**Exercise 1: Control Structures**

**Scenario 1:** The bank wants to apply a discount to loan interest rates for customers above 60 years old.

* **Question:** Write a PL/SQL block that loops through all customers, checks their age, and if they are above 60, apply a 1% discount to their current loan interest rates.

BEGIN

FOR rec IN (SELECT LoanID, InterestRate FROM Loans JOIN Customers ON Loans.CustomerID = Customers.CustomerID WHERE EXTRACT(YEAR FROM SYSDATE) - EXTRACT(YEAR FROM DOB) > 60) LOOP

UPDATE Loans

SET InterestRate = rec.InterestRate - 1

WHERE LoanID = rec.LoanID;

END LOOP;

END;

**Scenario 2:** A customer can be promoted to VIP status based on their balance.

* **Question:** Write a PL/SQL block that iterates through all customers and sets a flag IsVIP to TRUE for those with a balance over $10,000.

BEGIN

FOR rec IN (SELECT CustomerID FROM Customers WHERE Balance > 10000) LOOP

UPDATE Customers

SET IsVIP = TRUE

WHERE CustomerID = rec.CustomerID;

END LOOP;

END;

**Scenario 3:** The bank wants to send reminders to customers whose loans are due within the next 30 days.

* **Question:** Write a PL/SQL block that fetches all loans due in the next 30 days and prints a reminder message for each customer.

DECLARE

CURSOR loan\_cursor IS

SELECT CustomerID, LoanID, EndDate FROM Loans WHERE EndDate BETWEEN SYSDATE AND SYSDATE + 30;

BEGIN

FOR loan\_rec IN loan\_cursor LOOP

DBMS\_OUTPUT.PUT\_LINE('Reminder: Loan ' || loan\_rec.LoanID || ' for Customer ' || loan\_rec.CustomerID || ' is due on ' || loan\_rec.EndDate);

END LOOP;

END;

**Exercise 2: Error Handling**

**Scenario 1:** Handle exceptions during fund transfers between accounts.

* **Question:** Write a stored procedure **SafeTransferFunds** that transfers funds between two accounts. Ensure that if any error occurs (e.g., insufficient funds), an appropriate error message is logged and the transaction is rolled back.

CREATE OR REPLACE PROCEDURE SafeTransferFunds(p\_fromAccount NUMBER, p\_toAccount NUMBER, p\_amount NUMBER) IS

insufficient\_funds EXCEPTION;

v\_balance NUMBER;

BEGIN

SELECT Balance INTO v\_balance FROM Accounts WHERE AccountID = p\_fromAccount;

IF v\_balance < p\_amount THEN

RAISE insufficient\_funds;

END IF;

UPDATE Accounts SET Balance = Balance - p\_amount WHERE AccountID = p\_fromAccount;

UPDATE Accounts SET Balance = Balance + p\_amount WHERE AccountID = p\_toAccount;

COMMIT;

EXCEPTION

WHEN insufficient\_funds THEN

DBMS\_OUTPUT.PUT\_LINE('Error: Insufficient funds.');

ROLLBACK;

WHEN OTHERS THEN

DBMS\_OUTPUT.PUT\_LINE('Error: ' || SQLERRM);

ROLLBACK;

END;

**Scenario 2:** Manage errors when updating employee salaries.

* **Question:** Write a stored procedure **UpdateSalary** that increases the salary of an employee by a given percentage. If the employee ID does not exist, handle the exception and log an error message.

CREATE OR REPLACE PROCEDURE UpdateSalary(p\_employeeID NUMBER, p\_percentage NUMBER) IS

employee\_not\_found EXCEPTION;

v\_salary NUMBER;

BEGIN

BEGIN

SELECT Salary INTO v\_salary FROM Employees WHERE EmployeeID = p\_employeeID;

EXCEPTION

WHEN NO\_DATA\_FOUND THEN

RAISE employee\_not\_found;

END;

UPDATE Employees SET Salary = Salary \* (1 + p\_percentage / 100) WHERE EmployeeID = p\_employeeID;

COMMIT;

EXCEPTION

WHEN employee\_not\_found THEN

DBMS\_OUTPUT.PUT\_LINE('Error: Employee not found.');

ROLLBACK;

WHEN OTHERS THEN

DBMS\_OUTPUT.PUT\_LINE('Error: ' || SQLERRM);

ROLLBACK;

END;

**Scenario 3:** Ensure data integrity when adding a new customer.

* **Question:** Write a stored procedure **AddNewCustomer** that inserts a new customer into the Customers table. If a customer with the same ID already exists, handle the exception by logging an error and preventing the insertion.

