**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.

Answer –

BEGIN

FOR rec IN (SELECT LoanID, CustomerID, 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 = 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.

Answer –

BEGIN

FOR rec IN (SELECT CustomerID, Balance 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.

Answer –

DECLARE

CURSOR loan\_cursor IS

SELECT CustomerID, LoanID, EndDate

FROM Loans

WHERE EndDate <= SYSDATE + 30;

BEGIN

FOR loan IN loan\_cursor LOOP

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

Answer –

CREATE OR REPLACE PROCEDURE SafeTransferFunds(

p\_from\_account\_id IN NUMBER,

p\_to\_account\_id IN NUMBER,

p\_amount IN NUMBER

) AS

insufficient\_funds EXCEPTION;

BEGIN

-- Check balance

DECLARE

v\_balance NUMBER;

BEGIN

SELECT Balance INTO v\_balance FROM Accounts WHERE AccountID = p\_from\_account\_id;

IF v\_balance < p\_amount THEN

RAISE insufficient\_funds;

END IF;

END;

-- Transfer funds

UPDATE Accounts SET Balance = Balance - p\_amount WHERE AccountID = p\_from\_account\_id;

UPDATE Accounts SET Balance = Balance + p\_amount WHERE AccountID = p\_to\_account\_id;

COMMIT;

EXCEPTION

WHEN insufficient\_funds THEN

ROLLBACK;

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

WHEN OTHERS THEN

ROLLBACK;

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

END SafeTransferFunds;

/

**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.

Answer –

CREATE OR REPLACE PROCEDURE UpdateSalary(

p\_employee\_id IN NUMBER,

p\_percentage IN NUMBER

) AS

employee\_not\_found EXCEPTION;

BEGIN

UPDATE Employees

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

WHERE EmployeeID = p\_employee\_id;

IF SQL%ROWCOUNT = 0 THEN

RAISE employee\_not\_found;

END IF;

COMMIT;

EXCEPTION

WHEN employee\_not\_found THEN

ROLLBACK;

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

WHEN OTHERS THEN

ROLLBACK;

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

END UpdateSalary;

/

**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.

Answer –

CREATE OR REPLACE PROCEDURE AddNewCustomer(

p\_customer\_id IN NUMBER,

p\_name IN VARCHAR2,

p\_dob IN DATE,

p\_balance IN NUMBER

) AS

customer\_exists EXCEPTION;

BEGIN

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

VALUES (p\_customer\_id, p\_name, p\_dob, p\_balance, SYSDATE);

COMMIT;

EXCEPTION

WHEN DUP\_VAL\_ON\_INDEX THEN

ROLLBACK;

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

WHEN OTHERS THEN

ROLLBACK;

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

END AddNewCustomer;

/

**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.

Answer –

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 ProcessMonthlyInterest;

/

**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.

Answer –

CREATE OR REPLACE PROCEDURE UpdateEmployeeBonus(

p\_department IN VARCHAR2,

p\_bonus\_percentage IN NUMBER

) AS

BEGIN

UPDATE Employees

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

WHERE Department = p\_department;

COMMIT;

END UpdateEmployeeBonus;

/

**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.

Answer –

CREATE OR REPLACE PROCEDURE TransferFunds(

p\_from\_account\_id IN NUMBER,

p\_to\_account\_id IN NUMBER,

p\_amount IN NUMBER

) AS

BEGIN

-- Check balance

DECLARE

v\_balance NUMBER;

BEGIN

SELECT Balance INTO v\_balance FROM Accounts WHERE AccountID = p\_from\_account\_id;

IF v\_balance < p\_amount THEN

RAISE\_APPLICATION\_ERROR(-20001, 'Insufficient balance');

END IF;

END;

-- Transfer funds

UPDATE Accounts SET Balance = Balance - p\_amount WHERE AccountID = p\_from\_account\_id;

UPDATE Accounts SET Balance = Balance + p\_amount WHERE AccountID = p\_to\_account\_id;

COMMIT;

EXCEPTION

WHEN OTHERS THEN

ROLLBACK;

