

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 10g 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 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 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

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| <p>1. Course Introduction Course Objectives Overview Suggested References</p> | <p>3. PL/SQL Variables and Datatypes Anonymous Blocks Declaring Variables Datatypes Subtypes Character Data Dates and Timestamps</p> |
| <p>2. Triggers Beyond Declarative Integrity Triggers Types of Triggers Row-Level Triggers Trigger Predicates Trigger Conditions Using SEQUENCES</p> | <p>Cascading Triggers and Mutating Tables Generating an Error Maintaining Triggers</p> |

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