CREATE OR REPLACE PROCEDURE AddNewCustomer(p\_customerID NUMBER, p\_name VARCHAR2, p\_DOB DATE, p\_balance NUMBER) IS

customer\_exists EXCEPTION;

v\_existing\_count NUMBER;

BEGIN

SELECT COUNT(\*) INTO v\_existing\_count FROM Customers WHERE CustomerID = p\_customerID;

IF v\_existing\_count > 0 THEN

RAISE customer\_exists;

END IF;

INSERT INTO Customers (CustomerID, Name, DOB, Balance, LastModified) VALUES (p\_customerID, p\_name, p\_DOB, p\_balance, SYSDATE);

COMMIT;

EXCEPTION

WHEN customer\_exists THEN

DBMS\_OUTPUT.PUT\_LINE('Error: Customer already exists.');

ROLLBACK;

WHEN OTHERS THEN

DBMS\_OUTPUT.PUT\_LINE('Error: ' || SQLERRM);

ROLLBACK;

END;

**Exercise 3: Stored Procedures**

**Scenario 1:** The bank needs to process monthly interest for all savings accounts.

* **Question:** Write a stored procedure **ProcessMonthlyInterest** that calculates and updates the balance of all savings accounts by applying an interest rate of 1% to the current balance.

CREATE OR REPLACE PROCEDURE ProcessMonthlyInterest IS

BEGIN

FOR rec IN (SELECT AccountID, Balance FROM Accounts WHERE AccountType = 'Savings') LOOP

UPDATE Accounts

SET Balance = Balance \* 1.01

WHERE AccountID = rec.AccountID;

END LOOP;

COMMIT;

END;

**Scenario 2:** The bank wants to implement a bonus scheme for employees based on their performance.

* **Question:** Write a stored procedure **UpdateEmployeeBonus** that updates the salary of employees in a given department by adding a bonus percentage passed as a parameter.

CREATE OR REPLACE PROCEDURE UpdateEmployeeBonus(p\_department VARCHAR2, p\_bonus\_percentage NUMBER) IS

BEGIN

UPDATE Employees

SET Salary = Salary \* (1 + p\_bonus\_percentage / 100)

WHERE Department = p\_department;

COMMIT;

END;

**Scenario 3:** Customers should be able to transfer funds between their accounts.

* **Question:** Write a stored procedure **TransferFunds** that transfers a specified amount from one account to another, checking that the source account has sufficient balance before making the transfer.

CREATE OR REPLACE PROCEDURE TransferFunds(p\_fromAccount NUMBER, p\_toAccount NUMBER, p\_amount NUMBER) IS

v\_balance NUMBER;

BEGIN

SELECT Balance INTO v\_balance FROM Accounts WHERE AccountID = p\_fromAccount;

IF v\_balance < p\_amount THEN

RAISE\_APPLICATION\_ERROR(-20001, 'Insufficient balance in the source account.');

END IF;

UPDATE Accounts SET Balance = Balance - p\_amount WHERE AccountID = p\_fromAccount;

UPDATE Accounts SET Balance = Balance + p\_amount WHERE AccountID = p\_toAccount;

COMMIT;

END;

**Exercise 4: Functions**

**Scenario 1:** Calculate the age of customers for eligibility checks.

* **Question:** Write a function CalculateAge that takes a customer's date of birth as input and returns their age in years.

CREATE OR REPLACE FUNCTION CalculateAge(p\_DOB DATE) RETURN NUMBER IS

v\_age NUMBER;

BEGIN

v\_age := TRUNC(MONTHS\_BETWEEN(SYSDATE, p\_DOB) / 12);

RETURN v\_age;

END;

**Scenario 2:** The bank needs to compute the monthly installment for a loan.

* **Question:** Write a function **CalculateMonthlyInstallment** that takes the loan amount, interest rate, and loan duration in years as input and returns the monthly installment amount.

CREATE OR REPLACE FUNCTION CalculateMonthlyInstallment(p\_loanAmount NUMBER, p\_interestRate NUMBER, p\_years NUMBER) RETURN NUMBER IS

v\_monthlyInstallment NUMBER;

BEGIN

v\_monthlyInstallment := (p\_loanAmount \* p\_interestRate / 100 / 12) / (1 - POWER(1 + p\_interestRate / 100 / 12, -p\_years \* 12));

RETURN v\_monthlyInstallment;

END;

**Scenario 3:** Check if a customer has sufficient balance before making a transaction.

* **Question:** Write a function **HasSufficientBalance** that takes an account ID and an amount as input and returns a boolean indicating whether the account has at least the specified amount.

