Statements.....	363
The FOR.....LOOP.....END LOOP Statement .....	363
The WHILE.....LOOP.....END LOOP Statement.....	367
The LOOP ..... END LOOP Statement .....	369
Unconditional Branching Statement.....	370
Sequential Control Statement .....	372
Summary .....	373
Exercise.....	373
<b>Chapter 24: Interaction with Oracle.....</b>	<b>375</b>
The SELECT.....INTO Statement.....	376
Cursor .....	378
Cursor Declaration .....	379
Opening a Cursor.....	380
Cursor using parameter.....	381
Closing a Cursor .....	383

Using Cursor FOR Loops .....	384
Substituting Subqueries in Place of Cursor .....	388
Using Aliases for Fields .....	388
Passing Parameters to Cursor .....	389
Cursor Attributes .....	391
The %FOUND Attribute .....	391
The %NOTFOUND Attribute .....	393
The %ISOPEN Attribute .....	393
The %ROWCOUNT Attribute .....	394
Implicit Cursor Attributes.....	395
The %FOUND Attribute .....	395
The SQL%ISOPEN Attribute.....	397
The SQL%NOTFOUND Attribute.....	397
The SQL%ROWCOUNT Attribute.....	397
Cursor Variables.....	397
Weakly Typed Cursor.....	399
Opening a Cursor Variable in Stored Procedure.....	401
Fetching Data from Cursor.....	404
Closing the Cursor.....	405
Reducing Network Traffic by using Cursor Variables .....	405
Cursor Expressions .....	413
DDL and Dynamic SQL.....	414
Transaction Control Statements .....	415
Rollback Statement.....	417
Statement ROLLBACK .....	417
Savepoint .....	418
Read Only Transactions .....	419
Returning Clause and Single Set Aggregate.....	424
Using WITH CHECK OPTION .....	426
SQL Facility in PL/SQL.....	426
Summary .....	427
Exercise.....	427
<b>Chapter 25: Collections and Records .....</b>	<b>429</b>
VARRAY and Nested Table Structure.....	430
Declaring Collections .....	432
Initializing Collections .....	433
Referencing Collection Elements.....	435
Assignment Operation.....	436
Comparing Collections.....	438
Operation on Whole Collections .....	439
INSERT Operations .....	439

## Table of Contents

---

UPDATE Statement.....	439
DELETE Statement.....	440
SELECT.....INTO Statement.....	440
Operations on VARRAY.....	440
INSERT Statement.....	441
UPDATE Statement.....	441
DELETE Statement.....	442
SELECT..... INTO Statement.....	442
Manipulating Individual Element in the Nested Table.....	442
INSERT Statement.....	442
UPDATE Statement.....	443
DELETE Statement.....	443
SELECT.....INTO Statement.....	443
Manipulating Individual Elements in VARRAY.....	444
INSERT Operation.....	444
UPDATE Statement.....	445
DELETE Statement.....	445
Retrieving Elements.....	446
Collection Methods.....	446
EXISTS (n) Function.....	447
COUNT Function.....	447
LIMIT Function.....	447
FIRST Function.....	448
LAST Function.....	448
PRIOR(n) Function.....	448
NEXT(n) Function.....	448
EXTEND(n,i) Procedure.....	449
TRIM(n) Function.....	451
DELETE(m, n) Procedure.....	451
Use of Methods to Parameters.....	453
Built-in Exceptions.....	453
Records.....	453
Record Definition.....	454
Accessing Fields in the Record.....	455
Operations on Records.....	455
Using Collections as Input and Output.....	457
Use the Table Function.....	460
PL/SQL Table or Associative Array.....	461
Bulk Operations.....	461
Use of the FORALL Statement.....	462
FORALL Statement for Object Tables.....	463

