Contents

1 Introduction

Objectives 1-2

Course Objectives 1-3

Introducing Oracle Database 1-4

Oracle Database 18c 1-5

Oracle Database 18c On-Premises Editions 1-6

Oracle Database Standard Edition 2 1-8

Oracle Database Options 1-9

Oracle Management Packs 1-11

What Is Oracle Cloud? 1-12

Oracle Database Cloud Service: Overview 1-13

Oracle Database Cloud Service Editions 1-14

Oracle SQL and PL/SQL 1-15

HR Schema 1-16

Suggested Course Schedule 1-18

Summary 1-19

2 Oracle Database Architecture

Objectives 2-2

Oracle Database Server Architecture: Overview 2-3

Oracle Database Instance Configurations 2-4

Connecting to the Database Instance 2-5

Oracle Database Memory Structures 2-6

Shared Pool 2-8

Database Buffer Cache 2-10

Redo Log Buffer 2-11

Large Pool 2-12

Java Pool 2-13

Streams Pool 2-14

Program Global Area (PGA) 2-15

In-Memory Column Store: Introduction 2-16

In-Memory Column Store: Overview 2-18

Full Database In-Memory Caching 2-20

Process Structures 2-21

Database Writer Process (DBWn) 2-23

Log Writer Process (LGWR) 2-25

Checkpoint Process (CKPT) 2-27

System Monitor Process (SMON) 2-28

Process Monitor Process (PMON) 2-29

Recoverer Process (RECO) 2-30

Listener Registration Process (LREG) 2-31

Archiver Processes (ARCn) 2-32

Database Storage Architecture 2-33

Logical and Physical Database Structures 2-35

Segments, Extents, and Blocks 2-37

Tablespaces and Data Files 2-38

Default Tablespaces 2-39

SYSTEM and SYSAUX Tablespaces 2-40

Implementing Oracle Managed Files (OMF) 2-41

Oracle Container Database: Introduction 2-43

Multitenant Database 2-44

Multitenant Architecture 2-45

Default Tablespaces in the Multitenant Architecture 2-46

Application Containers 2-47

Automatic Storage Management 2-48

ASM Storage Components 2-49

Interacting with an Oracle Database: Memory, Processes, and Storage 2-50

Summary 2-52

3 Introduction to Oracle Database Cloud Service

Objectives 3-2

Oracle Cloud: Overview 3-3

Database Cloud Service Offerings 3-4

Infrastructure for Oracle Database Cloud Service 3-5

Database Cloud Service Architecture (OCI Classic) 3-6

Features and Tooling 3-7

Automated Database Provisioning 3-8

Additional Database Configuration Options 3-9

Summary 3-10

Practice 3: Overview 3-11

4 Creating DBCS Database Deployments

Objectives 4-2

Automated Database Provisioning 4-3

Creating a Database Deployment 4-4

How SSH Key Pairs Are Used 4-5

Creating an SSH Key Pair 4-6

Storage Used for Database Files 4-7

Summary 4-8

Practice 4: Overview 4-9

5 Accessing an Oracle Database

Objectives 5-2

Connecting to an Oracle Database Instance 5-3

Oracle Database Tools 5-5

Database Tool Choices 5-6

SQL*Plus 5-7

Oracle SQL Developer 5-9

Oracle SQL Developer: DBA Actions 5-10

SQL Developer Command Line (SQLcl) 5-11

Database Configuration Assistant (DBCA) 5-12

Oracle Enterprise Manager Database Express 5-13

Using the Database Home Page 5-15

Enterprise Manager Cloud Control 13c Features 5-16

Single Pane of Glass for Enterprise Management 5-18

Oracle Database Cloud Service Tools 5-19

Cloud Tooling 5-20

Accessing Tools and Features from the DBCS Console 5-21

Using Enterprise Manager Cloud Control 5-22

Summary 5-23

Practice 5: Overview 5-24

6 Managing DBCS Database Deployments

Objectives 6-2

Managing the Compute Node 6-3

Managing Network Access to DBCS (OCI Classic) 6-4

Enabling Access to a Compute Node Port (OCI Classic) 6-5

Scaling a Database Deployment 6-6

Patching DBCS 6-7

Using the DBCS Console to Manage Patches 6-8