CREATE OR REPLACE FUNCTION HasSufficientBalance(p\_accountID NUMBER, p\_amount NUMBER) RETURN BOOLEAN IS

v\_balance NUMBER;

BEGIN

SELECT Balance INTO v\_balance FROM Accounts WHERE AccountID = p\_accountID;

RETURN v\_balance >= p\_amount;

END;

**Exercise 5: Triggers**

**Scenario 1:** Automatically update the last modified date when a customer's record is updated.

* **Question:** Write a trigger **UpdateCustomerLastModified** that updates the LastModified column of the Customers table to the current date whenever a customer's record is updated.

CREATE OR REPLACE TRIGGER UpdateCustomerLastModified

BEFORE UPDATE ON Customers

FOR EACH ROW

BEGIN

:NEW.LastModified := SYSDATE;

END;

**Scenario 2:** Maintain an audit log for all transactions.

* **Question:** Write a trigger **LogTransaction** that inserts a record into an AuditLog table whenever a transaction is inserted into the Transactions table.

CREATE OR REPLACE TRIGGER LogTransaction

AFTER INSERT ON Transactions

FOR EACH ROW

BEGIN

INSERT INTO AuditLog (TransactionID, AccountID, TransactionDate, Amount, TransactionType)

VALUES (:NEW.TransactionID, :NEW.AccountID, :NEW.TransactionDate, :NEW.Amount, :NEW.TransactionType);

END;

**Scenario 3:** Enforce business rules on deposits and withdrawals.

* **Question:** Write a trigger **CheckTransactionRules** that ensures withdrawals do not exceed the balance and deposits are positive before inserting a record into the Transactions table.

CREATE OR REPLACE TRIGGER CheckTransactionRules

BEFORE INSERT ON Transactions

FOR EACH ROW

DECLARE

v\_balance NUMBER;

BEGIN

IF :NEW.TransactionType = 'Withdrawal' THEN

SELECT Balance INTO v\_balance FROM Accounts WHERE AccountID = :NEW.AccountID;

IF v\_balance < :NEW.Amount THEN

RAISE\_APPLICATION\_ERROR(-20002, 'Insufficient balance for withdrawal.');

END IF;

ELSIF :NEW.TransactionType = 'Deposit' THEN

IF :NEW.Amount <= 0 THEN

RAISE\_APPLICATION\_ERROR(-20003, 'Deposit amount must be positive.');

END IF;

END IF;

END;

**Exercise 6: Cursors**

**Scenario 1:** Generate monthly statements for all customers.

* **Question:** Write a PL/SQL block using an explicit cursor **GenerateMonthlyStatements** that retrieves all transactions for the current month and prints a statement for each customer.

DECLARE

CURSOR transaction\_cursor IS

SELECT AccountID, TransactionDate, Amount, TransactionType FROM Transactions WHERE TransactionDate BETWEEN TRUNC(SYSDATE, 'MM') AND LAST\_DAY(SYSDATE);

BEGIN

FOR trans\_rec IN transaction\_cursor LOOP

DBMS\_OUTPUT.PUT\_LINE('Account: ' || trans\_rec.AccountID || ', Date: ' || trans\_rec.TransactionDate || ', Amount: ' || trans\_rec.Amount || ', Type: ' || trans\_rec.TransactionType);

END LOOP;

END;

**Scenario 2:** Apply annual fee to all accounts.

* **Question:** Write a PL/SQL block using an explicit cursor **ApplyAnnualFee** that deducts an annual maintenance fee from the balance of all accounts.

DECLARE

CURSOR account\_cursor IS

SELECT AccountID, Balance FROM Accounts;

BEGIN

FOR acc\_rec IN account\_cursor LOOP

UPDATE Accounts

SET Balance = Balance - 100

WHERE AccountID = acc\_rec.AccountID;

END LOOP;

COMMIT;

END;

**Scenario 3:** Update the interest rate for all loans based on a new policy.

* **Question:** Write a PL/SQL block using an explicit cursor **UpdateLoanInterestRates** that fetches all loans and updates their interest rates based on the new policy.

DECLARE

CURSOR loan\_cursor IS

SELECT LoanID, InterestRate FROM Loans;

BEGIN

FOR loan\_rec IN loan\_cursor LOOP

UPDATE Loans

SET InterestRate = loan\_rec.InterestRate \* 1.02

WHERE LoanID

**Exercise 7: Packages**

**Scenario 1:** Group all customer-related procedures and functions into a package.

* **Question:** Create a package **CustomerManagement** with procedures for adding a new customer, updating customer details, and a function to get customer balance.