---

Use of %BULK_ROWCOUNT .....	464
Fetching into Multiple Collections .....	466
Cast and Multiset Operators .....	467
Summary .....	470
Exercise .....	470
<b>Chapter 26: LOB, BFILE, and DBMS_LOB .....</b>	<b>471</b>
New Data types (LOB).....	472
The BLOB Datatype.....	472
CLOB and NCLOB .....	472
BFILE.....	472
Creating LOB .....	472
Inserting LOB Columns .....	473
Copying LOBs.....	473
LOB Locator .....	474
Reading a LOB Value.....	474
Deleting LOB.....	474
Updating LOB.....	474
LOB Locators across Transactions (For Read Operation) .....	478
LOB Locators Across Transactions (For Write Operation) .....	478
EMPTY_BLOB and EMPTY_CLOB Functions .....	480
BFILE Operations .....	480
Creating BFILE.....	480
Updating BFILE .....	481
Deleting BFILE.....	481
Scope of a BFILE Locator.....	481
Directory Object.....	481
Information about Directories.....	481
Guidelines for Using DIRECTORY .....	482
The BFILENAME() Function – Use of Directory Object .....	482
The DBMS_LOB Package .....	483
Exceptions.....	483
Procedures/Functions .....	484
Using the DBMS_LOB Package.....	494
Summary .....	495
Exercise .....	495
<b>Chapter 27: Objects and Object Types .....</b>	<b>497</b>
Concept of Object .....	498
Methods.....	499
The Constructor Method .....	499
The Comparison Method.....	499

## Table of Contents

---

Using Static Methods .....	502
Inheritance in PL/SQL .....	502
Object Functions .....	504
The IS OF() Function .....	504
The TREAT() Function .....	504
The SYS_TYPEID() Function .....	505
Method Overriding .....	505
The NOT INSTANTIABLE Clause .....	507
Object Table .....	508
REF Datatype .....	509
Creating Table of REF .....	510
Name Resolution .....	516
Table Function .....	517
Pragma Restrict References .....	519
Summary .....	520
Exercise .....	520
<b>Chapter 28: Sample Programs-I .....</b>	<b>521</b>
<b>Chapter 29: Sample Programs-II .....</b>	<b>533</b>
<b>Chapter 30: Error Handling .....</b>	<b>541</b>
Exceptions .....	542
Utility of Exceptions .....	543
Built-in Exceptions .....	543
User-defined Exceptions .....	545
Declaring an Exception .....	546
Scope Rules .....	546
Pragma EXCEPTION_INIT .....	547
The RAISE_APPLICATION_ERROR Procedure .....	548
Raising an Exception .....	549
Propagation of an Exception .....	549
Re-raising an Exception .....	551
Handling Exceptions .....	551
Exceptions Raised in Declarations .....	553
Exception Raised in a Handler .....	553
Restriction on Use of the GOTO Statement in an Exception Handler .....	554
The SQLCODE and SQLERRM Functions .....	554
Unhandled Exceptions .....	555
Guidelines for Handling Errors .....	555
Continuing after an Error has Occurred .....	555
Using a Locator Variable .....	556
Retrying Transactions .....	557

---

Summary .....	558
Exercise.....	558
<b>Chapter 31: Subprograms in PL/SQL .....</b>	<b>559</b>
Describing a Subprogram.....	560
Procedure .....	561
Functions .....	562
Subprogram Declaration .....	564
Forward Declaration .....	564
Subprogram Declaration in a Package .....	565
Stored Subprograms .....	565
Parameters.....	566
Methods for Passing Actual Parameters.....	566
Mode of Passing Parameters .....	567
Default Values .....	569
Aliasing.....	570
Overloading.....	571
Restrictions While Overloading.....	572
Resolving Subprograms Calls.....	573
Built-in Functions.....	573
Recursion.....	574
Summary .....	593
Exercise.....	593
<b>Chapter 32: Package.....</b>	<b>596</b>
Package Specification .....	599
Package Body .....	599
Advantages of Packages .....	600
Referencing Package Element .....	600
Overloading.....	601
Serially Reusable Packages .....	603
Built-in Packages in Oracle .....	606
Summary .....	607
Exercise.....	607
<b>Chapter 33: Trigger (Database).....</b>	<b>609</b>
Sample Trigger .....	610
Referring the :new and :old Values.....	611
Trigger Concept.....	613
Statement-Level Atomicity.....	613
Savepoint .....	613
Restriction on Trigger Code .....	614
Row Evaluation Order .....	615

