

A Relational Database Management System (RDBMS) is a software system that allows you to create and manage a relational database. Minimum requirements for such a system are defined by both ANSI and ISO. PL/SQL is Oracle's Procedural Language for SQL. It is Oracle's database programming language for creating stored procedures, functions, database triggers, and object methods. PL/SQL can be used for implementing business rules, computing algorithms, manipulating data, and for stand-alone programs. The Oracle 11g release has greatly enhanced the features and functionality of PL/SQL.

Students will write stored procedures, functions, packages, and triggers, and implement complex business rules in Oracle. Students will learn programming, management, and security issues of working with PL/SQL program units. Programming topics will include the built-in packages that come with Oracle, the creation of triggers, and stored procedure features.

### Course Objectives:

- Create triggers on database tables.
- Use PL/SQL's datatypes for database and program data.
- Use program structure and control flow to design and write PL/SQL programs.
- Create PL/SQL stored procedures and functions.
- Write robust programs that handle runtime exceptions.
- Use PL/SQL's collection datatypes.
- Use cursors to work with database data.
- Use bulk operations for improved performance.
- Use the packages supplied with Oracle.
- Design and write your own packages.
- Maintain and evolve your PL/SQL programs.
- Manage the security of your stored PL/SQL programs.

**Audience:** Application developers and database administrators.

**Prerequisites:** *Introduction to Oracle 11g SQL Programming* is required. Programming experience in a high-level language, such as COBOL, Java, or Perl is also required.

**Number of Days:** 3 days

<b>1</b> <b>Course Introduction</b> Course Objectives Overview Suggested References	<b>2</b> <b>Triggers</b> Beyond Declarative Integrity Triggers Types of Triggers Trigger Sequencing Row-Level Triggers	Trigger Predicates Trigger Conditions Using Sequences Cascading Triggers and Mutating Tables Generating an Error Maintaining Triggers <b>3</b> <b>PL/SQL Variables and Datatypes</b> Anonymous Blocks Declaring Variables Datatypes
--	---	--

	Subtypes	8	<b>Cursors</b>
	Character Data		Multi-Row Queries
	Dates and Timestamps		Declaring and Opening Cursors
	Date Intervals		Fetching Rows
	Anchored Types		Closing Cursors
	Assignment and Conversions		The Cursor FOR Loop
	Selecting into a Variable		FOR UPDATE Cursors
	Returning into a Variable		Cursor Parameters
4	<b>PL/SQL Syntax and Logic</b>		The Implicit (SQL) Cursor
	Conditional Statements – IF/THEN	9	<b>Bulk Operations</b>
	Conditional Statements – CASE		Bulk Binding
	Comments and Labels		BULK COLLECT Clause
	Loops		FORALL Statement
	WHILE and FOR Loops		FORALL Variations
	SQL in PL/SQL		Bulk Returns
	Local Procedures and Functions		Bulk Fetching with Cursors
5	<b>Stored Procedures and Functions</b>	10	<b>Using Packages</b>
	Stored Subprograms		Packages
	Creating a Stored Procedure		Oracle-Supplied Packages
	Procedure Calls and Parameters		The DBMS_OUTPUT Package
	Parameter Modes		The DBMS_UTILITY Package
	Named Parameter Notation		The UTL_FILE Package
	Default Arguments		Creating Pipes with DBMS_PIPE
	Creating a Stored Function		Writing to and Reading from a Pipe
	Stored Functions and SQL		The DBMS_METADATA Package
	Invoker's Rights		XML Packages
6	<b>Exception Handling</b>		Networking Packages
	SQLCODE and SQLERRM		Other Supplied Packages
	Exception Handlers	11	<b>Creating Packages</b>
	Nesting Blocks		Structure of a Package
	Scope and Name Resolution		The Package Interface and
	Declaring and Raising Named		Implementation
	Exceptions		Package Variables and Package State
	User-Defined Exceptions		Overloading Package Functions and
7	<b>Records and Collections</b>		Procedures
	Record Variables		Forward Declarations
	Using the %ROWTYPE Attribute		Strong REF CURSOR Variables
	User-Defined Object Types		Weak REF CURSOR Variables
	VARRAY and Nested TABLE	12	<b>Working with LOBs</b>
	Collections		Large Object Types
	Using Nested TABLES		Oracle Directories
	Using VARRAYS		LOB Locators
	Collections in Database Tables		Internal LOBs
	Associative Array Collections		LOB Storage and SECUREFILES
	Collection Methods		External LOBs
	Iterating Through Collections		Temporary LOBs

- The DBMS\_LOB Package
- 13 Maintaining PL/SQL Code**
  - Privileges for Stored Programs
  - Data Dictionary
  - PL/SQL Stored Program Compilation
  - Conditional Compilation
  - Compile-Time Warnings
  - The PL/SQL Execution Environment
  - Dependencies and Validation
  - Maintaining Stored Programs
- 14 Appendix A – Dynamic SQL**
  - Generating SQL at Runtime
  - Native Dynamic SQL vs. DBMS\_SQL Package
  - The EXECUTE IMMEDIATE Statement
  - Using Bind Variables
  - Multi-row Dynamic Queries
  - Bulk Operations with Dynamic SQL
  - Using DBMS\_SQL
  - DBMS\_SQL Subprograms
- 15 Appendix B – PL/SQL Versions, Datatypes, and Language Limits**
- 16 Appendix C – Oracle 11g Supplied Packages**