CREATE OR REPLACE PACKAGE CustomerManagement AS

PROCEDURE AddCustomer(p\_customerID NUMBER, p\_name VARCHAR2, p\_DOB DATE, p\_balance NUMBER);

PROCEDURE UpdateCustomerDetails(p\_customerID NUMBER, p\_name VARCHAR2, p\_balance NUMBER);

FUNCTION GetCustomerBalance(p\_customerID NUMBER) RETURN NUMBER;

END CustomerManagement;

CREATE OR REPLACE PACKAGE BODY CustomerManagement AS

PROCEDURE AddCustomer(p\_customerID NUMBER, p\_name VARCHAR2, p\_DOB DATE, p\_balance NUMBER) IS

BEGIN

INSERT INTO Customers (CustomerID, Name, DOB, Balance, LastModified)

VALUES (p\_customerID, p\_name, p\_DOB, p\_balance, SYSDATE);

COMMIT;

END AddCustomer;

PROCEDURE UpdateCustomerDetails(p\_customerID NUMBER, p\_name VARCHAR2, p\_balance NUMBER) IS

BEGIN

UPDATE Customers

SET Name = p\_name, Balance = p\_balance, LastModified = SYSDATE

WHERE CustomerID = p\_customerID;

COMMIT;

END UpdateCustomerDetails;

FUNCTION GetCustomerBalance(p\_customerID NUMBER) RETURN NUMBER IS

v\_balance NUMBER;

BEGIN

SELECT Balance INTO v\_balance FROM Customers WHERE CustomerID = p\_customerID;

RETURN v\_balance;

END GetCustomerBalance;

END CustomerManagement;

**Scenario 2:** Create a package to manage employee data.

* **Question:** Write a package **EmployeeManagement** with procedures to hire new employees, update employee details, and a function to calculate annual salary.

CREATE OR REPLACE PACKAGE EmployeeManagement AS

PROCEDURE HireEmployee(p\_employeeID NUMBER, p\_name VARCHAR2, p\_position VARCHAR2, p\_salary NUMBER, p\_department VARCHAR2, p\_hireDate DATE);

PROCEDURE UpdateEmployeeDetails(p\_employeeID NUMBER, p\_name VARCHAR2, p\_salary NUMBER);

FUNCTION CalculateAnnualSalary(p\_employeeID NUMBER) RETURN NUMBER;

END EmployeeManagement;

CREATE OR REPLACE PACKAGE BODY EmployeeManagement AS

PROCEDURE HireEmployee(p\_employeeID NUMBER, p\_name VARCHAR2, p\_position VARCHAR2, p\_salary NUMBER, p\_department VARCHAR2, p\_hireDate DATE) IS

BEGIN

INSERT INTO Employees (EmployeeID, Name, Position, Salary, Department, HireDate)

VALUES (p\_employeeID, p\_name, p\_position, p\_salary, p\_department, p\_hireDate);

COMMIT;

END HireEmployee;

PROCEDURE UpdateEmployeeDetails(p\_employeeID NUMBER, p\_name VARCHAR2, p\_salary NUMBER) IS

BEGIN

UPDATE Employees

SET Name = p\_name, Salary = p\_salary

WHERE EmployeeID = p\_employeeID;

COMMIT;

END UpdateEmployeeDetails;

FUNCTION CalculateAnnualSalary(p\_employeeID NUMBER) RETURN NUMBER IS

v\_salary NUMBER;

BEGIN

SELECT Salary INTO v\_salary FROM Employees WHERE EmployeeID = p\_employeeID;

RETURN v\_salary \* 12;

END CalculateAnnualSalary;

END EmployeeManagement;

**Scenario 3:** Group all account-related operations into a package.

* **Question:** Create a package **AccountOperations** with procedures for opening a new account, closing an account, and a function to get the total balance of a customer across all accounts.