## Table of Contents

---

Mutating and Constraining Table .....	617
Case Studies .....	619
Generating a Primary Key Based on Max Value of Column.....	619
Implementing Update Cascade Functionality Using Trigger .....	620
Reversing Update .....	622
Deleting Cascade .....	623
Altering Trigger .....	624
Enabling and Disabling Trigger.....	624
Information on Triggers.....	625
Summary .....	625
Exercise.....	625
<b>Chapter 34: Autonomous Transaction .....</b>	<b>627</b>
Concept of Autonomous Transaction.....	628
Behavior of the SERIALIZABLE Transaction .....	630
Autonomous Triggers.....	632
Calling Autonomous Functions from SQL .....	633
Summary .....	634
Exercise.....	634
<b>Chapter 35: Important PL/SQL Packages .....</b>	<b>635</b>
The DBMS_SQL Package.....	636
Deciding Procedure Execution at Runtime .....	638
DML operations using Dynamic SQL.....	639
Using DDL in a PL/SQL Program .....	641
Dynamic Single Row Query .....	641
Dynamic Multiple Row Query .....	642
Native Dynamic SQL and DBMS_SQL Packages .....	643
The DBMS_SESSION Package.....	648
The DBMS_PIPE Package.....	650
Writing and Reading Pipes .....	652
Private Pipes.....	652
Uses of Pipes .....	652
DBMS_PIPE Procedures and Functions .....	653
The DBMS_ALERT Package .....	655
The DBMS_JOB Package .....	658
The UTL_FILE Package .....	659
Summary .....	660
Exercise.....	660
<b>Chapter 36: Object Views .....</b>	<b>661</b>
Column Types in View.....	664
Object Datatype .....	664



Nested Table Datatype.....	665
REF Datatype .....	667
VARRAY Datatype.....	668
Summary .....	670
Exercise.....	670
<b>Chapter 37: Transaction Processing in Oracle .....</b>	<b>671</b>
Introduction .....	672
Properties of a Transaction (ACID).....	672
Transactions in Oracle .....	673
Transaction States .....	673
Durability of a Transaction.....	673
Problems in Providing Durability .....	674
Size of Volatile Storage .....	675
General Buffer Management .....	675
Writing of DBWR.....	676
Solution of Durability or Implementation of Commit .....	676
Concept of Log File .....	677
Transaction Recovery using a Log File .....	678
Two Modes of using Log Files .....	678
How a Log File Decreases Disk Writes .....	678
Locking row using PL/SQL.....	682
Isolation Level Serializable .....	683
Serial Schedule.....	683
Non-Serial Schedules .....	683
Serializable .....	683
The Read Only Transaction.....	686
Discrete Transaction.....	686
Summary .....	688
Exercise.....	688
<b>Chapter 38: Locking in Oracle .....</b>	<b>689</b>
Introduction to Locking.....	690
Deadlock.....	691
Detecting Blocking Transactions .....	693
Using Package DBMS_LOCK .....	694
Summary .....	696
Exercise.....	696
<b>Chapter 39: Rollback Segments .....</b>	<b>697</b>
What is Rollback Segment? .....	698
Implementation of Read Consistency .....	698
Operations related with Rollback Segment.....	699