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

END TransferFunds;

/

**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.

Answer –

CREATE OR REPLACE FUNCTION CalculateAge(

p\_dob IN DATE

) RETURN NUMBER IS

v\_age NUMBER;

BEGIN

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

RETURN v\_age;

END CalculateAge;

/

**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.

Answer –

CREATE OR REPLACE FUNCTION CalculateMonthlyInstallment(

p\_loan\_amount IN NUMBER,

p\_interest\_rate IN NUMBER,

p\_duration\_years IN NUMBER

) RETURN NUMBER IS

v\_monthly\_installment NUMBER;

BEGIN

v\_monthly\_installment := p\_loan\_amount \* (p\_interest\_rate / 1200) /

(1 - POWER(1 + (p\_interest\_rate / 1200), -p\_duration\_years \* 12));

RETURN v\_monthly\_installment;

END CalculateMonthlyInstallment;

/

**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.

Answer –

CREATE OR REPLACE FUNCTION HasSufficientBalance(

p\_account\_id IN NUMBER,

p\_amount IN NUMBER

) RETURN BOOLEAN IS

v\_balance NUMBER;

BEGIN

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

RETURN v\_balance >= p\_amount;

END HasSufficientBalance;

/

**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.

Answer –

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.

Answer –

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.

Answer –

CREATE OR REPLACE TRIGGER CheckTransactionRules

BEFORE INSERT ON Transactions

FOR EACH ROW

BEGIN

IF :NEW.TransactionType = 'Withdrawal' THEN

DECLARE

v\_balance NUMBER;

BEGIN

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;

END;

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.

Answer –

DECLARE

CURSOR transactions\_cursor IS

SELECT CustomerID, AccountID, Amount, TransactionDate, TransactionType

FROM Transactions

WHERE TransactionDate BETWEEN TRUNC(SYSDATE, 'MM') AND LAST\_DAY(SYSDATE);

BEGIN

FOR trans IN transactions\_cursor LOOP

DBMS\_OUTPUT.PUT\_LINE('Customer ID: ' || trans.CustomerID ||

', Account ID: ' || trans.AccountID ||

', Date: ' || trans.TransactionDate ||

', Amount: ' || trans.Amount ||

', Type: ' || trans.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.

Answer –

DECLARE

CURSOR accounts\_cursor IS

SELECT AccountID, Balance FROM Accounts;

v\_annual\_fee CONSTANT NUMBER := 50; -- Define the annual fee amount

BEGIN

FOR acc IN accounts\_cursor LOOP

UPDATE Accounts

SET Balance = Balance - v\_annual\_fee

WHERE AccountID = acc.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.

Answer –

DECLARE

CURSOR loans\_cursor IS

SELECT LoanID, InterestRate FROM Loans;

v\_new\_interest\_rate CONSTANT NUMBER := 4; -- Define the new interest rate

BEGIN

FOR loan IN loans\_cursor LOOP

UPDATE Loans

SET InterestRate = v\_new\_interest\_rate

WHERE LoanID = loan.LoanID;

END LOOP;

COMMIT;

END;

/

**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.

Answer –

CREATE OR REPLACE PACKAGE CustomerManagement AS

PROCEDURE AddCustomer(p\_customer\_id IN NUMBER, p\_name IN VARCHAR2, p\_dob IN DATE, p\_balance IN NUMBER);

PROCEDURE UpdateCustomerDetails(p\_customer\_id IN NUMBER, p\_name IN VARCHAR2, p\_dob IN DATE, p\_balance IN NUMBER);

FUNCTION GetCustomerBalance(p\_customer\_id IN NUMBER) RETURN NUMBER;

END CustomerManagement;

/

CREATE OR REPLACE PACKAGE BODY CustomerManagement AS

PROCEDURE AddCustomer(p\_customer\_id IN NUMBER, p\_name IN VARCHAR2, p\_dob IN DATE, p\_balance IN NUMBER) IS

BEGIN

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

VALUES (p\_customer\_id, p\_name, p\_dob, p\_balance, SYSDATE);

COMMIT;

END AddCustomer;

PROCEDURE UpdateCustomerDetails(p\_customer\_id IN NUMBER, p\_name IN VARCHAR2, p\_dob IN DATE, p\_balance IN NUMBER) IS

BEGIN

UPDATE Customers

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

WHERE CustomerID = p\_customer\_id;

COMMIT;

END UpdateCustomerDetails;

FUNCTION GetCustomerBalance(p\_customer\_id IN NUMBER) RETURN NUMBER IS

v\_balance NUMBER;

BEGIN

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

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.