Using the dbaascli Utility to Manage Patches 6-9

Summary 6-10

Practice 6: Overview 6-11

7 Managing Database Instances

Objectives 7-2

Working with Initialization Parameters 7-3

Initialization Parameters 7-5

Modifying Initialization Parameters 7-7

Viewing Initialization Parameters 7-9

Starting the Oracle Database Instance 7-11

Shutting Down an Oracle Database Instance 7-12

Comparing SHUTDOWN Modes 7-14

Opening and Closing PDBs 7-16

Working with the Automatic Diagnostic Repository 7-17

Automatic Diagnostic Repository 7-18

Viewing the Alert Log 7-19

Using Trace Files 7-20

Administering the DDL Log File 7-22

Querying Dynamic Performance Views 7-23

Considerations for Dynamic Performance Views 7-24

Data Dictionary: Overview 7-25

Querying the Oracle Data Dictionary 7-26

Summary 7-28

Practice 7: Overview 7-29

8 Oracle Net Services

Objectives 8-2

Oracle Net Services: Overview 8-3
Oracle Net Listener: Overview 8-4

The Default Listener 8-5

Establishing Oracle Network Connections 8-6

Connecting to an Oracle Database 8-7

Name Resolution 8-8

Establishing a Connection 8-9

User Sessions 8-10

Configuring Dynamic Service Registration 8-11

Configuring Static Service Registration 8-13

Naming Methods 8-15

Easy Connect 8-16

Local Naming 8-17

Directory Naming 8-18

Tools for Configuring and Managing Oracle Net Services 8-19

Defining Oracle Net Services Components 8-20

Advanced Connection Options 8-21

Testing Oracle Net Connectivity with thsping 8-22

Configuring Communication Between Database Instances 8-23

Comparing Dedicated and Shared Server Configurations 8-25

Summary 8-27

Practice 8: Overview 8-28

9 Administering User Security

Objectives 9-2

Oracle Cloud User Roles and Privileges 9-3

Administering Oracle Cloud Users, Roles, and Privileges 9-4

Managing Oracle Cloud Compute Node Users 9-5

Database User Accounts 9-6

Oracle-Supplied Administrator Accounts 9-8

Creating Oracle Database Users in a Multitenant Environment 9-9

Schema-Only Account 9-10

Authenticating Users 9-11

Password Authentication 9-12

Password File Authentication 9-13

OS Authentication 9-14

OS Authentication for Privileged Users 9-16

Privileges 9-17

System Privileges 9-18

System Privileges for Administrators 9-20

Object Privileges 9-21

Granting Privileges in a Multitenant Environment 9-22

Granting and Revoking System Privileges 9-24

Granting and Revoking Object Privileges 9-25

Using Roles to Manage Privileges 9-26

Assigning Privileges to Roles and Assigning Roles to Users 9-27

Oracle-Supplied Roles 9-28

Creating and Granting Roles 9-29

Assigning Roles 9-31

Making Roles More Secure 9-32

Revoking Roles and Privileges 9-34

Profiles and Users 9-35

Creating Profiles in a Multitenant Architecture 9-36

Profile Parameters: Resources 9-38

Profile Parameters: Locking and Passwords 9-40

Oracle-Supplied Password Verification Functions 9-42

Assigning Profiles 9-44

Assigning Quotas 9-45

Applying the Principle of Least Privilege 9-47

Privilege Analysis 9-49

Privilege Analysis Flow 9-50

Summary 9-51

Practice 9: Overview 9-52

10 Creating PDBs

Objectives 10-2

Methods and Tools to Create PDBs 10-3

Creating PDBs from Seed 10-4

Creating a New PDB from PDB\$SEED 10-5

Examples: Creating a PDB from Seed 10-6

Cloning PDBs 10-7

Cloning Regular PDBs 10-8

Unplugging and Plugging in PDBs 10-9

Plugging an Unplugged Regular PDB into a CDB 10-10

Plugging Using an Archive File 10-11

Dropping PDBs 10-12

Summary 10-13

Practice 10: Overview 10-14

11 Creating Master Encryption Keys for PDBs