## Table of Contents

---

Rollback Segment States .....	701
Space Allocation in Rollback Segments .....	702
Administrative Aspects in a Rollback Segment .....	704
The Role of the OPTIMAL Parameter in the Rollback Segment .....	705
Finding Rollback Segments Allocated to transaction .....	706
Allocating ROLLBACK SEGMENT to Transaction .....	707
Summary .....	709
Exercise .....	709
<b>Chapter 40: UNDO Tablespace .....</b>	<b>711</b>
Manual Mode .....	712
Auto UNDO Management (AUM) .....	712
Configuration .....	712
Management of the UNDO Tablespace .....	713
Creating the UNDO Tablespace .....	714
Using the CREATE DATABASE Statement .....	714
Using the CREATE UNDO TABLESPACE Statement .....	714
Altering the UNDO Tablespace .....	714
Switching the UNDO Tablespace .....	715
Dropping the UNDO Tablespace .....	715
The UNDO Retention .....	716
UNDO_suppress_errors .....	716
Performance Views .....	717
The V\$UNDOSTAT View .....	717
The V\$ROLLSTAT View .....	717
The V\$TRANSACTION View .....	717
The DBA_UNDO_EXTENTS View .....	718
Dictionary Managed Tablespaces .....	718
Why UNDO Tablespaces .....	718
Case1: Using Dictionary Managed Roll Back Segment .....	718
Case2: Using UNDO Segment in UNDO Tablespace .....	719
DDL Statements on Dictionary/Locally Managed Tablespaces .....	722
Tracking Changes in Database Using Triggers .....	723
Summary .....	726
Exercise .....	726
<b>Chapter 41: Invoker Rights and NOCOPY Clause .....</b>	<b>727</b>
Understanding Invoker Rights .....	728
The NOCOPY Clause .....	730
Summary .....	732
Exercise .....	732

<b>Chapter 42: Dependency Tracking in Oracle .....</b>	<b>733</b>
Understanding Scripts for Dependency Tracking .....	734
Summary .....	736
Exercise .....	736
<b>Chapter 43: FlashBack Queries .....</b>	<b>737</b>
Use of Flashback Queries .....	738
Concept of Flashback Queries.....	738
Advantages of Flashback Queries .....	738
Flashback Table .....	743
Using FLASHBACK_ARCHIVE .....	748
Creating FLASHBACK_ARCHIVE .....	749
Assigning table to archive .....	749
Using Recycle Bin.....	750
Summary .....	754
Exercise.....	754
<b>Chapter 44: Sequence .....</b>	<b>755</b>
Sequence Usage.....	756
<b>Chapter 45: PL/SQL Wrapper .....</b>	<b>759</b>
Utility of PL/SQL Wrapper .....	760
Wrapping Code Using PL/SQL Wrapper .....	760
Summary .....	761
Exercise.....	761
<b>Chapter 46: Oracle Expression Filter .....</b>	<b>763</b>
Using an Expression Filter .....	764
Experimentation .....	766
Summary .....	768
Exercise.....	768
<b>Chapter 47: Server Model for Bill Entry System.....</b>	<b>769</b>
Table Definition.....	770
Customer Table.....	770
Items Table .....	770
Billcustomer Table .....	771
Billitems Table.....	772
Table Scripting.....	773
Creating Table BILLITEMS – BILL.tab .....	773
Creating Primary Key on BILLITEMS – BILL.con.....	774
Functionality .....	775
Sample Scripts .....	775
Package Specification for the BILLCUSTOMER – Billcust.pks Table .....	776

## Table of Contents

---

Package Body for the BILLCUSTOMER – Billcust.pkb Table.....	777
Package for Table BILLCUSTOMER – billcust.trg .....	796
Summary .....	803
<b>Chapter 48: Security and Auditing .....</b>	<b>805</b>
Creating a User .....	806
External System Authentication .....	807
License Parameters.....	807
Privileges .....	808
List of Privileges .....	809
Role .....	818
Predefined Oracle Roles.....	824
Activation of System Privileges, Object Privileges, and Roles.....	824
Effect of Revoking a Privilege and Dropping a User .....	827
Profile.....	830
Creation of Profile .....	830
Composite Limit.....	831
Setting Password Parameters .....	832
Auditing .....	834
The DBA_STMT_AUDIT_OPTS View.....	841
Summary .....	842
Exercise.....	842
<b>Chapter 49: PL/SQL Questions .....</b>	<b>843</b>
Datatypes.....	844
Control Structure.....	844
Collections.....	844
Interaction with Oracle .....	844
Triggers.....	844
Procedures, Packages, and Objects .....	845
PL/SQL Packages .....	845
Autonomous Transactions .....	846
Exception.....	846
Transactions .....	847
RBS, UNDO.....	847
Locks .....	848
FLASHBACK, INVOKER RIGHTS, NOCOPY, PL/SQL Wrapper .....	848
Security and Auditing .....	849
<b>Appendix A: Tables.....</b>	<b>851</b>
<b>Index.....</b>	<b>861</b>