Answer –

CREATE OR REPLACE PACKAGE EmployeeManagement AS

PROCEDURE HireEmployee(p\_employee\_id IN NUMBER, p\_name IN VARCHAR2, p\_position IN VARCHAR2, p\_salary IN NUMBER, p\_department IN VARCHAR2, p\_hiredate IN DATE);

PROCEDURE UpdateEmployeeDetails(p\_employee\_id IN NUMBER, p\_name IN VARCHAR2, p\_position IN VARCHAR2, p\_salary IN NUMBER, p\_department IN VARCHAR2);

FUNCTION CalculateAnnualSalary(p\_employee\_id IN NUMBER) RETURN NUMBER;

END EmployeeManagement;

/

CREATE OR REPLACE PACKAGE BODY EmployeeManagement AS

PROCEDURE HireEmployee(p\_employee\_id IN NUMBER, p\_name IN VARCHAR2, p\_position IN VARCHAR2, p\_salary IN NUMBER, p\_department IN VARCHAR2, p\_hiredate IN DATE) IS

BEGIN

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

VALUES (p\_employee\_id, p\_name, p\_position, p\_salary, p\_department, p\_hiredate);

COMMIT;

END HireEmployee;

PROCEDURE UpdateEmployeeDetails(p\_employee\_id IN NUMBER, p\_name IN VARCHAR2, p\_position IN VARCHAR2, p\_salary IN NUMBER, p\_department IN VARCHAR2) IS

BEGIN

UPDATE Employees

SET Name = p\_name, Position = p\_position, Salary = p\_salary, Department = p\_department

WHERE EmployeeID = p\_employee\_id;

COMMIT;

END UpdateEmployeeDetails;

FUNCTION CalculateAnnualSalary(p\_employee\_id IN NUMBER) RETURN NUMBER IS

v\_salary NUMBER;

BEGIN

SELECT Salary \* 12 INTO v\_salary FROM Employees WHERE EmployeeID = p\_employee\_id;

RETURN v\_salary;

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.

Answer –

CREATE OR REPLACE PACKAGE AccountOperations AS

PROCEDURE OpenAccount(p\_account\_id IN NUMBER, p\_customer\_id IN NUMBER, p\_account\_type IN VARCHAR2, p\_balance IN NUMBER);

PROCEDURE CloseAccount(p\_account\_id IN NUMBER);

FUNCTION GetTotalBalance(p\_customer\_id IN NUMBER) RETURN NUMBER;

END AccountOperations;

/

CREATE OR REPLACE PACKAGE BODY AccountOperations AS

PROCEDURE OpenAccount(p\_account\_id IN NUMBER, p\_customer\_id IN NUMBER, p\_account\_type IN VARCHAR2, p\_balance IN NUMBER) IS

BEGIN

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

VALUES (p\_account\_id, p\_customer\_id, p\_account\_type, p\_balance, SYSDATE);

COMMIT;

END OpenAccount;

PROCEDURE CloseAccount(p\_account\_id IN NUMBER) IS

BEGIN

DELETE FROM Accounts WHERE AccountID = p\_account\_id;

COMMIT;

END CloseAccount;

FUNCTION GetTotalBalance(p\_customer\_id IN NUMBER) RETURN NUMBER IS

v\_total\_balance NUMBER;

BEGIN

SELECT SUM(Balance) INTO v\_total\_balance FROM Accounts WHERE CustomerID = p\_customer\_id;

RETURN v\_total\_balance;

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'));*