CREATE OR REPLACE PACKAGE AccountOperations AS

PROCEDURE OpenAccount(p\_accountID NUMBER, p\_customerID NUMBER, p\_accountType VARCHAR2, p\_balance NUMBER);

PROCEDURE CloseAccount(p\_accountID NUMBER);

FUNCTION GetTotalBalance(p\_customerID NUMBER) RETURN NUMBER;

END AccountOperations;

CREATE OR REPLACE PACKAGE BODY AccountOperations AS

PROCEDURE OpenAccount(p\_accountID NUMBER, p\_customerID NUMBER, p\_accountType VARCHAR2, p\_balance NUMBER) IS

BEGIN

INSERT INTO Accounts (AccountID, CustomerID, AccountType, Balance, LastModified)

VALUES (p\_accountID, p\_customerID, p\_accountType, p\_balance, SYSDATE);

COMMIT;

END OpenAccount;

PROCEDURE CloseAccount(p\_accountID NUMBER) IS

BEGIN

DELETE FROM Accounts WHERE AccountID = p\_accountID;

COMMIT;

END CloseAccount;

FUNCTION GetTotalBalance(p\_customerID NUMBER) RETURN NUMBER IS

v\_totalBalance NUMBER;

BEGIN

SELECT SUM(Balance) INTO v\_totalBalance FROM Accounts WHERE CustomerID = p\_customerID;

RETURN v\_totalBalance;

END GetTotalBalance;

END AccountOperations;

**Schema to be Created**

*CREATE TABLE Customers (*

*CustomerID NUMBER PRIMARY KEY,*

*Name VARCHAR2(100),*

*DOB DATE,*

*Balance NUMBER,*

*LastModified DATE*

*);*

*CREATE TABLE Accounts (*

*AccountID NUMBER PRIMARY KEY,*

*CustomerID NUMBER,*

*AccountType VARCHAR2(20),*

*Balance NUMBER,*

*LastModified DATE,*

*FOREIGN KEY (CustomerID) REFERENCES Customers(CustomerID)*

*);*

*CREATE TABLE Transactions (*

*TransactionID NUMBER PRIMARY KEY,*

*AccountID NUMBER,*

*TransactionDate DATE,*

*Amount NUMBER,*

*TransactionType VARCHAR2(10),*

*FOREIGN KEY (AccountID) REFERENCES Accounts(AccountID)*

*);*

*CREATE TABLE Loans (*

*LoanID NUMBER PRIMARY KEY,*

*CustomerID NUMBER,*

*LoanAmount NUMBER,*

*InterestRate NUMBER,*

*StartDate DATE,*

*EndDate DATE,*

*FOREIGN KEY (CustomerID) REFERENCES Customers(CustomerID)*

*);*

*CREATE TABLE Employees (*

*EmployeeID NUMBER PRIMARY KEY,*

*Name VARCHAR2(100),*

*Position VARCHAR2(50),*

*Salary NUMBER,*

*Department VARCHAR2(50),*

*HireDate DATE*

*);*

**Example Scripts for Sample Data Insertion**

*INSERT INTO Customers (CustomerID, Name, DOB, Balance, LastModified)*

*VALUES (1, 'John Doe', TO\_DATE('1985-05-15', 'YYYY-MM-DD'), 1000, SYSDATE);*

*INSERT INTO Customers (CustomerID, Name, DOB, Balance, LastModified)*

*VALUES (2, 'Jane Smith', TO\_DATE('1990-07-20', 'YYYY-MM-DD'), 1500, SYSDATE);*

*INSERT INTO Accounts (AccountID, CustomerID, AccountType, Balance, LastModified)*

*VALUES (1, 1, 'Savings', 1000, SYSDATE);*

*INSERT INTO Accounts (AccountID, CustomerID, AccountType, Balance, LastModified)*

*VALUES (2, 2, 'Checking', 1500, SYSDATE);*

*INSERT INTO Transactions (TransactionID, AccountID, TransactionDate, Amount, TransactionType)*

*VALUES (1, 1, SYSDATE, 200, 'Deposit');*

*INSERT INTO Transactions (TransactionID, AccountID, TransactionDate, Amount, TransactionType)*

*VALUES (2, 2, SYSDATE, 300, 'Withdrawal');*

*INSERT INTO Loans (LoanID, CustomerID, LoanAmount, InterestRate, StartDate, EndDate)*

*VALUES (1, 1, 5000, 5, SYSDATE, ADD\_MONTHS(SYSDATE, 60));*

*INSERT INTO Employees (EmployeeID, Name, Position, Salary, Department, HireDate)*

*VALUES (1, 'Alice Johnson', 'Manager', 70000, 'HR', TO\_DATE('2015-06-15', 'YYYY-MM-DD'));*

*INSERT INTO Employees (EmployeeID, Name, Position, Salary, Department, HireDate)*

*VALUES (2, 'Bob Brown', 'Developer', 60000, 'IT', TO\_DATE('2017-03-20', 'YYYY-MM-DD'));*