Objectives 11-2

Encryption in Database Cloud Service 11-3

Transparent Data Encryption (TDE): Overview 11-4

Components of TDE 11-5

Using TDE 11-6

Defining the Keystore Location 11-7

CDB and PDB Master Encryption Keys 11-8

Do You Need to Create and Activate a Master Encryption Key? 11-9

Creating and Activating a Master Encryption Key 11-10

Summary 11-11

Practice 11: Overview 11-12

12 Creating and Managing Tablespaces

Objectives 12-2

How Table Data Is Stored 12-3

Database Block Content 12-4

Creating Tablespaces 12-5

Creating Permanent Tablespaces in a CDB 12-8

Altering and Dropping Tablespaces 12-9

Viewing Tablespace Information 12-11

Review: Implementing Oracle Managed Files (OMF) 12-12

Moving or Renaming Online Data Files 12-14

Examples: Moving and Renaming Online Data Files 12-15

Tablespace Encryption by Default in DBCS 12-16

Controlling Tablespace Encryption by Default 12-17

Managing the Software Keystore and Master Encryption Key 12-18

Creating an Encrypted Tablespace by Using a Nondefault Algorithm 12-19

Summary 12-20

Practice 12: Overview 12-21

13 Managing Storage Space

Objectives 13-2

Space Management Features 13-3

Block Space Management 13-4

Row Chaining and Migration 13-5

Free Space Management Within Segments 13-6

Types of Segments 13-7

Allocating Extents 13-8

Understanding Deferred Segment Creation 13-9

Controlling Deferred Segment Creation 13-10

Restrictions and Exceptions 13-11

Space-Saving Features 13-12

Private Temporary Tables 13-13

Table Compression: Overview 13-14

Compression for Direct-Path Insert Operations 13-15

Advanced Row Compression for DML Operations 13-16

Specifying Table Compression 13-17

Using Compression Advisor 13-18

Resolving Space Usage Issues 13-19

Monitoring Tablespace Space Usage 13-20

Reclaiming Space by Shrinking Segments 13-21

Shrinking Segments 13-22

Results of a Shrink Operation 13-23

Managing Resumable Space Allocation 13-24

Using Resumable Space Allocation 13-25

Resuming Suspended Statements 13-27

What Operations Are Resumable? 13-29

Summary 13-30

Practice 13: Overview 13-31

14 Managing Undo Data

Objectives 14-2

Undo Data: Overview 14-3

Transactions and Undo Data 14-5

Storing Undo Information 14-6

Comparing Undo Data and Redo Data 14-7

Managing Undo 14-8

Comparing SHARED Undo Mode and LOCAL Undo Mode 14-9

Configuring Undo Retention 14-10

Categories of Undo 14-11

Guaranteeing Undo Retention 14-12

Changing an Undo Tablespace to a Fixed Size 14-13

Temporary Undo: Overview 14-14

Temporary Undo Benefits 14-15

Enabling Temporary Undo 14-16

Monitoring Temporary Undo 14-17

Viewing Undo Information 14-18

Viewing Undo Activity 14-19

Summary 14-20

Practice 14: Overview 14-21

15 Moving Data

Objectives 15-2

Moving Data: General Architecture 15-3

Oracle Data Pump: Overview 15-4
Oracle Data Pump: Benefits 15-5

Data Pump Export and Import Clients 15-7

Data Pump Interfaces and Modes 15-8

Data Pump Import Transformations 15-10

SQL Loader: Overview 15-11

Comparing Loading Methods 15-13

Data Save Feature 15-14

Express Mode 15-15

External Tables 15-16

External Table Benefits 15-17

Migrating to Oracle Database Cloud Service: Considerations 15-18

Migrating to Oracle Database Cloud Service: Information Gathering 15-19

Applicable Migration Methods 15-20

Summary 15-22

Practice 15: Overview 15-23

16 Backup and Recovery Concepts

Objectives 16-2

DBA Responsibilities 16-3

Categories of Failure 16-4

Statement Failure 16-5

User Process Failure 16-6

Network Failure 16-7

User Error 16-8

Instance Failure 16-9

Media Failure 16-10

Understanding Instance Recovery 16-11

The Checkpoint (CKPT) Process 16-12

Redo Log Files and the Log Writer (LGWR) Process 16-13

Automatic Instance Recovery or Crash Recovery 16-14

Phases of Instance Recovery 16-15

Tuning Instance Recovery 16-16

Using the MTTR Advisor 16-17

Comparing Complete and Incomplete Recovery 16-18

The Complete Recovery Process 16-19

The Point-in-Time Recovery Process 16-20

Oracle Data Protection Solutions 16-22

Flashback Technology 16-23

Summary 16-24

17 Backup and Recovery Configuration

Objectives 17-2

Configuring for Recoverability 17-3

Configuring the Fast Recovery Area 17-4

Monitoring the Fast Recovery Area 17-5

Multiplexing Control Files 17-6

Redo Log Files 17-8

Multiplexing the Redo Log 17-9

Creating Archived Redo Log Files 17-10

Archiver (ARCn) Process 17-11

Archived Redo Log Files: Naming and Destinations 17-12

Configuring ARCHIVELOG Mode 17-13

Summary 17-14

Practice 17: Overview 17-15

18 Creating Database Backups

Objectives 18-2

Understanding Types of Backups 18-3

Backup Terminology 18-4

Understanding Types of Backups 18-5

RMAN Backup Types 18-6

Using Recovery Manager (RMAN) 18-8

Backing Up the Control File to a Trace File 18-9

Using RMAN Commands to Create Backups 18-10

Backing Up Databases on DBCS 18-11

Backup Destination Choices 18-12

Backup Configuration 18-13

Creating an On-Demand Backup 18-14

Customizing the Backup Configuration 18-15

Summary 18-16

Practice 18: Overview 18-17

19 Performing Database Recovery

Objectives 19-2

Opening a Database 19-3

Keeping a Database Open 19-5

Data Recovery Advisor 19-6

Loss of a Control File 19-8

Loss of a Redo Log File 19-9

Loss of a Data File in NOARCHIVELOG Mode 19-11

Loss of a Noncritical Data File in ARCHIVELOG Mode 19-12

Loss of a System-Critical Data File in ARCHIVELOG Mode 19-13

DBCS: Performing Recovery by Using the Console 19-14

DBCS: Performing Recovery by Using the dbaascli Utility 19-15

Summary 19-16

Practice 19: Overview 19-17

20 Monitoring and Tuning Database Performance

Objectives 20-2

Performance Management Activities 20-3

Performance Planning Considerations 20-4

Database Maintenance 20-6

Automatic Workload Repository (AWR) 20-7

Automatic Database Diagnostic Monitor (ADDM) 20-8

Advisory Framework 20-9

Automated Maintenance Tasks 20-11

Server-Generated Alerts 20-12

Setting Metric Thresholds 20-13

Reacting to Alerts 20-14

Alert Types and Clearing Alerts 20-15

Database Server Statistics and Metrics 20-16

Performance Monitoring 20-17

Viewing Statistics Information 20-18

Monitoring Wait Events 20-20

Monitoring Sessions 20-21

Monitoring Services 20-22

Performance Tuning Methodology 20-23

Managing Memory Components 20-24

Automatic Memory Management 20-26

Automatic Shared Memory Management 20-28

Managing the SGA for PDBs 20-30

Managing the Program Global Area (PGA) 20-31

Managing the PGA for PDBs 20-33

Summary 20-34

Practice 20: Overview 20-35

21 Tuning SQL

Objectives 21-2

SQL Tuning Process 21-3

Oracle Optimizer 21-4

Optimizer Statistics 21-5

Optimizer Statistics Collection 21-6

Setting Optimizer Statistics Preferences 21-8

Optimizer Statistics Advisor 21-10

Optimizer Statistics Advisor Report 21-11

Executing Optimizer Statistics Advisor Tasks 21-12

SQL Plan Directives 21-13

Adaptive Execution Plans 21-14

SQL Tuning Advisor: Overview 21-16

SQL Access Advisor: Overview 21-18

SQL Performance Analyzer: Overview 21-19

Summary 21-21

Practice 21: Overview 21-22